Science Magazine Podcast

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Promo

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Music

Interviewer – Sarah Crespi

Finally today, David Grimm, editor for our daily news site, *Science*NOW, is here to talk about some recent stories. I'm Sarah Crespi. First up we have a story on the formation of one of Saturn's moons. Besides its infamous rings, Saturn has another feature unique in the solar system - its monstrous moon Titan. What makes this moon so unusual?

Interviewee – David Grimm

Well, first of all this moon is, it is really a monster. It's dominatingly big, it has almost twice the mass of earth's moon, and it actually comprises 90% of all of the mass orbiting Saturn. So all of the moons and everything else orbiting Saturn - 90% of that belongs to Titan. So it's unusual that it's really big. It's also unusual in that it doesn't have any moons near it. When you have a giant planet that has a lot of moons around it, those moons tend to be regularly spaced. There's a lot of empty space around Titan. Also its orbit is a bit odd. It's slightly elliptical rather than nearly circular, as you see with most moons, and it's tilted with respect to Saturn's equator. So it's just kind of an odd moon.

Interviewer – Sarah Crespi

What is the going theory on how this moon got so weird?

Interviewee – David Grimm

Well, the going theory for all moons is that there's this disk of primordial debris that's orbiting a planet, and this debris eventually coalesces into moons. But as you alluded to, that's probably not what happened in Titan's case, or at least that's what one researcher is speculating. He has a different theory that's a little bit more violent than just moons coalescing from particles of dust around a planet.

Interviewer – Sarah Crespi

Right. There's a collision involved but he describes it as a slow collision, which just kind of blew my mind.

Interviewee – David Grimm

That was a little disappointing, actually, like I was hoping for like a big Armageddon-style collision. But what he thinks happened is that the moons around Saturn formed like they usually do, they were all sort of coalescing into

these small moons. But somewhere along the way four of these moons crashed into each other and formed Titan. Now when you say crash, he actually doesn't mean very violently. He thinks that they sort of merged together very slowly so it was more of a gentle merger than a splatter. But the end result was the same. You basically had this giant moon, and because a lot of moons went into that moon, there's no other moons next to it because all those other moons have become Titan.

Interviewer – Sarah Crespi
But does this theory also account for the other oddities associated with Titan?

Interviewee – David Grimm
Well, yeah, because it would also explain why Titan has this sort of weird tilt. If you had a bunch of proto-moons kind of merging into each other it could create enough disturbance that it could actually tilt the orbit of what eventually became Titan, which would explain one of the other oddities of the moon.

Interviewer – Sarah Crespi
So can this idea be confirmed?

Interviewee – David Grimm
Well, there is a spacecraft orbiting Saturn right now - the Cassini spacecraft - and the researcher hopes that it could pin down the nature of Titan's interior, or if it could at least it might be able to shed some light on exactly how the moon formed.

Interviewer – Sarah Crespi
Next up we have the story on how exercise affects the brain. Like many studies that aim to figure out the mechanism of a disease or even a normal phenomenon in the body, it eventually comes down to following a pathway of signals from cause to effect. In this case, we're talking about what exactly exercise does to strengthen the brain. What do we know about this connection? What brain benefits does exercise have?

Interviewee – David Grimm
Well, I think we all know that exercise is good for the body. We exercise: it's good for our heart, it's good for our weight, it's good for our overall health. But exercise has also been shown to have some mental benefits as well. It seems to have an effect on countering depression and even fighting Alzheimer's and Parkinson's disease. So we know exercise has positive benefits for the brain, we just don't know exactly how that happens.

Interviewer – Sarah Crespi
Okay. So who are the key molecular players we're going to be talking about here?

Interviewee – David Grimm
Well, the main player we're going to be talking about is a protein called FNDC5, and it's a shame they don't give these things more user-friendly names. But what we do know about this protein is that it's actually produced when we exercise and that it's already been linked to some positive impacts for our fat. For example, studies have shown that a fragment of this protein actually gets lopped off during exercise, goes into the bloodstream and drives the formation of brown fat. And this is actually a good type of fat. This is a fat that can protect against diseases like diabetes and obesity. And what the researchers are trying to figure out in this new study is does FNDC5 also play some sort of role in the brain.

Interviewer – Sarah Crespi
And so why do they even think that this might be an important player for the brain?

Interviewee – David Grimm
Well, what researchers have observed is that in mice that don't produce a activator of FNDC5 - and this is our second player in the story, this is a protein known as PGC-1α - they were hyperactive and they had tiny holes in their brains, which suggested that this FNDC5 pathway was playing some sort of role in cognition.

Interviewer – Sarah Crespi
So with these factors in mind, the researchers tried to basically get mice to exercise, right?

Interviewee – David Grimm
They, they actually put mice on a running wheel and they had them running the equivalent of a 5K every night. So these mice were doing a lot of working out. And they compared them to mice that weren't working out. And what they found is the mice that were running a lot had a lot more FNDC5 in their hippocampus, and this is an area of the brain that's responsible for learning and memory. So it was really drawing much more of that connection between exercise and what's going on in our heads.

Interviewer – Sarah Crespi
And they were also able to look at this interaction in cultured cells. What did they find there?

Interviewee – David Grimm
And they found something similar in cultured cells. They found that this PGC-1α, which is this activator of FNDC5, drove the formation of another player - this is our third and final player in the story, BDNF - which is a really important protein for the health of neurons in the brain.

Interviewer – Sarah Crespi
So now that we know that these are important players for the connection between

exercise and the brain, can we use these components perhaps to keep the brain healthy without running 5K a night?

Interviewee – David Grimm
Right. Well, that's the billion-dollar question. And the researchers say that it's possible they could potentially develop an injectable form of one of these important players, and that not only would give you sort of the health benefits without having to exercise but could even be a counteracter for these diseases of aging like Alzheimer's and Parkinson's. So if you've got a very old person that's not going to be running that 5K anyway, you might be able to develop a drug based on these findings. Still a long way away, but that's definitely a possibility.

Interviewer – Sarah Crespi
Finally, we have a story on frogs leaping. The story is about the mechanics of some far-jumping frogs. Can you take us back, Dave, to the beginning - all the way to Mark Twain's 1865 story on this same topic?

Interviewee – David Grimm
So Mark Twain wrote this story called the "The Celebrated Jumping Frog of Calaveras County" and it's all about a frog that's a pretty good jumper. Well, it turns out that Twain's story has now become fodder for scientific research. And the reason is because researchers are actually kind of fascinated by frogs. They're really good jumpers, and we want to figure out what's going on in the muscles in our own legs or how our muscles work. Frogs make great study subjects and scientists have been studying them for decades. In fact, in 1978 they started measuring the record-setting potential of frog jumps and it was actually published in a scientific journal that one bullfrog could hop up to 1.295 meters.

Interviewer – Sarah Crespi
There's also a Guinness record.

Interviewee – David Grimm
Right. So about 10 years later, actually eight years later, the Guinness Book of World Records recorded an even more impressive jump for a bullfrog called Rosie the Riveter, who was reported to have jumped about 2.18 meters, which is, you know, almost twice the length as the scientifically recorded jump.

Interviewer – Sarah Crespi
These measurements - being very precise about them is important because there's kind of a tipping point, right? If the jump surpasses a particular length, then something happens.

Interviewee – David Grimm
Right. If frogs could only hop about 1.3 meters, they're just using their muscles. But if they're hopping more than that, they're using the stretchy power of their tendons to help them hop. And the reason that's important, especially for

bullfrogs, is that scientists have hypothesized that bullfrogs actually gave up this tendon-assist ability to become better swimmers. So if the 1978 study is right and the frogs were only hopping 1.295 meters, then the chances are they're just using their muscles. But if Rosie the Riveter indeed hopped 2.18 meters, then bullfrogs are probably using these stretchy tendons as well.

Interviewer – Sarah Crespi
Okay. So one researcher went into the field - or should I say the fair - to get some real numbers here. What did he do?

Interviewee – David Grimm
Well, what happened is after Mark Twain's story was published, Calaveras County - which is actually a real place, a bit east of San Francisco - started hosting a frog-jumping contest, which they've been doing for many, many decades now. And people basically gather in a stadium and the owners of these frogs try to scare the heck out of their frogs to make them jump as far as they can. Whoever's frog jumps the farthest wins, and so as you mentioned, actually a group of researchers went to the fair and they took along some video-recording equipment and they recorded 20 hours of high-definition video of frogs jumping.

Interviewer – Sarah Crespi
And I think some of that video is on the site?

Interviewee – David Grimm
It is.

Interviewer – Sarah Crespi
So what did they find when they analyzed the footage?

Interviewee – David Grimm
Well, what they found was that 58% of the more than 3,000 jumps that they analyzed were longer than 1.295 meters, and again that's the magic number from the scientific studies. And the longest jump was 2.2 meters, basically in the range of Rosie the Riveter. And all this suggests that frogs can actually jump a lot farther than we thought, and again - really important for the bullfrog - it suggests that evolutionarily they probably didn't lose this ability to use their tendons, that they're probably still using their stretchy tendons to help them hop very far.

Interviewer – Sarah Crespi
And this also says something about frog behavior in the lab and in the field and what we should actually be measuring.

Interviewee – David Grimm
Right. Because the scientific study was done in the lab and these real-world studies were done in the real world. They were done at the county fair. So it suggests to scientists…in fact, one of the outside experts consulted for this story

says, you know, we've really got to re-evaluate what we're seeing in the lab because what we're seeing in the lab doesn't always reflect what we see in the real world, even if that real world started out as fiction.

Interviewer – Sarah Crespi
Okay Dave. So what else is on the site this week?

Interviewee – David Grimm
Well, Sarah, we've got a story about how marmoset monkeys know how to have polite conversations. Also a story about what happens to our brains when we sleep and how sleep might actually be a sort of washing machine for the brain. For *Science*Insider we're continuing our coverage of the government shutdown in the U.S. and the impact it's having on science, we have various stories from across the country. And finally, for *Science*LIVE - our weekly chat on the hottest topics in science - this week's chat is about earth's water supply. Is it going to last? What can we do to make it more sustainable? And next week's chat is about the science of spinal cord injuries. So be sure to check out all of these stories on the site.

Interviewer – Sarah Crespi
Thanks, Dave.

Interviewee – David Grimm
Thanks, Sarah.

Interviewer – Sarah Crespi
David Grimm is the editor for our online daily news site, *Science*NOW. I'm Sarah Crespi. You can check out the latest news, our upcoming live chats, and the policy blog *Science*Insider, at news.science.mag.org.