

This is the Blue & Goldcast. I'm Santa Ono the president and vice-chancellor of UBC.

And I'm Jennifer Gardy professor in UBC School of Population and Public Health. Blue & Goldcast is a monthly podcast where Santa and I talk with people at the university about the big issues in higher education. And this month's topic is concussions. Santa, I know this is a topic that you personally wanted to cover on the show.

Absolutely because we have several hundred, very talented, scholar-athletes here at UBC and I can tell you personally this is important to me because when I was actually in university, I went to my friend's house in the suburbs of Chicago and we played football and I ran into a tree and I don't remember exactly what happened. I completely blacked out and when I came back to consciousness, my friend said that, "You just ran into a tree, hit your head, and you blacked out for four minutes." And it took me days to recover. I probably had a concussion and that was the first time that I realized personally that being hit in the head hard is something that can really affect you at least acutely. But later on, as you know, I've been president of a number of universities that have had what we call D1A sports and I was able to actually get to know a number of football players personally and I've had many opportunities to speak with them about concussions they have actually experienced and the impact on them soon after the concussion, and then even situations where individuals have been affected seriously long-term. And for that reason, I think that I'm excited about the kind of research that's going on here at UBC to look at the neuroscience behind post-concussion injury and I'm very hopeful that we can mobilize that knowledge to try to take care of our scholar-athletes better.

I think it's a fascinating area. When I was growing up, I wasn't a team sports player. I did ballet and piano lessons, neither of which are particularly known for high rates of concussions. But as somebody that is working in public health and as somebody who pays attention to sports and what's happening in the news, it's pretty obvious that things like chronic traumatic encephalopathy in the NFL players, for example, or the rash of suicides amongst NHL enforcers, really we're seeing the effect of traumatic brain injury like concussion on very high-paid, powerful athletes that people sort of hold up as these paragons of athleticism can be crippled, brought down to earth by a simple knock to the head.

Absolutely. And it's for that reason that it's really, I think, the responsibility of institutions like UBC that have world-class researchers studying the brain and its health to share that information with the world and to be involved even beyond that in policy discussions as to what we can do and who should be accountable for ensuring that the health of young athletes is top of mind.

Well, let's dive in and talk to one of those world-class researchers [music]. Dr. Naznin Virji-Babul is a neuroscientist and a professor of physical therapy here at UBC. We recently sent our producers to the Djavad Mowafaghian Center for Brain Health where Dr. Biwil is testing a rugby player named Patrick O'Flaherty for brain damage.

So this is a EEG cap and it has 64 channels of electrodes and each of these electrodes is recording activity from different parts of the brain. So we're actually getting activity from the entire brain when we put this on.

I'm currently just taking out his size of cap.

Have you done this with Patrick before?

Yes [laughter]. Multiple times.

[music] I had my most recent concussion in February 27th of this year. I play rugby for a team in East Vancouver. The guy who hit me was basically bringing his knee up while my head was going down.

Was he on your team or the other team?

He was on my team [laughter].

Did you talk to him after?

I did talk to him after. Yeah. Yeah. It was an accident but he knows not to do it again [laughter]. When I initially had it and I got up and I couldn't see from my left eye. I thought I'd lost my eye because the blood had gone into my eye. I knew my nose was probably broken and I had lots of the kind of the eyesight light sensitivity, tired, dizzy, unstable on my feet. So I was brought to accident and emergency. Luckily for me, I'm a physiotherapist - my background - and I actually work in a concussion clinic. It was interesting from my point of view sustaining it because then I can see how my patients feel.

Mind if I just ask, well, you said it was interesting. How quickly did you transition to thinking, "This is interesting?" When you got hit right in the nose? 10 seconds later, "Oh, interesting."

I suppose it was when I was in emergency and I was kind of feeling my symptoms and I said, "Oh, this is exactly how my patients were describing it."

So I'll get Patrick to sit down.

So the cap kind of looks like a mesh of--

Swim cap.

Kind of like a-- yeah, a swim cap with all the different electrodes attached to it.

Could you show me kind of where in the electrodes where you're sort of most interested in?

So we're most interested in this part of the brain, right and left sides, which is the frontal areas. These are the areas that have to do with executive function, working memory, risk-taking, emotion control. So all of this frontal activity is what we're interested in. But when you look at the physics of the brain, what happens when you get a hit to the head is that your brain kind of bashes in the back of the skull to the back of the head and then it kind of comes forward. So the front part is also bashing against the front part of the skull.

[music] I'm just wondering what makes it worth the risk for you.

Yeah. The game is something that I've played since I was 12. Well, even younger than that. So it's kind of how I identify as a person. And if I didn't play rugby I feel I'd probably be a little bit depressed. So, yeah, it's kind of ingrained in me as a person.

Naznin, thank you so much for being with us on this show. We're really looking forward to this interview and we are really impressed with everything that you do at the university.

Thank you. I'm really excited to be here and talk about this work.

So let's start by hearing some more about that clip. What was that test looking for?

So what I'm doing right now is using EEG to look at brain signals, to look at changes in the brain in athletes who have had a concussion and athletes who haven't had a concussion. So we basically collect just five minutes of resting state data and we look

at the brain activity in these athletes and what we can tell from that is whether there's been any change as a result of a concussion that they might've experienced. So our brain is sort of like the World Wide Web. Even if you're not doing anything and you're just sitting, resting with your eyes closed, there's all this tremendous activity that's going on in the background. Different parts of your brain are talking to each other and it's essentially a network and we can now model this network. And with the tools that we're using, we can actually tell if there's been a change in the network after somebody's had a concussion. And that's what we're doing with Patrick to see if any of his networks have changed. And what we saw with him was that there are subtle changes in how his brain is organized as a result of the concussion.

So what were you looking for? What kind of things were you looking for that you were hoping you wouldn't see in the actual scan?

Well, what we see is it's not so much a visual scan. It tells us a little bit more about how different parts of the brain are actually communicating with each other and if there's a shift in that pattern. So I often compare the network organization to, say, a map of the airlines. You know how there are certain hubs - like Vancouver's a hub, Toronto's a hub for the airlines - and if there's ever a storm, let's say there's a big snow storm in Toronto, flights would get diverted to Ottawa. Now all of a sudden Ottawa airport has a tremendous load on it because there's all these flights coming in and has to deal with that extra load. And that's kind of what happens in your brain. Part of your brain seems to be affected by the concussion and as a result, your brain reorganizes itself so that another part of the brain seems to take over. And the area of the brain that seems to be the most vulnerable, especially in adolescence, is the pre-frontal cortex. And this is an area that's critical for things like emotion processing, executive function, working memory, risk-taking behaviors and these are the areas that are really developing during this time period. So having a concussion that is in some way impacting those really important areas of development, that's a question that I'm asking, is how is concussion actually affecting that area and what does that reorganization tell us.

So as an individual, Patrick or an athlete, when you actually detect those organizational changes, what steps would one take if you were his parent or his provider of health care?

So one of the things, people just want to know that something has actually happened to their brain. Very often they go to see a health professional. The tests that we have right now are fairly subjective. It's based on symptoms. There's no real objective gold standard that says that somebody's had a concussion. And that's what we're working on. So we're using a lot of artificial intelligence tools to try and classify a concussion. I'm working with a lot of the engineers here at UBC. It's a very exciting collaboration to bring the neuroscience and the engineering together to use AI to try and find ways that we can classify a concussion and give people an objective measure that there has been a change in their brain. Now this change doesn't necessarily have to be negative. It's just that there is a change and this means that they may be experiencing things very differently than they did before. A lot of the parents when the first come in they say to me, "This is not my kid anymore. Something has changed." Either they're more emotional, they get upset about things they normally wouldn't have. A lot of them often have early signs of depression - partly that's because of the interventions that we do have. Usually, health professionals will recommend that people, after a concussion, have complete rest - physical and mental rest - and that they sort of stay in a dark room. These are sort of the older ideas about what to do after a concussion.

We now know that prolonged rest probably makes the symptoms get worse and can lead to early signs of depression. And you can understand that because somebody like Patrick who's playing rugby in a team, it's an environment where he's with his friends

enjoying himself, physically he's very active, and now, all of a sudden, he has a concussion and has to be in a dark room and he can't be around his friends. Well, he's spending all his time alone. All his friends are out there having fun. Of course, that leads to changes in his mental health. So that's an area that I'm very interested in looking at further with this.

Those are really, really serious consequences especially for young people. And then you think beyond that, they are serious consequences for their developing brain itself. That analogy of the airport connectiveness and what happens when a whole chunk of the airport network goes down I think really drives home how serious a problem these can be. Do you see more and more young people coming into your practice, coming into your studies with concussions? Is this really a problem of young people? And what's bringing them in the door? What's causing these concussions?

Well, a lot of it is related to the rules of the game. So there are certain rules that are more risky than others. We know, for instance, ice hockey, rugby, football, those are sports that are more riskier. Ringette, for girls, is also one. I also see a lot of girls who come in who have played ringette. There is certainly been a lot of awareness of concussion and sort of the links with later neurodevelopmental changes that could happen from repeated concussions. So I think parents are very worried about this, health professionals are becoming more aware so that when somebody does have a hit to the head, usually it's a first line to say, "I really want my kid checked out. Tell me what's going on in their brain." So there does seem to be an increase in incidents but we don't really know whether that's related to the fact that there's so much more awareness about concussions now especially because of all the issues with American Football and the lawsuits and the legal actions that have been taken and sort of this indirect link with CTE.

Yeah. Thinking about the increased incidents which as you said might be just a function of us seeing these more frequently - looking for them and so finding them more often - do we have enough data yet to really understand the long-term consequences? I mean it seems like there's this sort of wave of concussions in our young people but we've maybe not had enough time to follow them longitudinally to really realize the long-term impacts of these.

Yeah. So that's one area that I'm really excited about. My graduate students and I have been collecting data on kids longitudinally for up to one year. We usually go out at the beginning of the season to Richmond where there's lots of teams that play ice hockey and soccer and we scan the entire team at the beginning of the season - all two, three hundred kids. All our students go out and we do this. And then we ask the kids who've had a concussion to come back to the lab when they do have a concussion and we've been tracking them for up to one year after their concussion. These kids brains, even after a single concussion, they're not going back to their baseline function. Their brain has changed as a result of even a single concussion and it doesn't ever go back to baseline. Now, this is kind of an interesting story because you have a developing brain so, of course, the network is changing over development. And how do you track what baseline is - because they're no longer at their baseline? What we don't know right now is is that reorganization, is that plasticity that we're seeing in their brain actually just as good as it was before? Can they just do exactly the same things they've always done but with a different underlying brain organization? Or is this something that will eventually develop into some later neurodegenerative changes? All of that kind of makes us think about how do we intervene. We need the longitudinal tracking data but we also need to figure out what's the best way to intervene at these different spots.

Kind of follow up on the intervention issue. You may or may not know, maybe I told you that when I was at the University of Cincinnati I helped fund a study of varsity

athletes in the football team and it was not so much looking at brain organization but looking at recovery where there was a third-party sort of test where we would flash lights in different places in the visual field and determine how quickly the athlete could actually--

Reach for it?

--with a fast-changing moving light retrain. And the data there indicated that post-concussion, it took longer to be responsive and they actually used it as a surrogate measure of recovery. And once it got back to the time it takes to respond to this moving light, once it got back to baseline, then they were deemed fit to go back on the field. What do you think about that [crosstalk]?

Yeah. I think that's a great study and I would've loved to have you have included some brain measures because we know there's actually a disconnect between behavioral recovery and brain recovery. Those two things seem to be quite different. In terms of behavioral recovery, if we see changes in symptom recovery, it doesn't always match up with how the brain has recovered. So there's still a danger of putting kids back on the ice or on the field too early before their brain is ready. And many of the kids who come in who have had repeat concussions often say to me they had their first concussion, the first five minutes they get back on the ice, they have the second one. And it's partly because of what you said - their reaction time was slower, their movement times were slower. They're not able to really process all the different kinds of information that's coming at them in this very fast-paced game situation and they end up getting another hit.

But in this case there's actually an unbiased, measurable assessment of functional recovery. I get your point that you also have to look at the brain organization. But in the past, it was a coach saying, "Oh, you're okay. You see my finger? You can go back on the ice or you can go back on the field."

Yeah. So it's definitely more objective what you were doing. Yes.

But I would love to follow up offline with how I might be able to support a similar sort of study and extending it here.

That would be great. Let's do it [laughter].

That's kind of the opposite reaction of what I would imagine what people have to your work. I think probably a lot of people who are sports supporters, maybe coaches, for example, would be not necessarily supportive of something that's going to change, say, their coaching style and say, "Oh, wait, I can't send this person back in? This is a problem." So it's great to hear somebody who's like, "No, we should be doing this this way."

Yes. It is great. Yeah. Exactly.

Do you get objections from coaches, from sports fans, from people saying that your work is just going to screw up how we've always played the game? You shouldn't be doing this.

Yes. I made a presentation-- and I don't know if I should be saying this. I made a presentation to the Blue Jays who are coming to UBC to develop the baseball fields here and to say, "I have a way of actually looking at the brain in adults who have had a concussion. Would you be interested?" They basically said no because if you take a player off the field it's going to cost \$1 million every day that they're not on the field. So at this point, we don't actually want to know whether they've had a concussion or not. We'll just use our behavioral measures. So yes.

For varsity athletics it's a different ethos. As the president of UBC, the welfare of my student-athletes is what matters. And I would rather a student not go on the field, and I would say this to a coach, if they're not better. So here's a question. With that sort of surrogate measure approach that I discussed as being able to respond to moving light, I understand the limitation to know what's really happening with the brain. If you look at the organization of the brain, the changes that you see is there a level of change where you would say to the player or the parent or the coach, "Your son or daughter should not go back on the field"?

Yeah. I mean I think we would probably use your measure for that more than the brain measure because we don't really understand how the shift in the brain organization is affecting or would affect their subsequent performance. But something like what you mentioned if they're much slower and if they can't do it then you know what the consequence of that is going to be when you're in a fast-paced, very competitive environment. So that person is definitely not ready. So if we could actually work on that together, I think it would really advance the field in terms of having a quick measure that's objective and reliable that would actually help us decide when someone's ready to go on the field or not. Yeah. I'm excited to work on that with you.

It seems like a quick measure is a really useful and necessary tool right now but it also seems like a good diagnosis of concussion in general, just that being able to in with a scan, for example, and say, "Yes. Something is different," that is extremely valuable. So what does having that diagnosis mean personally for an athlete?

Well, I think for the athletes what they've said is that they wish they had some kind of physical indication that they've had a concussion like a bandage around the head or if someone has a scar or something, a splint, then people know that something has actually happened to them, right, and they are a little bit more empathetic when they say, "Well, I can't play. I can't do this." There is a lot of pressure on the kids, on our varsity athletes especially the ones who are very good. There is a lot of pressure to get them back on the ice or on the field. But having some objective measure that says, "No. Look, I really have a problem." I had somebody who came from the States, she was 19 and playing varsity soccer, and was getting terrible symptoms - headaches, she couldn't see that well, she was having double vision - and her coaches were not very empathetic, wanted her to get back on the field. And every time she went back, she would just feel like throwing up, felt sick to her stomach and she kept thinking, "This is just in my head." And she came to UBC and we did a lot of different scans - we have other scans that we can now do besides the EEG - and we were able to show her that, "No. Look, there actually has been some change in your brain as a result of all the concussions that you've had." And you know what she did? She printed out pictures of all the scans and she has them over her bedroom in her dorm room because she said, "Every night, I got to sleep, I look at this and I say it's not in my head in my sense of being in my head, actually something has changed in my brain." And she's now much more empowered to say to her coaches, "I'm not ready to do this. I need to wait. I need to have some therapy," whatever she needs. So I think having that measure is really, really empowering for the kids to know that something has changed.

I would say that it's probably not fair to put that burden on the athlete. First of all, the athletes are young, they have dreams, they've always wanted to be Wayne Gretzky or they wanted to be a famous figure skater or something like that. And they're too young to have that responsibility. And in a way, sometimes the parents are the wrong individuals because they've always wanted their son or daughter to be Olympic medalists. And sometimes I watch them on the field and they are really aggressively encouraging their kids to perform at a high level. And sometimes it's not the coach

because they want to win and they're assessed on winning. And so I think that perhaps what we should do is to ensure that athletic associations, u-sport, the universities it's at the policy level are aware of the power of your technology and our responsibilities as organizations that host these scholar-athletes that we have a responsibility and we're held accountable for making sure that we take care of those that are in our charge.

Yeah. I think that's so important. I think we as a university have a really critical responsibility to get that education, get that information to translate the knowledge, "I'm not the only one at the university who's doing this work." We have so many collaborators, so many different people looking at different aspects and we have a chance to really shift policy in youth and varsity sports and I think we need to step up and really do that.

This seems like a really emotionally charged issue. We're talking about young people, we're talking about brain injury, we're talking about parenting, we're talking about sports decisions. Does this work? Does doing this sort of research have an impact on you emotionally as well?

It does when I hear the stories. Especially the kids who come in who've had mental health issues and they're not able to keep up with their friends or they're having trouble with their schoolwork. I had two kids who came in just a few months ago who are applying to university and they were applying to university in the States and had to do their SAT tests and could not get a deferment to do their SAT test later because there was no objective evidence that they'd actually had a concussion. So they did quite badly on their SATs, couldn't get into the universities that they wanted. So it's really just impacted their entire life. It's changed. This was somebody who was an A student who has done really well and suddenly, just before she had to do the SATs, she had this concussion. And the hard part is that even though I'm working on the diagnostic side, people say, "Okay. Great. Now you've told me this, what do we do to make my child better, the athletes better?" And this is another huge gap that we don't really have evidence-based interventions that can help with the recovery.

One of the things that I think about often is a young man that I knew personally - a football player - who was a star, high-school football player and played for the Cincinnati Bearcats where I was president. An upstanding young man who had a big heart and played very well - a little bit small for his position. And then he played well and nobody thought he would make it and he made it to university and then he made it onto the Bengals. His name's J.K. Schaffer. And the reason I bring him up is that when you play that many years you have probably many concussions - some that you're aware of and some that you may not even be aware of that might also have an impact. What I worry about is clearly he was able to recover functionally and play all those games but what happened was that out of character several years later there was behavior that was criminal that was totally out of character that experts feel might be associated with long-term accumulation of micro-concussions. What do you think about that? So that goes back to your point that just measuring return of function is not the only task. That accumulated changes in brain organization are things that we need to monitor.

Yes. I mean your example reminds me of somebody I met a while ago. His name is Jino Odjick and he's an enforcer or he was an enforcer in the Canucks and his main job was to get beat up and beat other people up during the game. And he said to me one day that, "If I was in a game and somebody didn't hit me, I would actually have to go home and hit myself," because he had become addicted to that beating and getting smashed in the head and he had to do that to himself. So there are a lot of consequences of the brain injury that we don't even understand and we really need to look at it longitudinally to see the impact and this is why we don't need to wait to

collect longitudinal data. We already know there are changes from anecdotal stories like the ones you told and the one with Jino. And this is why it's so critical to change policy now. In terms of policy in ice hockey, those changes are already been made. So Carolyn Emery at University of Calgary has been really instrumental in changing the age at which body checking is allowed. So it's now in much more older kids that that's allowed in and not in the younger kids. I think getting rid of fighting altogether in ice hockey or in any sport-- we don't need that. I mean what's the point of having fighting during a sporting event where kids are there to enjoy and play competitively and learn how to work with each other. There's a lot of people here doing work on different kinds of helmets to see what's the best way to try and protect the brain. I think we shouldn't be playing contact football just because of all the things I know about what's happening in the brain but we need to play football, we need to play soccer - the physical activity and all the changes that happen socially, emotionally. Learning that happens in team sports is so important. So team sports and those kinds of sports are really critical to our development and to our functioning [music].

Well, Naznin, thank you so much for being on Blue & Goldcast today.

You can find links to Naznin's work at our website Blue & Goldcast.com.

I'm Santa Ono.

And I'm Jennifer Gardy.

You're listening to Blue & Goldcast, a podcast from the University of British Columbia back in one minute.

Hi. You've reached the voicemail box of the Blue & Goldcast. We can't come to the phone right now but if you're an artist or musician at UBC, please leave us a message telling us about your work right after the beep.

Hi. My name's Sam Tudor. I'm a musician from Vancouver British Columbia. I originally grew up in this really small town in Interior BC and moved to Point Grey and it was a really weird transition for me and that's what my newest album's about [music]. We performed at Block Party and I remember thinking someone mentioned to us that there was going to be 3,000 people there and so we were so excited to play Block Party and at the time it felt kind of like a big break for us. We were all hyped and got haircuts for this show and stuff and then we accidentally got given the tent that belong to the headliner. So when we were given this tent there was burgers and free alcohol, and we all thought we'd made it, and we were like, "Oh, this is awesome." And then someone came up to us and was like, "Oh, actually, sorry. You're in the wrong tent. Your tent's over here." There was nothing in it, just a fold out table [laughter] [music].

So this song's called New Apartment and as it sounds, it was written when I'd just moved into this bare, empty, classic, Vancouver apartment and was just feeling really weird and feeling far from home and was thinking about how a place like a Vancouver apartment is simultaneously your private space that you get to occupy but it's also not yours at all and I might just feel that way in my whole life, I don't know. But that's sort of what the song is about [music]. Bye.

[music] Welcome back to Blue & Goldcast. Now in the back part of each episode, we take a moment to talk about ongoing projects here at UBC. And Santa, now that we've talked about some of the risks that go along with sports, let's talk about the positive side of athletics because I know you are a massive sports fan.

Well, I am and the reasons for it are multiple. One is that I've seen so many athletes really benefit from their participation in varsity athletics and also other students being just involved in other recreational activities through intramurals and UBC has a lot to

be proud of in both arenas. In varsity sports, not many people know that if we were a nation, we would be one of the top nations in the number of Olympic medals that have been received by graduates and current students at UBC. I think among the top 25. And among universities in North America, we are one of the top in the number of medals that have been won over the years by UBC graduates. So it's something that's a point of pride for UBC and if you look at athletes as a cohort they tend to outperform students that are not involved in athletics at the varsity level. And that's true also for students that are involved in other kinds of activities. But being involved and engaged is really something that helps with academic performance in general and many of our athletes are near perfect students. So that's one positive effect.

The other is teamwork. Many athletes that are involved in teams talk about how transformational their participation on teams has been to their lives and to their leadership in organizations many decades after they participated in varsity sport. The other reason that I'm a big fan of varsity athletics is that I think more than anything else it brings a very large community such as UBC together. And so when you go watch the hockey teams play or the football team play, you have now thousands of people that come together and they from every faculty, they come from every ideology and it brings them together cheering for UBC. And a sense of community is really, really important for a place like UBC to have people rally around not only what they do but what all that represents UBC.

I love going out to the games. My dad is a UBC alumnus and he was a Thunderbirds football player in the 60s. So every year, we always go out to at least one Tbirds game together and it's so much fun to see so much of the campus community and so much of the alumni community come out to these things too. It's really quite a social hub, I think, for the campus. How do you think that compares to schools that you've seen in the States, for example? Are we just as lively a football culture, a hockey culture as some of the sporting universities down there?

I'd say that UBC is really on the top end of institutions in terms of involvement and it's growing every single year. There aren't many universities that will have 10 or 11 thousand or 12,000 people show up for a football game. I mean you hear about the Ohio States of the world with 100,000 but that's the top point five percent or so of the 3,000 college and university programs in the US. So it's something that we should be proud of that we can get that kind of attendance at a football game. And we have growing attendance at basketball games and hockey games and so I would say the electricity is there. I'm excited when I root for the Tbirds and as I said, I think we do very well as a university.

What are you excited in terms of athletic initiatives happening on campus? What can we look forward to over the next few years?

Well, as you know the AMS has voted to make a sizeable contribution to expanded recreational facilities. And that's really important because that's one area that we really need investment. If you look at the amount of recreational space that's available to the non-varsity athlete, then we don't have the same resources and infrastructure as many universities in Canada. And actually, we're near the bottom in terms of the amount of space that we have for non-varsity athletes. So the university is committed to matching that and exceeding that because part of the university's strategic plan really focuses on the wellness of the entire community. So not just students but also faculty and staff. They need also the kinds of recreational facilities where they can engage in sport and really take care of themselves and look after their wellness [music].

That does it for the November edition of the Blue & Goldcast. You can find links to our guests' work as well as previous editions of the show at blue&goldcast.com.

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If you have a topic you'd like us to cover, an artist you'd like us to feature, or you want to ask me or Santa a question, send us an email at feedback@blue&goldcast.com. You can also tweet at us. Santa is @ubcpres - that's with a Z - and I am @jennifergardy.

We're back with a new episode next month. From Jennifer Gardy and everyone at the Blue & Goldcast, I'm Santa Ono, thank you for listening. [music]

I never told you that I ran into a tree.

That's crazy.

You have been listening to a Cited Media production, C-I-T-E-D. Find out more at citedmedia.ca.