

Exploration and Risk-Taking: Hallmarks of Adolescence That Increase Well-Being

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Exploration is a fundamental human behavior. Exploring our environment can promote the acquisition of knowledge by exposing us to novelty. Adolescence is a prime time to explore, take risks, and learn, but why is exploration so enticing—and so rewarding—in the lives of teenagers and young adults?

The role of exploration and risk taking in sustaining adolescent well-being and establishing social connectivity is the topic of a recent article published in [*Psychological Science*](#). In this podcast, you'll hear from the two psychological scientists who wrote this article, Natalie Saragosa-Harris, of the University of California in Los Angeles, and Catherine Hartley, of New York University. They'll talk with APS's Ludmila Nunes about their examination of exploration patterns in adolescents and young adults.

Unedited Transcript

[00:00:12.990] – Ludmila Nunes

Exploration is a fundamental human behavior. Exploring our environment can promote the acquisition

of knowledge by exposing us to novelty. Adolescence is a prime time to explore, take risks and learn. But what role does exploration play in teenagers lives? This is Under the Cortex, I am Ludmila Nunes, with the Association for Psychological Science. To speak about the role of exploration and risk taking in sustaining adolescent wellbeing and establishing social connectivity. I have with me Natalie Saragosa-Harris from the University of California in Los Angeles and Catherine Hartley from the New York University. They co-authored an article published in Psychological Science examining exploration patterns in adolescents and young adults over three months. Natalie and Catherine, thank you for joining me today. Welcome to Under the Cortex.

[00:01:15.450] – Catherine Hartley

Thank you, Ludmila, for the invitation to join today. It's a pleasure.

[00:01:19.470] – Natalie Saragosa-Harris

Yes, thank you for having us. We're really happy to be here.

[00:01:22.470] – Ludmila Nunes

It's great to have you both. So as we start, please explain what you set out to study and why.

[00:01:30.750] – Catherine Hartley

Sure. So there's a large literature suggesting that adolescence is a period of heightened exploration. This evidence comes from research across species in both rodents and humans. But predominantly it has relied on laboratory studies of exploration. So exploration within controlled experimental tasks or in the case of rodents, sort of limited geospatial locations. There is some sort of behavioral ecology research looking at exploration across adolescents and rodents in the wild. But to date there really hasn't been studies of adolescent exploration within the real world. And so one of our primary goals within this study was to see whether we could find evidence that adolescence is a period of heightened exploration using real world behavioral measures that were inspired by work that has been conducted in rodents where rodents could be continuously tracked within their rearing environments. And you can derive a measure that's called roaming entropy. And this was our central measure of exploration here which is really a measure of how an individual is distributing their time across locations. And so we use this measure of roaming entropy as our metric of exploration in this study. And maybe, Natalie, do you want to explain how we did this?

[00:02:56.790] – Natalie Saragosa-Harris

Sure. So what we did is we recruited a group of 13 to 27 year olds who were living in New York City and we asked them to download this tracking app on their phone and to keep it basically open for a three month period. And what this app did is it allowed us to pull down their exact location, their geolocation using GPS data about every minute to two minutes of every single day and for every single person for every single day they got this roaming entropy or exploration value based on that GPS data. And one of the main things we're interested in is looking at how this related just to age but also to some self report data that they had filled out in labs.

[00:03:44.730] – Ludmila Nunes

And did you also measure well being and social connectivity?

[00:03:49.730] – Natalie Saragosa-Harris

Yeah. So another sort of facet of this study that was really important to us is this idea that it's adaptive for adolescents to engage in this exploration in order to promote independence right as they're sort of leaving the family unit. And it's also connected to well being. So an idea sort of there is that exploration should be rewarding. It should be something that puts you in contact with novel places and exposure to novelty is supposed to be experienced as rewarding. So actually, in another study before this one Kate and Aaron Heller who is also in this current city that we're talking about, looked at this in adults. So they use this roaming entropy measure to look at how everyday exploration is related to positive affect being in a good mood. And they found that they are highly correlated. So on days in which adults explored more or had higher roaming entropy they also reported greater positive affect or better mood. And so we did that again in this study. And so about every 48 hours that we sort of varied when in the day we sent it to them we would send a text message to these participants saying how good do you feel right now?

[00:04:57.780] – Natalie Saragosa-Harris

There's a basic sliding scale, zero to 100. We wanted to make sure people weren't overwhelmed with having to answer these questions. We wanted them to be able to do it and respond quickly and easily. And what we looked at also was on days in which people explored more did they also report better mood? So can we replicate this effect? But we were also interested in if this varied depending on their age. Is it the case that for a 13 year old and a 25 year old is experienced the same? Or is it maybe more rewarding during adolescence when there's this heightened adaptive nature to exploring more as you're sort of learning about the world, forming new social groups, etc.

[00:05:37.980] – Ludmila Nunes

Great. So you're able to track these young adults and teenagers and what did you find?

[00:05:46.470] – Catherine Hartley

So as Natalie told you, we collected many measures and we had many hypotheses. Our primary hypothesis was whether we could find evidence from this real world data that adolescents were indeed exploring more. If we look at our data and we divide our under 18 year olds from our 18 and over participants we see that the 18 and over participants show a higher level of mean daily exploration than our 13 to 17 year olds do. However, if we look at age continuously from 13 to 27 we see that this effect how much an individual explores on an average day mean roaming entropy shows a pattern that looks like almost Ushaped. It increases across 13 to 17 years old. It shows a peak roughly at the age of 18 to 20 after the transition to legal adulthood. And then our sample size really isn't sufficient to draw strong conclusions about whether it is Ushaped and decreases, but it appears to have reached a plateau or at least have peaked shortly after the age of legal adulthood. So we're seeing an increase in exploration across adolescents that is at a maximum at the age of legal independence, at least for these teens that we measured in our study in New York City.

[00:07:14.310] – Catherine Hartley

So this was consistent with the notion that adolescence is a period of increasing exploration. The second hypothesis we wanted to test is whether adolescents found days of greater exploration to be more subjectively rewarding so we could use these measures of self reported well being how good do you feel every other day? To test this hypothesis. So we replicated our prior finding that individuals report greater levels of wellbeing on days where they explored more. But we didn't find that this effect varied with age. So adolescents, just like young adults, reported feeling better on days where they had higher levels of roaming entropy. Our measure of exploration. We also wanted to ask whether higher levels of roaming entropy might relate to social connectivity to the size of an individual social network. So we had individuals complete retrospective reports of how many individuals they had interacted with, they had communicated with via social media or text messages in the prior 30 days. And we used this as a proxy for an individual social network size. And we found that individuals who had higher mean levels of roaming entropy so who tended to explore more on average, also had larger social network sizes.

[00:08:46.170] – Catherine Hartley

And so we interpreted this as perhaps reflecting that those individuals that may have a stronger drive to seek out novelty or who are visiting more locations in their environment also have greater diversity or variability in their social interaction partners. Finally, we wanted to ask whether there was a relationship between levels of exploration and risk taking and we found, yes, this was the case, but only amongst our cohort of 13 to 17 year olds. So we found higher mean level of exploration was associated with greater selfreported risk taking, but only amongst the adolescents, the 13 to 17 year olds, the under 18 in our sample, not amongst the young adults. We're really interested in following up on this finding to understand this age difference further. But our speculation about what this might reflect is that it may be that when you are younger, when you explore, you're more likely to encounter novel types of situations that you've not been in before. And adolescents may be more likely to encounter decision contexts in which they might take potential risks without well formed sort of personal policies about how they behave in those situations. If I go to a party, I know that I might have one glass of wine or two, but I'm very unlikely to have eight or nine.

[00:10:19.760] – Catherine Hartley

An adolescent who encounters a party for the first time might not have such a policy and might be more likely to explore different behaviors until they learn from experience the consequences of these decisions.

[00:10:33.510] – Ludmila Nunes

Because these contexts and this novelty is what will allow them to form those rules and learn from experience, right?

[00:10:41.290] – Catherine Hartley

Absolutely. And sort of what's required to learn how to behave in these situations. Yeah.

[00:10:47.670] – Ludmila Nunes

So I'm curious about one thing. So you measured these roaming entropy every day, but did you analyze how it changed from day to day and if that was correlated with any measures?

[00:11:03.090] – Natalie Saragosa-Harris

Yeah, I can take this one. We didn't look too much at how roaming entropy changed day to day. I will say in looking at the relationship between roaming entropy, this exploration measure, and, wellbeing, that positive affect text. We did look at if this was explained by any other variable. For instance, so you can imagine this is a measure of physical movement over space and this is New York. And so it could be that on days when it was miserably hot, because it was sort of during a period of the transition from summer to fall, I believe you could imagine it's miserably hot outside. It's New York, so it smells like trash. When it's hot, people might not go outside as much. They might be in a bad mood. You can kind of see how that would affect it.

[00:11:47.080] – Catherine Hartley

Right.

[00:11:47.240] – Natalie Saragosa-Harris

So we control for things like weather. We also looked at precipitation or rain, right? If it's raining outside, someone might already be in maybe a poor mood, but that also means that maybe they don't go outside as much. Maybe they decide to stay indoors that day. We also looked at time of day in which they responded to the text message about their mood to see if that had any sort of effect. And so we did this sort of as a sensitivity measure of like, can we replicate this effect with this sort of strict control of all these other variables that you can imagine might be contributing to this? Especially because this measure was about movement over physical space within the city. Right.

[00:12:28.430] – Catherine Hartley

Day of the week is a really robust variable that predicts exploration differences. So we all tend to go out more and explore our environments on weekend days than on weekdays. So that's an example of the sort of control that we applied in these analyses. And that was one factor that was predictive of differences in entropy.

[00:12:49.890] – Natalie Saragosa-Harris

And Mondays were associated with at worst mood, as you might imagine. But even after controlling for these things, there was still the strong relationship between your levels of exploration and your mood. But that is a great question, and I know in future work we are interested in a little bit of this idea of prediction error, if you will. So this idea of if you were to estimate how much will this person explore tomorrow just based on their history of like, how much do they tend to explore. And like this week, how much have they been exploring? Is there sort of this expectation that they'll have the same level of exploration and how much it differs from what you would expect based on their prior behaviors? Is it really how much it differs that matters, right? So one thing we did do, we actually coded every single location for a given person relative to how novel it was for them. And we counted how many times they

visited that place. So if there's like a certain coffee shop or something, if it was somewhere that they constantly went, that actually wouldn't be as weighted in their estimate for novelty.

[00:13:51.450] – Natalie Saragosa-Harris

Anyway, all this is saying that these daily entropy measures were sensitive to how novel that location was for a given person.

[00:14:01.350] – Ludmila Nunes

So the other question I had was you tested and I know this is going to be just speculation because you don't have data for this, but you tested people from New York City. Would you expect a different pattern if you have tested young adults from a small town or even from a different culture?

[00:14:19.910] – Natalie Saragosa-Harris

I really love this question and it's something we speculate a little bit about, I think, in the discussion in the paper. But the first thing is not a different culture per se, but in the adult paper that was run before this one. In that study we looked at adults in New York and Miami. Obviously they're both within the US. But differ a lot importantly in the use of public transportation versus cars. So you might imagine that people's exploration and physical movement patterns are going to look quite different if you're sort of going across Manhattan in the subway versus maybe driving just from home to work in Miami. But it's a really important question specifically about how do adolescence vary in this way, because New York is pretty unique in the autonomy as it affords people who can't drive yet or who don't drive, right? So a 14 year old, depending on how strict maybe their parents are, can get on a subway and go visit a friend in maybe a different borough, for example, whereas in maybe a more remote area that can't really be done without driving or having someone else drive you. And so I think even just purely looking at patterns of exploration in other areas would be very interesting and specifically looking at how this might differ as a function of important transitional periods such as getting your license.

[00:15:43.610] – Natalie Saragosa-Harris

And one thing that we sort of proposed for future work is looking at this, like you said, across different cultures, especially in between countries or maybe the legal age of adulthood varies. So a lot of what we find in this study, it really suggests that there's a sort of peak and exploration around that 18 to 21, when socioculturally people are afforded more independence, right, they maybe move away from home, they're considered a legal adult. And you are afforded a lot more opportunities and you're kind of allowed to do more things. And so if we were to look at somewhere else or maybe the legal age of adults would differ. That's a really interesting question from this idea of is it really something about being 18, or is it something about being at the age where culturally you're afforded this sort of autonomy and able to explore in the way that's developmentally appropriate?

[00:16:38.490] – Ludmila Nunes

So what are the practical implications of these findings? If you could summarize them in a couple of sentences.

[00:16:44.850] – Catherine Hartley

Sure. So I think one important takeaway from this study is adolescents often get a bad rap as being overly prone to engage in risk taking behavior and maybe making bad decisions. Here we found that it's important for their subjective sense of wellbeing, for adolescents to sort of get out in the world, and that this may be a behavior that, yes, may present them with more opportunities to take risks, but that this is an important learning phenomenon in adolescent development. So for parents, for policymakers to think about our cultural practices, when and how we grant this autonomy to teenagers. So I think that's one important practical implication. We're currently, in our ongoing research, interested in the way in which these sorts of behaviors unfold at these cultural transition points, like sending teenagers off to college that really are strong demarcations, where they're really given a large degree of independence all at once. So how do they navigate these transitions and establish sort of new behavioral routines? How does this relate to well being and social adaptations? And I think as we begin to understand more how to interpret these metrics of real world behavior, we may get sort of more actionable, practical insights, but we're sort of in the process right now of understanding the nature of the interactions between these complex behavioral domains.

[00:18:29.270] – Ludmila Nunes

This is Ludmila Nunes with APS, and I've been speaking to Natalie Saragosa-Harris and Catherine Hartley, authors in an article on the effects of exploration patterns in adolescents and young adults.

[00:18:42.870] – Catherine Hartley

Thank you so much for having us today.

[00:18:45.020] – Natalie Saragosa-Harris

Thank you. This was quite fun to discuss this study with you.

[00:18:49.370] – Ludmila Nunes

If anyone is interested in reading about this study or learning more, please visit our website psychologicalscience.org.

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