The Telegraph

Revealed: The Science Behind Teen Laziness

They may lie in, act selfishly and take risks, but research by a leading neuroscientist suggests that adolescents may be right when they say nobody understands them.

By Louise Carpenter

8:00AM GMT 14 Feb 2015

Professor Sarah-Jayne Blakemore, whose research lab is based at UCL in London. Photo: Laura Pannack

Teenagers really get a bad time,' says Sarah-Jayne Blakemore. 'It is amazing how it seems to be totally acceptable – even institutionalised – to parody and demonize them. We laugh at things that mock teenagers, but if you applied those sorts of jokes to any other sector of society, it just wouldn't be acceptable.' Blakemore is a professor of cognitive neuroscience and deputy director of the University College London Institute of Cognitive Neuroscience. She is sitting in her office behind Russell Square, the heartland of London academia, mounting a strong defence for **every teenager in Britain** who has slammed a bedroom door, smoked a cigarette, driven a car too fast and even – though she certainly doesn't condone this – given in to the peer pressure that surrounds drugs such as Ecstasy.

Society's response to the teenage conviction that 'nobody understands' is often lack of patience. Teenagers, we think, are moody, **self-absorbed, reckless, defiant creatures** who reject our wisdom in favour of a path of personal sabotage. But the rallying cry from Blakemore – an increasingly powerful voice in the world of international neuroscience, who has given policy advice to the British government – is that teenagers are right. Beyond the world of neuroscientific research, for the most part society does not understand them.

Only 20 years ago, it was thought that brain development stopped in early childhood. Then, with the advent of sophisticated MRI scanners, scientists in the US discovered that the brain continued to change into adolescence. Over the past 10 years, Blakemore (supported by a series of Royal Society research fellowships and other grants) and a growing group of international neuroscientists have been discovering more about how the brain develops during this period of life. The change to grey matter in the prefrontal cortex is particularly acute during the teenage years, wreaking havoc on our children and, by extension, family life.

So only now, when scientists can properly 'see' into a brain and the way it activates during various experiments, can they begin to get to grips with the way that teenage behaviour is shaped by more than hormones and the environment; Blakemore and her laboratory team are presenting new findings each year about tangible, measurable physiological changes to adolescent brains in terms of structure and function. At the end of 2013, Blakemore was awarded the prestigious Royal Society Rosalind Franklin prize, given to female scientists conducting breakthrough work. For her, it is as much about explaining and trying to understand teenagers as it is about exploring – through the possibility of adapting different educational methods in the future (she's on the former science minister David Willetts's speed dial) – how best to maximise every British teenager's full potential.

'We work with many schools all over London for research purposes,' she explains of her experiments, 'and I hope that in the next 20 years or so we will be applying more evidence-based science in education because at the moment there is not much. We know a lot about how the teenage brain learns and how it develops but it hasn't filtered through yet. There is no neuroscience on PGCE [teacher training] courses. Why not? What is education? It is about shaping children's brains. That's how children learn. Sometimes I am asked, "Do you think neuroscience is relevant to education?" That is an understatement. It is completely central.'

She is passionate, for example, about the madness of an 8.30/9am school start time. 'It's the middle of the night for a

teenager!' she says. Teenagers release melatonin (the sleepy hormone) a couple of hours later in the day than adults and so are able to stay up later, but then they need more sleep in the morning. 'It's like getting us up at 5.30am,' Blakemore elaborates. Teenagers experience 'social jet-lag' as a result, hence the long lie-ins at the weekends (this is absolutely not slothfulness, she says, but their bodies catching up after being forced to awaken so early).

Teenage brains are also capable of immense creativity, Blakemore says, rather like the way a child under the age of one is receptive to learning languages. Secondary schools, she says, often don't plug into such creativity. When she advised government aides in 2011 (brought in by Willetts), it was with the aim of trying to broaden their outlook, away from a sole focus on the Charlie and Lola generation (a catchphrase for the under-fives). 'There is such a large amount of new information about teenage brain development, which should be taken into account when politicians are considering evidence-based policy,' she explains. 'Traditionally policy has focused on the early years; the new research suggests that investment into adolescence is important too.

'The teenage brain is very capable of learning,' she continues, 'and this is absolutely the wrong time to stifle creativity. They can do amazing things, and yet schools haven't changed that much for 400 years. The more I learn about how plastic and changing the teenage brain is, the more I question whether [what we have] is the right learning environment for teenagers. One of the things I've often thought is that if teenagers were allowed to design schools, maybe they would look completely different.'

And their changes? 'Maybe more peer-to-peer learning,' she says, 'and more creative timetabling. Open-plan spaces, less making them sit at a desk all day, and more self-initiated learning rather than being spoon-fed stuff all the time.'

So what exactly goes on inside the teenage brain? 'Not all teenagers behave in the same way,' Blakemore is keen to stress. 'They are all different. But there are some behaviours that characterise teenagers more than other age groups, such as peer influence and risk-taking. What we ask is, what is the biological basis and why are these behaviours there in the first place?'

The answer is this: the prefrontal cortex, which regulates emotional responses and inhibits risk-taking, is going through physiological changes that make some adolescents act in such seemingly incomprehensible ways.

'It is proportionally much bigger in humans than in any other species,' Blakemore explained **during her immensely successful TED talk** (at the TEDGlobal conference in Edinburgh in June 2012), in which she managed to be simultaneously intellectual, charismatic and funny, 'and it's involved in a whole range of high-level cognitive functions, things like decision-making, planning what you're going to do tomorrow or next week or next year, inhibiting inappropriate behaviour. It's also involved in understanding other people and self-awareness.'

The 'grey matter volume' in the prefrontal cortex peaks in early adolescence and then decreases. What follows is what Blakemore calls 'a really important developmental process'. As the prefrontal cortex changes, 'synaptic pruning' starts. The connections between the cells in a teenage prefrontal cortex that aren't getting used in a particular environment are being 'pruned' away, rather like a rose bush. 'You prune away the weaker branches so that the remaining important branches can grow stronger.' This is what is happening in our teenagers' brains.

There are consequences. Take, for example, the kind of reckless risk-taking that keeps parents of teenagers up at night: the boy, with his mates in the back of his car, driving far too fast, or wanting to jump off a roof at a party; the girl who tries Ecstasy or legal highs, or decides to have sex or text pictures of her breasts. This type of behaviour is governed by the limbic system, a set of brain regions that are hypersensitive during adolescence to the 'rewarding' feeling of risk-taking. Added to this, the prefrontal cortex – the very part of the brain built to temper this impulse throughout life – is, in itself, at this point also in a massive state of flux.

The teenager who appears to be entirely selfish and unable to see a point of view other than his or her own – well, there's a reason for that too. This is to do with the changes going on in the 'medial prefrontal cortex' (right down the middle), which is connected to social decisions and thinking about other people. 'Activity' in this part of the brain decreases for a teenager, and one explanation for this is that they actually use a completely different cognitive strategy

from adults to make social decisions. Experiments – such as those conducted in Blakemore's 'lab' (six female researchers, two males) – have proved it. 'So if you have a teenage son or a daughter and you sometimes think they have problems taking other people's perspectives, this might be why.'

Teenagers, too, care much more than adults about 'social outcomes'. From a neuroscientific perspective, their brains register the impact of social exclusion more acutely. They think entirely about their own environment and the immediate positive or negative effect on them – which is often not the 'educated' or 'correct' path.

As Blakemore points out, for a teenage girl whose friends smoke but who also understands the health implications of smoking, the far more immediate, tangible negative consequence of her decision about whether to join in is possible rejection by her peer group – rather than the threat of cancer. So she might begin to smoke regardless, because she wants to 'belong', because it is the immediately 'safer' option for her.

This is an example of 'adaptive' behaviour, predicated on the journey towards independence.

It doesn't make teenage smoking 'acceptable', but the physiological factors involved make it explainable. 'You need, after puberty, to go out and explore your environment,' Blakemore says, 'and also you need to affiliate with your social group because you have to become more independent of your family. I don't have any magic parenting advice to offer, but when I talk to parents and to teenagers about the research we do on the teenage brain, many times they say that it is useful for them to just know what is going on in there. It is like a penny drops, and I think that knowledge [alone] is empowering. Not many people have that knowledge at the moment.

'Teenagers might appear to reject their parents' love, but they need their parents as much as babies do. They are still children but they are trying to be like adults and they want to be treated like adults – although they are not. It can be a really difficult time for them.'

Given Blakemore's extraordinary achievements to date – a first in experimental psychology from Oxford; a book co-published with Dame Uta Frith when she was 30; a secondment to the government's Education Committee during her PhD; being an early adviser to David Willetts; membership of the Royal Society Vision for Science and Mathematics Education Committee; that Rosalind Franklin Award; not to mention being only 40 years old, a wife and the mother of two young sons – it comes as some relief to know that she was a difficult teenager while growing up in Oxford.

'I wasn't particularly academic,' she says, laughing. 'I was a bit naughty until my A-levels and then I geeked out. I suddenly saw the point of buckling down. But it took until then.' She was a goth, apparently. Hard to imagine it, but true. Today she is every bit the accomplished modern young woman.

Her mother was once a professional ballerina and her father is the neuroscientist and Oxford academic Sir Colin Blakemore, who in the late 1980s brought us the seminal 13-part BBC series The Mind Machine (in which she appeared in one episode on memory, 'a very moody 13-year-old; not my finest hour!'). 'I had a lot of influence from him. His lab was round the corner from our house and my two younger sisters and I were often in there, hanging around waiting for him. We were very immersed in science but none of us was particularly "sciencey" while growing up. And I was hopeless at ballet.' She laughs. (Now, one sister is a pediatric nurse; the other designs computer games.) 'But I did go to an all girls' school and it was entirely normal for girls to study science. I don't see that in lots of the mixed schools I go into today.

'I really do remember going through about a year of rejecting my parents. You need them so much but at the time you are desperate to be independent.'

Nevertheless, work experience with Dame Uta Frith, a world authority on autism, when she was 15 obviously began to set her on the right path. Now, she says, 'I get lots of requests for work experience and I really try to accommodate them. It can have a massive impact.'

She came to her work on the teenage brain after specialising first in the symptoms of schizophrenia. She then became interested in why the condition is normally diagnosed after the age of 18 (scientists still don't know why but one theory

is that it is linked to something going wrong in the teenage brain). This led on to a specialism in the adolescent brain generally. During this period, she met and married Dr James Kilner, a neuroscientist working on motor disorders.

Today she has her own lab, which essentially translates as a team of people working with and under her: a couple of post-doctoral researchers, five PhD students whom she supervises, and a couple of research assistants. She also teaches postgraduates and undergraduates.

The UCL Institute of Cognitive Neuroscience with its 15 or so different labs sounds a rather glamorous place. In reality, however, it is more of a bog-standard office block, with a series of rooms and departments on several floors fulfilling different functions. There are rooms with EEG equipment (recording electrical activity via electrodes on the head); there are sound-proof behavioural labs, where subjects are tested on computers; there are seminar rooms; and then there are the MRI brain scanners around the corner, where the recruited teenagers go to be monitored by Blakemore's researchers while undergoing various tasks. Blakemore is in charge of the direction of her whole lab, while her team carries out the day-to-day research. 'We design the experiments together, analyse the data, interpret it and then write it up.'

Their research works broadly in two ways. The first is using individual volunteer teenagers recruited through schools – about 100 to 150 each year – whose parents bring them into the research unit for their brains to be scanned while they perform the tasks. The second are large-scale research projects that involve entire classes in schools all over London and sometimes beyond. These sorts of projects can involve up to 1,000 children.

'It's interesting,' she says, 'when we started scanning teenagers in MRI I thought there would be lots of problems – children dropping out, feeling scared of being in there. But in 12 years of scanning thousands, that has only happened once or twice. Though I have to say, recruitment is the hardest part of our research. You have to advertise it to a lot of people before you get a sufficient number of volunteers. But wouldn't you want to see your child's brain?'

Are there any risks from the MRI scanner? 'No. We would not get ethical permission to do it if it was at all harmful, nor would I do it,' she says.

There is a vast experiment going on now, Blakemore explains, in which her lab is working with an educational software company on an app that teaches non-verbal reasoning plus various other skills. It is being trialled by dozens of state-secondary schools and a couple of private schools using hundreds of children of all ages (with parental consent) to test various skills relating to brain regions and age. 'We are looking at whether there is an age bracket when it is particularly easy or those skills are particularly efficiently learnt compared with either later or earlier.' An experiment of this kind goes to the heart of her interest in neuroscience and education.

The lab is collecting the results over many months, and then will be looking at all the test scores, seeing how the children improve and whether or not age is a factor in this improvement. The general aim is to try to find out if brain changes make teenagers particularly susceptible to learning certain skills such as algebra at certain ages. 'It is quite an undertaking and I don't have any results yet,' she says. 'It will probably be another year before we have anything.'

Blakemore has just learnt that, along with colleagues in both Cambridge and Oxford, her lab has been awarded funding from the Wellcome Trust (and a research fellowship from the Royal Society) to conduct a large study looking at the effects of mindfulness meditation on adolescents in schools. Teenagers will be trained at their school, but this will be followed up by lab work. 'The idea is that if you can empower young teenagers with a strategy to cope with negative thoughts and stressful life events and anxiety, you might be able to prevent depression from occurring in the first place,' she explains. 'The thinking is that mindfulness will be beneficial in regulating one's emotions and exerting self-control – like stopping yourself from taking risks when your friends are egging you on, or coping with social anxiety.'

Blakemore may not have all the answers as yet, but what parent of a teenager can't be thankful that she is at least asking and exploring the right questions. She is clear that as a society we are nowhere near the point of doing our teenagers justice. And yet, as her work slowly attracts more attention beyond the world of science itself, she is at least moving us in the right direction.