

Nature Podcast

Introduction

This is a transcript of the 22nd February 2018 edition of the weekly *Nature Podcast*. Audio files for the current show and archive episodes can be accessed from the *Nature Podcast* index page (<http://www.nature.com/nature/podcast>), which also contains details on how to subscribe to the *Nature Podcast* for FREE, and has troubleshooting top-tips. Send us your feedback to podcast@nature.com.

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Interviewer: Benjamin Thompson

Welcome back to the *Nature Podcast*. This week we've got adolescence special: we'll be defining adolescence and taking a look at the science of teen risk taking.

Interviewer: Adam Levy

Plus: getting high school students to do university level research. This is the *Nature Podcast* for the 22nd of February 2018. I'm Adam Levy.

Interviewer: Benjamin Thompson

And I'm Benjamin Thompson.

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Interviewer: Adam Levy

So listeners, this special episode of the *Nature Podcast* is just part of a wider collection of News Features, Comment pieces, and research articles published across the *Nature* family of journals, and in *Scientific American*. Find the whole collection at nature.com/collections/adolescence.

Interviewer: Benjamin Thompson

With that in mind, it's probably quite important to work out what the word 'adolescence' actually means. Does it just refer to somebody's age, or is it more of a developmental thing? I reached out to Ron Dahl, Director of the Institute of Human Development at the University of California, Berkley, to see if adolescence is something that we can agree on a definition of.

Interviewee: Ronald Dahl

One of the things that I find most interesting about even trying to define conceptually, let alone 'definition-ally' what adolescence is, is that you can't do it with any one discipline because the onset of adolescence where the end of childhood is a biological event, the beginning of puberty. However, the end of adolescence is a social construct. It's having the rights and responsibilities of an adult. Just because you finish growing or become sexually mature or have a certain amount of information in your brain does not make you an adult. What draws, I think, another level of curiosity and interest is that that transitional phase between childhood and adulthood has changed. It's changed across various historical scales.

There's certainly different species or different ancestors of humans that had shorter periods but it's also changing in recent history. Puberty has been happening earlier and taking on the full roles and responsibilities and rights of an adult has, in many ways, become a delayed process and is highly variable. So even as a developmental phase, there have been dynamic changes across this window of time.

Interviewer: Benjamin Thompson

Ron told me that the end of adolescence is really difficult to categorize. When someone is in their late teens or early twenties are they an adolescent or are they an adult?

Interviewee: Ronald Dahl

If you get together a group of scientists or a group of psychologists or a group of policymakers and say, how do we define adolescence, you have a great deal of difficulty coming up with any simple answers. If you define them conceptually, the scientists are happy that they're clearly defined concepts and the policy makers would say, yeah, but we can't pass laws based on this concept, we need an age. Give us something we can measure and enforce the laws around and therein lies the difficulty because these are not easily translated into a simple age when we should regard everyone as an adult.

Interviewer: Benjamin Thompson

So, what needs to be done? Will we ever be able to define adolescence?

Interviewee: Ronald Dahl

Rather than assume adolescence is some homogeneous time or group of individuals, we need to recognize that young people who are beginning to change when they're 10 or 11, young people who are in the middle of adolescence as teenagers, young people who are near the end of adolescence beginning to transition into adulthood, if we use some term that implies that they're all the same, we are misunderstanding this period of development. I think that when we try to define this period for scientific study, we're better to think about these developmental processes and how they change across this time rather than use a term that implies that they're all the same, just like we wouldn't regard all children as children whether they're infants or toddlers or preschoolers. We should really be thinking in a more sophisticated way about development if we really want to use that developmental science to inform practical issues and social policies that we're facing.

Interviewer: Benjamin Thompson

Ron Dahl there, who is co-author on a Perspective on adolescence, which you can find over at [Nature.com/nature](https://www.nature.com/nature). Now, it's clearly tricky to pin down exactly what adolescence actually is. But there are still plenty of ideas of what adolescents themselves are like. Next up, reporter Kerri Smith explores a particularly risky stereotype, with the help of neuroscientists and adolescents themselves.

Interviewer: Kerri Smith

When I say the word 'teenager', what pops into your head?

Interviewee: Eva Telzer

Emotional and impulsive and selfish and...

Interviewer: Kerri Smith

Rebellious, risk-taking...

Interviewee: Eva Telzer

There's almost never anything positive associated with the adolescent period.

Interviewer: Kerri Smith

This voice belongs to Eva Telzer. She's a neuroscientist at the University of North Carolina in Chapel Hill where she teaches undergraduates about the teenage brain and those are the words those students use when she asks them to describe adolescence on day one of the class.

[Music]

Interviewer: Kerri Smith

So, are they right? Take risk for example; do teens throw themselves off cliffs or into bed with each other never thinking of the consequences or stopping to consider others? Here's Adriana Galván who studies the teenage brain at the University of California, Los Angeles.

Interviewee: Adriana Galván

Teenagers show an uptake in risk taking. They are less concerned about the consequences of risk taking. They act more in the moment than children or adults and in general they just take more risks.

Interviewer: Kerri Smith

Okay, so they do seem to take more risks and that's one reason that neuroscientists have been so interested in risk. Teens are 35% more likely to die than children and many of the causes are things like road injury or self-harm. There are changes in the teenage brain that could be mediating this too.

Interviewee: Adriana Galván

One that is most relevant to increased risk-taking is that their reward centre is more excitable. The second thing that's changing is their prefrontal cortex is undergoing massive development.

Interviewer: Kerri Smith

The prefrontal cortex is the brain's cognitive control centre, the seat of rational decision making. Together, the peak in reward sensitivity and the fact that the prefrontal cortex is playing catch up, led researchers to think a certain way about teenagers.

Interviewee: Adriana Galván

For a long time we really had a definite model of adolescence. You know, what's wrong with adolescence? What's wrong with all the risks that they take?

Interviewer: Kerri Smith

But the opinion among researchers is shifting.

Interviewee: Adriana Galván

The risk-taking is serving as a learning opportunity for teens. Like all of us, we learn through trial and error often and during the teenage years that trial and error might involve taking risks in order to learn about the environment and to learn about one's own limits.

Interviewer: Kerri Smith

Risk-taking in teens isn't ubiquitous either. Not all teens are dare devils.

Interviewee: Lucy Redford

I wouldn't say I make many impulsive decisions.

Interviewer: Kerri Smith

This is Lucy Redford who's 15 and at a school in Oxfordshire in the UK.

Interviewee: Lucy Redford

I did a rock climbing course – indoor rock climbing course, recently – and there was a certain amount of danger involved with that but I figured I would get a qualification out of it, so that was a benefit. And the likelihood of something bad happening was very low, so I took the risk and it was very good fun.

Interviewer: Kerri Smith

Definitely a calculated risk taker. A study from 2013 showed that teens do calculate risk in much the same way as adults when the risks are known. It's when the outcome is fuzzier that teens are more likely to just go for it.

Interviewee: Theo Barron

My mum specifically said don't break anything, don't injure yourself, because we're going on holiday.

Interviewer: Kerri Smith

Lucy's classmate, Theo Barren, describing a visit to try indoor snowboarding.

Interviewee: Theo

They've got this not huge jump but a decently sized jump and I wasn't at the point where I should be taking jumps but out of instinct I just went over it anyway and I fell over. And it was that moment where you think you've hurt yourself, so I was really nervous then. I was like, oh, what have I done? And also the fact that you probably shouldn't have done it in the first place but you still did.

Interviewer: Kerri Smith

But physical risk-taking is only one type of risk and researchers have realised there are more than that which they need to think about. Social risks, for instance. These are the big ones for many teenagers. Here are Theo and his friend Will Sperrin telling me about the one day at school each year that's a guaranteed cyclone of risk-taking and risk avoidance: non-uniform day.

Interviewee: Will Sperrin

People are a lot more wary about their appearance and things like that. On non-school-uniform days people are always trying to impress people with what they wear and all that sort of stuff.

Interviewer: Kerri Smith

What was the last one of those like?

Interviewee: Theo Barron

Hectic. I sort of just put some stuff I had on but there were obviously people putting on clothes that they had prepared the week before.

Interviewer: Kerri Smith

To many people in Theo and Will's class, the right amount of risk and the associated reward is key at a time like this. Neuroscientists have known for a while that teens tend to take more risks if they're around their friends but peer influence doesn't always have to be bad. Eva Telzer has noticed yet another dimension.

Interviewee: Eva Telzer

Adolescents might take risks that the primary kind of reason for the decision is not necessarily to benefit themselves or get a thrill or what not but really focus on a positive outcome for somebody else. You might be sacrificing something like your peer status or risking getting bullied yourself to do something that benefits somebody else.

Interviewer: Kerri Smith

Her key question is, when a teen takes a risk to help someone, does the brain process it differently from a risk they take to please themselves? Not according to Telzer. Teenagers making these decisions show activation in the same brain region as those taking risks that benefit themselves. It's an area responsible for processing information about reward called the ventral striatum.

Interviewee: Eva Telzer

So I think it's helping us to kind of reframe what risk-taking is in teenagers. It's not these kind of selfish adolescent decisions where they're only thinking about themselves.

Interviewer: Kerri Smith

At the other end of the scale, there might be a cluster of risk-prone teens taking more dangerous risks than the average but research was done on a general population of teens and researchers have just assumed that riskier teens are like that but more so. That may be a false assumption.

Interviewee: Eva Telzer

There's fewer people who have looked at these higher risk populations. It's quite surprising because it is kind of the focus of so much attention in adolescent risk-taking, all of the really negative behaviours that are occurring.

Interviewer: Kerri Smith

The idea isn't necessarily to reduce risk-taking among teenagers because for many teens it's a useful way of figuring themselves out before adulthood. Teens themselves acknowledge this. Here's 18 year old David Kennedy from North East London reflecting on how his younger self would have dealt with conflict.

Interviewee: David Kennedy

It comes with age a bit. It was more about what other people wanted and now it's a little bit more about what I want. It is definitely like, you think things through a lot more when you're older compared to when you're young, it's a little bit more like impulse.

Interviewer: Kerri Smith

There's one more reason, Telzer thinks, to reframe risk-taking and teenagers in general. She and her colleagues have found that negative perceptions can become self-fulfilling prophecies. They asked middle-schoolers about their conceptions of adolescence and then scanned their brains and again in high school. Teens who thought the standard teen who misbehaves at school or is rude to their family was more likely to take risks in lab tests accompanied by changes in brain activity.

Interviewee: Eva Telzer

If everyone believes that this is how adolescents are, the research kind of shows that that becomes true.

Interviewer: Benjamin Thompson

That was Eva Telzer there, talking to Kerri Smith. You also heard from Adriana Galván and special thanks go to Faringdon Community College, Oxfordshire, and City and Islington College, London. You can read Kerri's feature over at Nature.com/news. And for a short documentary exploring this risky business, head over to our YouTube channel which you can find at youtube.com/NatureVideoChannel.

Interviewer: Adam Levy

Coming up, we'll be finding out about the amateur astronomer who stumbled upon a supernova. That's in the News Chat. But before that, it's the final segment in our adolescence special. Noah Baker has been investigating a slightly unusual research group.

Interviewee: Becky Parker

There was a sort of a bit of a race, who would get there first? Of course, NASA then got these same chips on the International Space Station.

Interviewer: Noah Baker

This is Becky Parker. She's a visiting professor at Queen Mary, University of London, and she's talking about her students' race with NASA to get some redesigned CERN technology up into space.

Interviewee: Becky Parker

Actually we managed to fly this technology in open space first. We're now about to get publishable work out of that.

Interviewer: Noah Baker

The experiment in question was designed by her students and monitors cosmic rays that utilize some CERN technology called Medipix chips. Putting any experiment into orbit is a significant achievement for a research group. The thing which makes Becky's group stand out though is that her students were in high school when they designed it.

Interviewee: Becky Parker

You probably think I'm making this up but I'm certainly not but actually this was students saying why don't we use that technology from CERN in space?

Interviewer: Noah Baker

You see, although she does hold a professorship at a university, first and foremost Becky is a high school science teacher. In fact, she was one of my teachers when I was at school.

Interviewee: Becky Parker

What a joy that was, Noah.

Interviewer: Noah Baker

Since teaching me, however, Becky has moved on to much bigger things and now she's...

Interviewee: Becky Parker

...The Director for the Institute for Research in Schools...

Interviewer: Noah Baker

The Institute for Research in Schools, or IRIS for short, is a small charity with the goal of helping young people and teachers contribute to novel research.

Interviewee: Becky Parker

We feel passionately that there's huge potential in young people and that they can engage more with what science is really about if they are part of that community.

Interviewer: Noah Baker

Becky was only just starting with her various initiatives when I was at school and I didn't really get involved at the time, so, I spoke to someone who did.

Interviewee: Peter Hatfield

My name is Peter Hatfield. I work at the Clarendon Laboratory at the University of Oxford. My first kind of experience doing research science: I was very lucky to be involved in several very interesting projects when I was in sixth form.

Interviewer: Noah Baker

Sixth form is a name given to the last two years of high school in the UK – between the ages of 16 and 18.

Interviewee: Peter Hatfield

I eventually ended up submitting to a peer review journal and getting published whilst I was in sixth form.

Interviewer: Noah Baker

Peter thinks that his experience of being a teenage researcher helped him on his journey to university and beyond.

Interviewee: Peter Hatfield

I think it was probably less though that they looked at my personal statement and saw, oh, he's done these projects, that looks great. It was probably more that doing those projects gave me the confidence and reasoning skills that I seemed like a good candidate in interviews and so on. So I think it was more the skills I gained rather than just the fact that I'd done them.

Interviewer: Noah Baker

Becky formed her charity, IRIS, to try to provide this kind of opportunity to all students.

Interviewee: Becky Parker

The vision of IRIS is that science education is about doing science in the same way that a music education would be about playing an instrument and being involved in the real process of music, not just learning about stuff which has gone before.

Interviewer: Noah Baker

But is it as simple as that?

Interviewee: Terry McGlynn

I think it's sensible. I think it depends on the context.

Interviewer: Noah Baker

That's Terry McGlynn, a biologist at Cal State, Dominguez Hills. In 2013 he published an article on his blog entitled, why I don't take high school students into my lab.

Interviewee: Terry McGlynn

In the US it's a very class based phenomenon. So, usually in the US, the opportunities to be able to work in a University laboratory for a high school student are provided to students who are wealthier.

Interviewer: Noah Baker

Now, that's not to suggest that Terry thinks there's anything about teenagers that means they're not capable of doing research.

Interviewee: Terry McGlynn

That just sounds fundamentally silly to me. I think there are a lot of 40 year old men who are PIs of labs that don't have the characteristics that are required to do original research, so what is it that's missing from a 16 years old? I don't even see where that would come from.

Interviewer: Noah Baker

But nonetheless he feels that he has a responsibility to his undergraduates first and foremost.

Interviewee: Terry McGlynn

My university's role in the community is to serve the under-served, and so actually our university was moved to its current location because the community of South LA didn't have a university. So if there's like a rich kid in a prep school in the rich part of town who wants to be in my lab, so he could like go to Harvard for undergraduate, well that goes against the interests of my own undergraduates.

Interviewer: Noah Baker

It's important to note here that the model that Terry is talking about of taking individual high school students into a lab to give them work experience is not the same as projects which aim to engage teenagers more widely with novel research. Terry's feelings towards that kind of work were actually quite different.

Interviewee: Terry McGlynn

If there's a scheme – especially if it's funded – where we can work with multiple teachers, design projects so that we can have whole high school classes involved in original research, I think that's awesome.

Interviewer: Noah Baker

But Terry's concerns are still important to consider. Is this concept of novel research in schools something which can really be accessible for all students? Research can be expensive. Grants don't necessarily cover collaborations with teenagers. Will this not just become a project for the economic elite? Becky doesn't think so.

Interviewee: Becky Parker

No, I think that's actually where IRIS comes in. Sometimes, you know, if you're doing an in depth project with a university, that might cost a lot. One of the things we have been absolutely determined to do is make scalable projects. I think the key thing here is IRIS is not about creating new projects which are suitable for young people. It's about seeing where young people can contribute and in those cases we're not adding to grants, we're actually trying to help the research institutes in the universities by having another wing, sort of having another arm to their operations.

Interviewer: Noah Baker

Becky is adamant that these programs aren't just for the intellectual elite either.

Interviewee: Becky Parker

So we're not just talking about stretching those high flyers. We're talking about empowering students of all abilities to realise that they have something to contribute.

Interviewer: Noah Baker

There have been about ten papers published linked to IRIS led research and there are more in the pipeline. IRIS has more than 500 schools signed up to their model and they're collecting data on its efficacy. So far they're seeing significant increases in academic achievement correlated with research projects, as well as an increase in the number of students continuing to study science, technology engineering or maths at university. But IRIS

is only two years old and time will tell how successful it or other initiatives like it will be in the longer term. I wonder, will you be collaborating with teenagers any time soon?

Interviewer: Benjamin Thompson

That was a report by Noah Baker. It featured Becky Parker from IRIS, Peter Hatfield from the University of Oxford and Terry McGlynn of California State University, Dominguez Hills. If you want to read more about bringing high school students into the research environment, check out the Careers piece in *Nature's* adolescent special. You can find the whole collection at nature.com/collections/adolescence.

Interviewer: Adam Levy

Time now for the News Chat, and I'm joined in the studio by Physical Sciences reporter Davide Castelvecchi. Hi Davide.

Interviewee: Davide Castelvecchi

Hello Adam.

Interviewer: Adam Levy

Now, first up, researchers have been looking for a way to transport antimatter. Before we get to why they want to transport it about, can you explain why this is such a difficult thing to do?

Interviewee: Davide Castelvecchi

Well, it's probably something a lot of our listeners know from science fiction. Antimatter just vanishes in a puff of energy when it bumps into ordinary matter and so you can imagine that you can't just hold it in a regular box because a regular box is made of regular matter.

Interviewer: Adam Levy

So what do you have to do instead if you can't hold it in a box?

Interviewee: Davide Castelvecchi

There are techniques for holding things in electromagnetic fields. The tricky thing is that for antimatter you have to keep it not only in a vacuum in an electromagnetic field but also the vacuum has to be exquisitely pure. You can imagine any stray atom of anything would destroy the antimatter.

Interviewer: Adam Levy

So why are researchers looking to go to all this trouble to transport antimatter around? Why can't they just keep it where they've got it?

Interviewee: Davide Castelvecchi

Well, first of all there's not many places where you can create antimatter and CERN, the particle physics lab near Geneva, has one of the few sources that can make a substantial amount of antimatter but then again there are a lot of experiments where you could potentially want to use it and in this particular case there's an experiment up the road on the CERN campus where they're going to ship it to.

Interviewer: Adam Levy

And what's this experiment actually hoping to use this antimatter for?

Interviewee: Davide Castelvecchi

This is a very interesting experiment because it could shed some light into the structure of neutron stars. Neutron stars are the densest form of matter known in the universe and what they're going to do is they're going to basically make the antimatter protons collide with very rare isotopes and see what happens and the interactions inside these isotopes' nuclei they hope, because they're similar to what might happen inside a neutron star, they could tell us something about the structure of a neutron star.

Interviewer: Adam Levy

So how many anti-protons are they actually planning on shipping across to do these experiments with these nuclei?

Interviewee: Davide Castelvecchi

So, this bottle, they're hoping that it will be able to hold about a billion antiprotons at a time which, it's not a microscopic amount of matter by any means, but it's a lot more than has ever been done before.

Interviewer: Adam Levy

Now, why can't they just, instead of shipping this really precarious antimatter over to the radioactive nuclei, just ship the nuclei over to the antimatter?

Interviewee: Davide Castelvecchi

Ah, because they're going to be doing this experiment with extremely rare, extremely short lived, isotopes and those decay within a fraction of a second so you wouldn't even have the time to put those in a bottle and take them to the antimatter factory.

Interviewer: Adam Levy

Well, it sounds like an experiment that is going to take a lot of care to get right which is in a way quite different to our second story which took a lot of fluke to get right. An amateur astronomer has made quite an amazing discovery. What did he actually capture?

Interviewee: Davide Castelvecchi

This man named Victor Buso in La Plata Argentina, on the 20th of September 2016, he was testing a new camera for his telescope and so he took repeated pictures of the same galaxy over a period of hours and he saw at the beginning of his night of observation, the galaxy just looked like its normal usual self and by the end there had been a super nova explosion. So in these pictures that he took every few minutes, he actually saw the supernova break out, something that had never been observed before.

Interviewer: Adam Levy

But haven't supernovas been captured before in comparison to previous images?

Interviewee: Davide Castelvecchi

Absolutely. It happens all the time. People take a picture of a galaxy. They see this very bright dot and they then compare it to archival images and they say that dot wasn't there before, this is a supernova and then sometimes they keep observing it for weeks at a time but the actual process of going from a star to the supernova and the star becoming rapidly brighter had never been seen before.

Interviewer: Adam Levy

Just how big a fluke is this? How often would you expect a supernova to pop into existence in a galaxy like this?

Interviewee: Davide Castelvecchi

You have to imagine this is a spiral galaxy just like the milky way and it's thought that maybe there's a supernova happening in another galaxy maybe once per century so you have to imagine if you take a picture, if you look at a random galaxy at a random time, the odds that you'll see a supernova happening at a certain time while you're looking at it are very low. One astronomer I interviewed said it's like hitting the jackpot in a lottery.

Interviewer: Adam Levy

Now obviously it must be wonderful for this amateur astronomer to have discovered this but are there research implications to now having an observation of a supernova exploding live, I guess?

Interviewee: Davide Castelvecchi

This is unclear. I mean, it seems that what happened was more or less what people expected from theory and from previous models but there haven't been very detailed computer simulations made so far to compare with the data. So it may need some more work to actually find out if there's a lot we can learn from this.

Interviewer: Adam Levy

Are there other examples where we've spotted something for the first time in the cosmos pretty much by chance like this?

Interviewee: Davide Castelvecchi

Astronomy actually is a science which has a lot of serendipity. One famous example was 1967, the discovery of the first pulsar. This mysterious radio signal that was flashing once every 1.33 seconds and the researchers who made the discovery, they were not looking for it. They didn't know this thing could exist. They were just looking at that part of the sky for other reasons. There's another famous example that's more recent in history: NASA's Cassini probe around Jupiter was doing a flyby of the moon Enceladus and just as it was flying by the moon it got hit by a plume of ice particles. There was an eruption from the surface of the moon and this was not entirely unexpected but the fact that it happened just as the probe was flying by and it got hit by the particles themselves, it didn't just observe them from afar – that was quite unexpected.

Interviewer: Adam Levy

Thank you Davide. For more on the latest science news, head over to nature.com/news. And for more on serendipity in science, keep an ear out for this month's Backchat. The round table discussion will be landing in your podcast inboxes very soon.

Interviewer: Benjamin Thompson

That's it for this week's show. Don't forget to follow the podcast on Twitter @NaturePodcast or send us an email, podcast@nature.com.

Interviewer: Adam Levy

And don't forget to go and check out *Nature Video's* short film about risk during adolescence. You'll find it, along with all our other science videos, over at youtube.com/naturevideochannel. I'm Adam Levy.

Interviewer: Benjamin Thompson

And I'm Benjamin Thompson. Thanks for listening.

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