

This is an explanation that has often been used to account for the differences in brain activity between adolescents and adults, as we shall see in later chapters of this book. However, it comes with a warning: it is not really valid to make inferences about psychological processes on the basis of activity patterns in the brain. This is because there isn't a one-to-one mapping between brain regions and specific psychological processes – each brain region is involved in multiple processes. To give an example, the temporo-parietal junction is involved in paying attention as well as thinking about other people's minds. Making a 'reverse inference' from the brain region activated to the psychological process is therefore potentially misleading. We cannot know what people are experiencing on a psychological or perceptual level from the parts of their brains that are activated. But we can speculate, and make predictions that can be tested in future experiments.

The sense of self can be altered by damage to single brain regions. However, damage to any single brain region does not, as far as we know, completely obliterate the sense of self. This makes sense: it's unlikely that something as complex as the sense of self resides in a single brain region. Rather, there are many different aspects of the self – including the ability to distinguish self and other, the looking-glass self, the ability to introspect, and our cumulative store of memories and experiences. It's likely that each aspect emerges from more than one different neural system. These different neural systems interact with each other to produce the complex set of behaviours, perceptions, dispositions and character traits that make up the (whole) self. For many of us, a deep and complex sense of self, particularly of our social self, has its origins in adolescence. And in developing that social self, one group of people stands out as being exceptionally significant: our friends; other adolescents – people like us.

Blaine More (2018)

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Fitting in

WHEN YOU THINK BACK to your teenage years and early twenties, what comes to mind? Perhaps you have vivid memories of school, holidays, discovering and learning about things for the first time, exams, parties and romance. For many people, most memories of these years focus on our friends and our social worlds. There might be good memories – forming strong friendships, celebrations, get-togethers, connecting with people; there might be some bad memories – being excluded from a social group, being teased or bullied, splitting up with a girl-friend or boyfriend. Whether positive or negative, memories of adolescence often involve our peers.

In adolescence, friends matter. Studies going back many decades have found, and new studies continue to find, that friends are more important to us during adolescence than at any other stage of life. And it is particularly important to adolescents to be accepted by their peer group. This has many consequences, including an especially strong susceptibility to peer influence; and this in turn has an important impact on adolescent risk-taking and decision-making.

The stereotypical image of adolescence includes a taste for engaging in risky and novelty-seeking behaviours: smoking cigarettes, taking drugs, drinking alcohol, dangerous driving. Not all adolescents are risk-takers or novelty-seekers, of course, but there is evidence that risky behaviours peak in adolescence. Beneath the stereotype, though,

lies a more complicated picture. To understand risk-taking in adolescence, it's important to think about the circumstances in which adolescents typically take risks. Usually it's not when they're on their own; most adolescents who take these kinds of risks do so when they're with their friends.

The effect of peers on risk-taking was shown very clearly in a series of experiments in the mid-2000s carried out by Laurence Steinberg and colleagues. They designed a driving video-game that participants played in the lab. In this computer game, called the Stoplight Task, each participant drives a car around a track, and the goal is to get to the end of the course in as short a time as possible. Every so often there are traffic lights and, if the light happens to be yellow, the participant has to make a decision. They can wait until the light goes green again, which will cost them time; or they can take a risk and drive through the yellow light. Sometimes the risk pays off: the light stays yellow and the participant gets round the track more quickly, earning more points in the process. But at other times the light turns red; this leads to a crash, and the participant loses time and points.

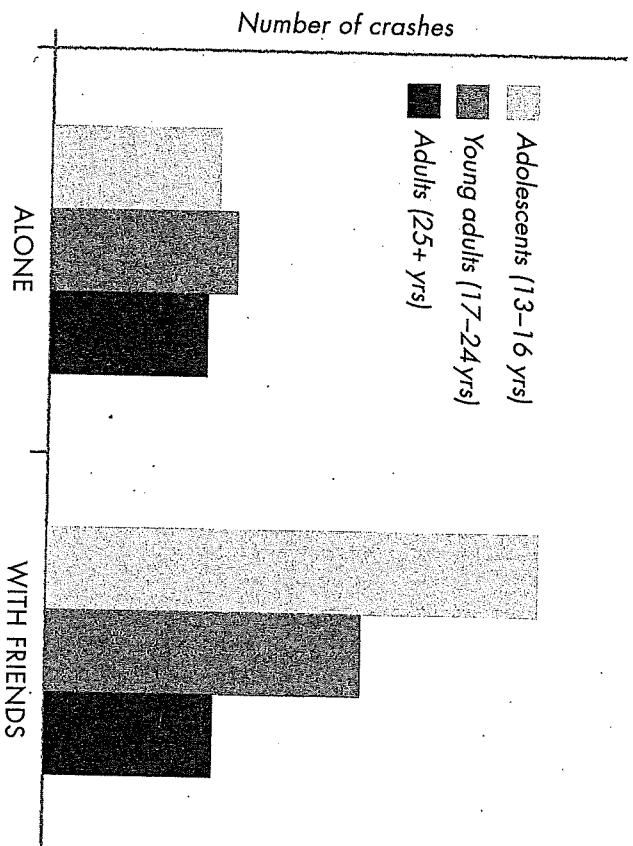
Participants play the game twice: once alone and once with friends of the same age. In this study, 306 participants, comprising adolescents (13–16 years), young adults (17–24 years) and adults (25 years and over), carried out the Stoplight Task.

When they were on their own, each age group took around the same number of driving risks. In the second version of the game, the researchers asked each participant to bring a couple of friends with them to the lab, and the friends stood behind the participant when he or she was playing the driving game. The friends were told that they could call out advice about whether to allow the car to keep moving or to stop it. The player was instructed that he or she could choose whether or not to follow the advice of his or her peers.

So, the same participants played exactly the same driving game as before – but there were stark differences between the two rounds.

When in the presence of their friends, adolescents took almost three times as many risks as when they were alone, and young adults took nearly twice as many risks. In adults, the presence of peers had no impact on risk-taking.

There are two important findings from this study. First, it shows that adolescents, young adults and adults all take around the same number of risks when they are alone, in optimal conditions with no distractions. It's important to note this, because it means that adolescents don't always take risks, contrary to the stereotype. Second, it shows that a critical factor in risk-taking for adolescents, and to a certain extent for young adults, seems to be the presence of peers, whereas this is not the case for adults aged 25 and over.



Risks taken in the Stoplight Task. Adolescents, young adults and adults all take around the same number of driving risks when alone, but adolescents and young adults take many more risks when being observed by friends

This lab-based finding is confirmed by real-life observations, for example in data from car insurance companies. If you have ever had a car accident and made a claim on your insurance company, you will know that you have to tell them the precise circumstances in which you had the accident. What you might not know is that the insurance company will often enter these details – anonymously – into a large database. The accumulated data can then be analysed to look at the circumstances in which crashes are most likely to happen.

When scientists have analysed car insurance data, they have found two key findings relating to young drivers. First, people aged 16–25 have more car accidents than people aged 26 and over. That's why young people's car insurance premiums are higher. These days, insurers offer special schemes in which 'black boxes' are fitted in cars and record young people's speed, braking and accelerating, so that their premiums can be reduced if they drive safely. Second, the datasets show that young people are more likely to crash when they have a passenger in the car with them. In contrast, this is a protective factor for adults 26 and over; who are less likely to crash if they have a passenger than when they're alone in the car.

What is it about the presence of peers that makes adolescent drivers more likely to crash their cars? One obvious possibility is that adolescents find passengers more distracting than adults do. Perhaps chatting to passengers makes concentrating on driving more difficult for adolescents. Another possibility is that risk-taking behaviour such as fast driving might be seen as being cool and socially desirable, and that adolescents are responding to this social pressure. Many people, including Kate Mills, Anne-Lise Goddings and I, have suggested that this need for social acceptance by one's peers plays a pivotal role in a lot of adolescent decision-making.

There's a long history of social psychology research on the importance of peers in adolescence. In one series of studies published in the 1990s, US researchers provided children aged 9–15 years with a pager.

At random times of the day, every day for a week, the children were paged and asked questions about where they were, what they were doing and who they were with, and about their current mood and feelings. The same children were tested again, a couple of years later. The researchers analysed the huge amount of data from the paged responses, and looked at how the responses changed with age. These studies mapped out the trend among American adolescents (especially girls) of spending more and more time with their friends, and less time with their parents and other family.

There were gender differences, too. Adolescent girls reported spending more time with peers and less time with parents compared with childhood, while the amount of time they spent alone didn't change much. Adolescent boys reported spending more time alone, the same amount of time with friends and less time with their parents. The difference is interesting; but it's important to remember that these are averages, and not true for all girls and all boys. In addition, this survey was first carried out in 1991; if it were replicated today, the results would most likely be different. In 1991, there were no social media, fewer interactive video-games and far fewer mobile phones. These days, adolescents spend a lot of time interacting with their friends over the internet and by instant messaging. How would this be classified? It's certainly social interaction, but it's different from face-to-face interaction.

More recent surveys have found marked cultural differences, with adolescents in some cultures, for example in Japan, South Korea and India, spending just as much time with their families as adolescents as they did when children. This emphasizes the importance of taking culture into account when thinking about adolescent development. Different cultures exert different pressures on adolescents. It might be permissible for adolescents to behave a certain way in one culture but not in another.

It's not just that adolescents in many Western cultures choose to spend more time with their friends than they did when they were younger (and of course they have more independence than when they were younger to do so). What is particularly significant is the weight of peer pressure at this time; the fact that, for adolescents, the opinions of their peers become more important to them than those of family members.

Insight as to why these opinions become more important can be found in a study from the late 1980s. When interviewed about friendships, children aged 10–13 years reported that friends provided companionship, stimulation and support, but they did not feel that peer acceptance influenced their evaluations of themselves – their self-worth. In contrast, adolescents aged 13–17 years reported that evaluations by their friends affected their feelings of social or personal worth, and that being rejected by peers indicated their unworthiness as individuals.

As young people move from childhood into adolescence they start to care more deeply about what their friends think about them, and this affects their sense of self-worth. What drives this increased sensitivity to friends' opinions and judgements? It is important for adolescents to become independent from their parents, if they are to thrive later in life; but it is also important to integrate into their peer group, for reasons we'll consider later in this chapter. In our theory, Kate Mills, Anne-Lise Goddings and I have suggested that adolescents feel a particular concern about being socially excluded by their peers and a strong desire to be included in their social group. This might result in adolescents being especially sensitive to what their friends think of them, so that they can integrate this information into their views of themselves and adapt to their friends' expectations and social norms, which would increase their chances of being accepted into the social group.

A few years ago, Catherine Sebastian and I carried out a study to look at whether adolescents are particularly negatively affected by being socially excluded. We conducted a lab-based experiment in which social exclusion was simulated using a computer game called Cyberball. This was originally devised over twenty years ago by Kip Williams at Purdue University in the United States. It's an online ball-throwing game in which the participant plays with two other players who are not present but are represented by cartoon icons on the screen. As soon as the game starts, the participant is thrown the virtual ball by one of the other two 'players'. The participant can then choose which of the two other players to return the ball to, by clicking on that player with the computer mouse. The player with the ball either returns the ball to the participant or throws it to the other player. This goes on for several minutes.

The game is programmed so that in some trials – called 'inclusion trials' – the participant is included in the ball game and is passed the ball around a third of the time. In 'exclusion trials', the other two players throw the ball back to the participant at first, but then stop doing so. For the rest of these exclusion trials, the other two players throw the ball to each other, but exclude the participant from their game of catch.

This game has been used in many different experiments with adults, which have shown that even in this simple and short online game, mood is lowered and anxiety is increased after exclusion trials. We don't like to be excluded, even if it's in an online ball game with players we will never meet. Catherine Sebastian and I wondered what would happen if we asked adolescents to play Cyberball. We hypothesised that their mood and anxiety levels would be even more affected by social exclusion than those of adults.

We studied groups of young adolescents (aged 11–13), mid-adolescents (aged 14–16) and adults (aged 22–47). The participants came to the lab in London and we told them they were playing the ball

game with real people their own age, online, but this was just a cover story. In fact, we had programmed the game ourselves and the other players weren't real, so that we could control precisely what happened during the course of a game. We checked – by asking them afterwards – that all our volunteers did indeed believe they were playing with real people online, because this was important for our study.

In the adult group, mood was lowered and anxiety was increased after being excluded by other players, just as Kip Williams and his colleagues had found previously. Both adolescent groups showed the same pattern as adults. However, both young and mid-adolescents reported significantly lower overall mood than adults after social exclusion. Young adolescents also reported higher anxiety than adults after exclusion. In other words, it seems to be the case that adolescents are *hypersensitive* to social exclusion.

This study provides some evidence that adolescents are especially sensitive to how they fit into their social environment – in this case, being included by other people in a game. The same heightened sensitivity has been observed in adolescent rodents. If rats are exposed to stress, including social stress (such as being isolated), in the twenty or thirty days of 'adolescence' between starting puberty and becoming an adult, some of the negative effects are longer-lasting than, and qualitatively different from, the effects of exposure to stress at other periods of life.

For example, exposing rats to social isolation – in which they are housed alone and have no contact with other rats – during adolescence increases the likelihood of depressive behaviours and is associated with changes in the structure of the prefrontal cortex in adulthood. Social isolation affects the way the brain develops in adolescent rats more than it does in adult rats. Male* adolescent rats exposed to social instability – in which they are isolated for an hour

each day and experience a change of cage partner – also show changes in behaviour and hormone production. Compared with rats that had stable social environments during adolescence, they are more anxious and less socially interactive when they reach adulthood, and exhibit abnormal sexual behaviours. The rats exposed to social instability also have lower testosterone concentrations as adults.

These studies suggest that for (male) rats, social isolation and social stress during adolescence have far-reaching consequences in respect of brain structure, hormone levels and behaviour in adulthood. Do we see any analogous effects in human studies? This is a tricky question to study, because we can't deliberately put human adolescents in truly socially stressful environments and measure their reactions – quite rightly, no university ethics committee would allow it. Cyberball is one thing: actually isolating an adolescent for a long period of time would be quite another. So instead, researchers observe humans who, sadly, are already exposed to severe levels of social stress in their lives.

These studies have shown that, just like adolescent rats, human adolescents who experience social stress suffer behavioural consequences in adulthood. Adolescents in very socially unstable environments – moving between foster homes and children's homes, for example, and possibly experiencing violence and chaos in the home – tend to be in poorer physical and mental health than adolescents whose social worlds are relatively consistent and stable. The consequences of social instability in adolescence – in both rats and humans – can be so detrimental that mechanisms and behaviours promoting peer acceptance can be considered adaptive. That is, it might be evolutionarily beneficial for adolescents to do their utmost to be accepted by their peer group, so as to avoid being socially isolated.

This brings me to the idea that the fear of being socially excluded influences many decisions that adolescents make. One of the questions I'm often asked by parents and teachers is why sensible, well-educated young people who know about the health risks of – say – cigarettes

* Most rodent studies are carried out with male animals. This is because fluctuations in hormones make it more challenging to study female animals. As a consequence, little is known about brain and behaviour in female rodents.

nevertheless take up smoking. Some people put this down to not really understanding risk, or to feeling invincible, but there's not much evidence for either of these. When asked in a laboratory setting to estimate the likely negative outcomes of risky behaviours, adolescents sometimes even tended to overestimate the risks. In addition, there's not a lot of evidence that adolescents feel invincible and unaffected by risk.

To understand why adolescents take risks, we have to look at the contexts in which risk-taking occurs. Adolescents are more likely than children and adults to make risky decisions in so-called 'hot' contexts, such as when they're with their friends or when emotions are running high.

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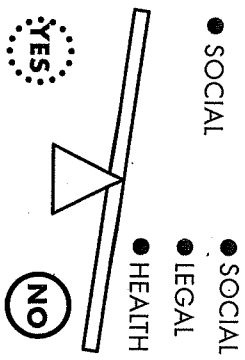
One summer recently, I was driving home from dinner at my parents' house in Oxford. The drive between Oxford and my house is along quiet countryside roads. It was about 1 a.m. and I noticed a young woman walking along the side of the road. This road had no pavement, it was dark, and the next village was miles away. I stopped and asked her if she'd like a lift somewhere. She took me up on the offer and, on the drive to her parents' house, told me she'd been at a party at a pub in a town a few miles back. She could have left the party earlier, in time to get the last bus home, but she was having so much fun with her friends she decided to stay – a classic 'hot' context! She had no money for a taxi, there were no night buses, and her phone had run out of battery so she couldn't call anyone. So she decided to walk 8 miles home in the middle of the night.

In the cold light of day it's easy to pass judgement, but I made similar decisions when I was that age (my passenger told me she was in her late teens). When we were teenagers, on holiday in France, my friends and I regularly hitch-hiked all over the place, day and night, without giving a second thought to its potential dangers. I wouldn't dream of doing it now.

But maybe I've become too risk-averse as an adult. Taking risks isn't always a bad thing: it can lead to new experiences, learning and personal development, and it can be fun. Some risky decision-making is necessary in development and indeed throughout life. Risk-taking can be useful in academic contexts. Putting your hand up in class, guessing answers in a test, public speaking, debating – these all entail risks that can result in new learning and gains in confidence. Some risks, such as staying out late at a pub with friends and missing the last bus home, as my passenger did, might result in peer acceptance. My passenger got to spend longer with her friends – and she got home safely: the risk paid off.

Kate Mills, Anne-Lise Goddings and I proposed a 'see-saw' model to show how social factors can affect risky decision-making. Every time we make a decision we weigh up potential good and bad outcomes. For example, when deciding whether to use a phone when driving, there are clear reasons not to: it's against the law and could cause an accident. However, a number of social factors make us more or less likely to use our phones despite knowing the risk of negative consequences. What would other people in the car (or on the street)

Should I use my phone when driving?



The see-saw of decision-making. It's clearly a really bad idea to use your phone while driving. Yet some people decide to do so, because of the social pressure to respond to messages.

think about us using our phones? But what if we really want to communicate with someone? We might need to let someone know we are running late, or share some exciting news. These social factors affect decision-making more for adolescents than other age groups.

Every day we make many decisions, mostly minor, occasionally major, some involving risks, others not. Whenever you make a decision, you weigh up its pros and cons. Another example, like deciding whether or not to use your phone while driving, might be speeding. Imagine you're at work and want to get home for a family dinner, but it's getting late. Do you drive over the speed limit to get home in time? Several factors feed into the decision-making process: the potential advantages of speeding, such as the satisfaction of getting home when you planned to, and the feeling of pleasure you might get from the experience (some people like to drive fast), as well as the potential disadvantages, such as the possibility of having an accident (health) or being caught by a speed camera or the police (law).

In addition to these pros and cons, there's also another potential element in the decision process – the social factor. Your family will be pleased to see you at dinner, and annoyed if you're late. But what will your friends think if you get caught speeding? That could be embarrassing at work, too. What if you have a couple of friends in the car with you, encouraging you to put your foot down? Maybe you want to impress them?

Of course, it's not just adolescents who are influenced by others – we all are. We behave differently when we're in a group compared with when we're on our own. The field of group behaviour in social psychology came about because researchers wondered why otherwise well-behaved adults sometimes behave completely differently when they're in crowds at football matches – the *football hooligan* stereotype – and many decades of research have now gone into investigating the phenomenon. It's not just football fans; most of us behave differently in crowds, especially when emotions are involved, perhaps because we

feel less personally responsible for our behaviour when many people are doing the same thing.

People also perform differently on cognitive tasks when they're being watched by someone else compared with when they're carrying out the same task unobserved. This is called the *audience effect*. An audience makes hard tasks even harder, and people perform worse at these when being watched than when alone. Picture reverse-parking your car while someone in another car is waiting for you to move out of the way – often, people in this situation feel under a lot of pressure, even though the actual physical task is no different from when you're doing it on your own. In contrast, people do better at easy or well-rehearsed tasks when being observed than when performing the same tasks alone. Both cases may have to do with the increased stress introduced by an audience: a small amount of stress improves performance in an easy task, but the combined stress of carrying out a challenging task and being observed impedes performance.

We are all influenced by other people. What I would argue is that adolescents are *especially* susceptible to social influence. In terms of the decision see-saw, this means that social factors weigh in particularly heavily for adolescents; adolescent decision-making is more driven by the need for peer acceptance and the desire to avoid being socially excluded. This means that in some situations adolescents might take risks when they're with their friends that they wouldn't take when on their own.

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Let's take the example of experimenting with drugs. Imagine a 15-year-old girl, doing well at school, close to her family and popular with her class-mates. One Saturday evening, she meets a group of her friends in town. They have all taken Ecstasy and offer her some. She knows that Ecstasy can be dangerous. She is also worried about being caught and getting into trouble. But despite all these things, she accepts the pill.

Even though adolescents understand the health risks of experimenting with drugs, there is also the *social risk* to consider: saying no to a drug when all your friends are taking it, and potentially being ostracized by your social group as a consequence, might be perceived as more risky than accepting the tablet. Adolescents might be particularly susceptible to this kind of social pressure because it's acutely important to them not to be rejected by their peer group.

Peer influence doesn't always lead to risk-taking. In fact, in some situations the desire to avoid peer rejection might lead adolescents to *avoid* taking a risk. Teachers I speak to often bemoan the fact that intelligent and knowledgeable students won't take risks in the classroom. The same adolescent who accepts a drug from her friends might not raise her hand to answer a question in class for fear of looking stupid (or too clever!) in front of her friends. In this way, social pressure can lead to risk aversion as well as risk-taking.

The important, if obvious, caveat to all of this is that there are large individual differences in adolescent behaviour. Some adolescents don't take many risks at all and don't seem to worry about what their peers think of them. Little is known about what causes these individual differences, or what the consequences are. Is it beneficial to be influenced by peers in order to fit in with the group? Does this make you a more successful adult – socially, professionally?

There are some interesting studies suggesting that risk-taking in adolescence might be associated with certain forms of success in adulthood. One study that began in 1965 involved assessing 1,000 Swedish children from the age of 10 for more than three decades. In one analysis, early rule-breaking behaviour in adolescence, such as staying out late without permission, cheating in an exam, getting drunk or shoplifting, was associated with entrepreneurial careers in adult men (but not in women). So perhaps there are adaptive advantages to being a risk-taking adolescent.

A few years ago, Lisa Knoll, a post-doctoral researcher in my lab,

and I designed an experiment to look at social influence on risk perception. We got permission to run it in the Science Museum in London, where we set up three laptops in a room at the back of one of the galleries. Lisa and a team including several students and interns then decamped to the museum, where they carried out the experiment for just over three weeks. In that time, they managed to test more than 660 visitors aged between 8 and 59 years on the computerized task we had constructed. An impressive number!

The task involves being shown a series of risky scenarios, such as crossing a street on a red light, riding a bike without a helmet or walking down a dark alley. Participants were asked to rate the level of risk they attached to each scenario. The scenarios were chosen because they carry a small to moderate amount of risk – and, critically, the assessment of that risk is subjective: different people perceive the same situation as carrying different amounts of risk. This was crucial, because what we were interested in was whether people's perceptions of risk would change when they were told how risky other people thought the situation was: that is, we were interested in the *social influence* effect.

Having registered their own risk ratings, participants were shown the risk ratings given by other people for the same scenarios. They were told that these were ratings given by other people – either adults or teenagers – who had taken part in the experiment, but in fact, this was just a cover story: the risk ratings provided were randomly generated by the computer. Participants were then asked to rate the riskiness of each scenario for a second time. We were interested to see how much participants changed their risk ratings after they had seen the ratings provided by other people.

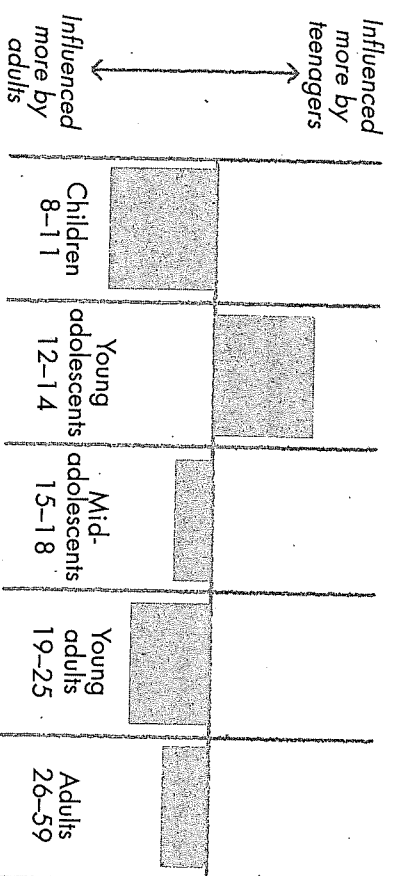
There were three main findings from this study. First, the perception of risk reflected in the first ratings differed between age groups. Children aged 8–11 rated the situations as more risky than other age groups. Interestingly, there was no evidence that young adolescents

(aged 12–14) or mid-adolescents (aged 15–18) perceived the situations as less risky than adults did. This supports the idea that adolescents understand risk and suggests they do not see themselves as immune to it.

The second finding was that all age groups showed a social influence effect: everyone shifted their risk perception in the direction of other people's risk ratings. This social influence effect was highest for children, and lowest for adults aged 26 and over. But even these older adults changed their risk ratings to be more in line with other people's ratings. This supports the idea that we are all influenced by other people.

The third finding was the most interesting to us. In our experiment, participants were told that the (actually fictitious) risk ratings provided by other people were either from all the adults who had taken part in the study, or from all the teenagers who had taken part. We could therefore look at whether participants were more influenced by the opinions of adults or those of teenagers. As the chart opposite shows, whereas children (8–11) and adults (19–59) were more influenced by *adults'* opinions about risk, young adolescents (12–14) were more influenced by the opinions of *teenagers*. Mid-adolescents (15–18) showed a similar level of influence by adults' and teenagers' opinions about risks (the small difference shown in the chart was not statistically significant), suggesting that this is a transitional stage in development.

We recently replicated these effects in a completely new study involving a different set of 590 participants aged between 8 and 59. In science it is vitally important to know that an effect is replicable. The results of both studies support the notion that early adolescence is a pivotal phase in which individuals begin to question the authority and experience of adults and place higher value on the opinions of other teenagers than on those of adults. They also suggest that health advertising aimed at young people, rather than focusing on the risks of



The social influence effect in risk perception

dangerous behaviours such as smoking, binge-drinking and experimenting with drugs, should perhaps focus on social norms and peer influence. What really seems to matter at this age is what friends and contemporaries think.

A 2016 study, carried out by researchers at Yale and Princeton universities, demonstrated the real-world implications of this peer influence effect. This study looked at the influence of social norms on bullying behaviour and conflict in schools. It covered fifty-six middle schools (with pupils aged 11–16 years) in the state of New Jersey, half of which were assigned at random to an anti-bullying programme. In this programme, groups of between twenty and thirty-two students in each year group were invited to participate in an anti-conflict workshop, which involved a trained researcher working with the students to help them understand the negative effects of bullying.

The students on the programme were encouraged to lead grassroots anti-bullying campaigns in their schools and become the public face of opposition to bullying. In one activity, the programme students were encouraged individually to design anti-bullying poster campaigns and slogans. Each student's photo and name were included next to the slogan he or she had created, and the posters bearing the

slogan were displayed around their schools. The aim of this was to create an association between the anti-bullying slogan and the identity of the individual student who had created it. In another activity, the programme students gave out orange wristbands to other students in their schools who were observed engaging in friendly behaviours. These wristbands acted as a visible reward for action against bullying. Across the course of the study, more than 2,500 wristbands were distributed and tracked.

Measures of conflict behaviour and bullying were taken from all fifty-six schools across the school year, and the results were remarkable. Compared with the control schools, in which no special anti-bullying programmes had been introduced, reports of student conflict in the schools that had implemented the student-led anti-bullying programme had fallen by 30 per cent. In each case the intervention, based on a small number of students publicly opposing bullying and conflict, had successfully spread new anti-bullying attitudes through the school. Furthermore, the researchers measured social connections in each school, asking all students to report which students in the programme they had chosen to spend time with in the previous few weeks, thereby generating an indication of the popularity of each student in the programme. This analysis identified a number of highly connected students, and the results showed that the effect of the anti-bullying programme was stronger when more of these highly connected students were involved in the campaign. In other words, when the anti-bullying campaign was led by the more popular students, it had a greater positive effect on behaviour. It seems that popular students have a greater influence than others on social norms and behaviour in schools. The study reveals the real-life power of peer influence in changing social norms of acceptable behaviour and conflict in schools.

Young adults emerging from adolescence need to be equipped to navigate the complexities of their social world. Anthropologists have accordingly suggested that adolescence is a time of particular cultural susceptibility, meaning that adolescents might be more likely than other age groups to pick up on cultural norms and behave according to local cultural rules and expectations. Suparna Choudhury, who did her PhD in my lab and subsequently changed fields from neuroscience to anthropology, has argued that the adolescent brain might change in response to the establishment of 'cultural niches' during adolescence.

Imagine a child who moves from one country to another – or even from one school to another – during their teenage years. It's socially important for them to fit in with their new peers and, to achieve this, they need to pick up on the cultural norms for their age group and to try to fit in with their new friends. A much younger child, on the other hand, has their parents to help them assimilate and is more likely to do what their parents do. Adults are more likely to have their original culture ingrained in them, and so to be slower to adapt to a new culture.

While the need for social acceptance plays a key role in adolescent risk-taking behaviour, it's not the only factor. The adolescent social environment is different from that of children and adults in various ways. In many school systems, the transition from primary to secondary school occurs around the onset of puberty, placing children in a new environment, often with a different and larger set of peers and different structures of learning. At this age, children move from being the oldest in the school to the youngest. Adolescents are also exposed to more novel situations – spending more time by themselves or with friends, getting to school by themselves, deciding who to hang out with, which classes to take, and so on – than they were likely to encounter as children. For perhaps the first time, they are making many more of their own decisions, independently of their parents or teachers. There is more opportunity to experiment and explore, and

this new-found freedom enables adolescents to take more risks than before.

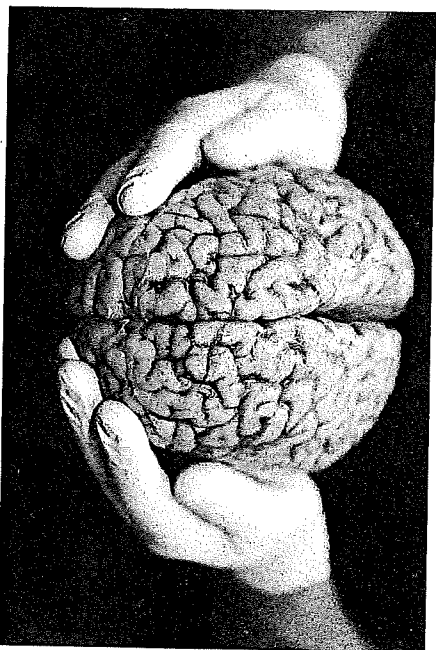
Putting this all together, it's clear that there are many factors, environmental as well as biological, to be taken into account in explaining 'typical' adolescent behaviour. It is also increasingly apparent that what is going on inside the adolescent brain is both complex and markedly different from what, until recently, was assumed to be the case. It's time to look more closely at what is happening inside the brain during these years of trying out, moving up and fitting in.

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Inside the skull

Sometimes my sons astonish me. Last year, in 2017, they turned 12 and 10, heading rapidly towards the fuzzy boundary between childhood and adolescence. It feels as if, in the blink of an eye, two tiny babies have become thinking, feeling, complicated people, with their own individual personalities and motivations and idiosyncrasies, their own wit and ripostes. I don't remember it happening: it has been such a gradual, intangible process. And the next ten years will see many more profound changes.

The transition in humans from birth to adulthood is astonishing. How does a newborn baby, who enters the world with so little understanding, competence or independence, eventually develop into an



The human brain