Science Magazine Podcast

Transcript, 26 July 2013

http://podcasts.aaas.org/science_news/SciencePodcast_130726_ScienceNOW.mp3

Promo

The following is an excerpt from the *Science* Podcast. To hear the whole show, visit www.sciencemag.org and click on "*Science* Podcast."

Music

Interviewer – Sarah Crespi

Finally today, David Grimm, online news editor for Science, is here to give us a rundown of some of the recent stories from our daily new site. I'm Sarah Crespi. So first up, we have a story on dogs as copycats. Dogs have been known to fetch the paper, but what I didn't know is that these types of behavior in dogs can be learned through imitation.

Interviewee – David Grimm

Right. And this story actually, Sarah, has a lot to do with memory. How long is a dog's memory? And it's not just I remember where my food bowl is, it's can I remember an event in the past and actually, sort of, be able to recall it with enough detail. And in this case, it's an action in the past, and I can actually repeat that action. And that suggests, if dogs can do that, it suggests that they form a mental representation, almost a mental image of events, which is considered actually to be a pretty advanced cognitive skill.

Interviewer – Sarah Crespi

So let's start with dogs being imitators. I really didn't know much about this before reading this story. How do we figure out that dogs can imitate people – that that's the process that they use?

Interviewee – David Grimm

Well, you know, any owner who has a dog probably knows that dogs imitate us to an extent. The question is, is how long they can wait before they do that. And there were some studies done, and researchers found dogs can only imitate us at most at five second delays. So you do something. You ask the dog to repeat it. As long as you don't wait more than five seconds, the dog can do it, which doesn't seem that much of an impressive ability and it's really not an impressive ability. So dogs were, sort of, written off as not having these super great photographic memories. But this new study really challenges that.

Interviewer – Sarah Crespi

So how did they test or how did they increase the distance between when they see something and when they actually imitate it?

Interviewee – David Grimm

So these researchers, they took a few dogs, and they taught them three commands. One was do as I do, which for the dog was a signal to watch whatever the owner was doing.

The owner would do various tasks like walk around a traffic cone or they would maybe put their head in a bucket or ring a bell. And then the dog had to sit and the owner would disappear, and the dog had to sit for a varying amount of time. And the owner would come back and then say do it. And that was the dog's cue to do what they remembered the owner doing.

Interviewer – Sarah Crespi
So they were able to spread out this distance. How long could the dogs wait?

Interviewee – David Grimm
Well, they actually tested it up to 10 minutes, and even up to 10 minutes, the dogs were actually able to repeat the task that they had seen earlier. And the researchers think the dogs could even go longer, but they said, well, we really didn't want to keep the owners waiting behind a door for an hour to see how long the dogs would last. But we know now that they can remember events at least 10 minutes before. And again, this is a more complicated type of memory. It's forming a mental representation of what the owner did. It's actually a pretty advanced cognitive skill that's only been seen in humans and other great apes.

Interviewer – Sarah Crespi
So we can ask a little bit more of our dogs from now on?

Interviewee – David Grimm
We can, and we actually may be able to train them better too.

Interviewer – Sarah Crespi
Next up, we have a story on head regeneration. In flat worms, it's not uncommon for them to grow a new head or tail if they are cut in half, but sometimes it doesn't work out quite right.

Interviewee – David Grimm
Not all flat worms can do this. This group of worms is known as planarians, and there's many species across the globe. And most of them, you chop off their head, they grow a new head. You chop off their tail, they grow a new tail. They are incredible regenerators. But as you mentioned, Sarah, there are a few species that don't regenerate their heads when you chop them off. And what's cool about regenerating a head is they are not just regenerating a head, they are growing a new brain. They are growing new sensory organs. So this is a pretty amazing talent, and researchers have obviously been interested in how do they do it?

Interviewer – Sarah Crespi
Right. So they have mapped out some of the basic players involved in this head regeneration process. One of them is Wnt?

Interviewee – David Grimm

Right. It's called Wnt signaling – that's W-n-t. And it's a molecular process that seems to drive this regeneration activity, and it's actually responsible for a whole lot of things in a whole lot of organisms. But in the worms, what Wnt seems to do is it drives the activity of a protein called β-catenin, and when this happens, if an organism dials back its Wnt signaling and its β-catenin levels, the worm grows a new head. If it amps up these levels, it produces a new tail. So it's kind of a very simple switch where the worm knows, okay, my tail is missing, I've got to make a new tail. My head's missing, I've got to make a new head. But it turns out that in some species of these planarians that the Wnt signaling seems messed up, and that seems to be why they can't grow this new head.

Interviewer – Sarah Crespi
So three different labs all focused in on this problem in this system in different worms, actually. Why are so many people interested in this problem?

Interviewee – David Grimm
Well, I mean, you can imagine, imagine if somebody chopped off your finger, and you could regrow a finger. Actually, humans do have a bit of regenerative potential. Children under the age of two can actually regenerate missing fingertips. We lose that ability as we grow up, and we're obviously not able to grow new heads. But wouldn't it be awesome if, you know, you lost an organ and you could regrow that organ instead of having to wait for a transplant? Or something happened to your hand, your hand got chopped off maybe by a lawnmower or whatever and, you know, you could regrow that.

Interviewer – Sarah Crespi
So we're looking at some very basic…

Interviewee – David Grimm
Right. We're not flat worms, but you've got to start somewhere. And it turns out that all three groups have found that this Wnt pathway is really important for this regeneration, and what's even cooler is that they were actually able to do restore the ability of these worms to regenerate their heads by futzing a little bit with the Wnt pathway. They were actually able to, what they say is reversing maybe a million years of evolution just by doing a fairly simple genetic trick.

Interviewer – Sarah Crespi
So I thought what was really interesting from an evolutionary perspective was that you'd think that head regeneration would always be favored, that this wouldn't be a trait you would lose very quickly.

Interviewee – David Grimm
Right, right. Why would some of these organisms evolve not to regenerate? You'd think that's something everybody would want to do. It turns out when these worms regenerate, their sex organs melt back into their bodies, which is fine for most worms, because these worms reproduce throughout their lives. So if there's a time span when they don't have their sex organs, hey, not such a big deal. But it turns out that with these worms that can't regrow their heads, actually, they don't reproduce very often. Some of them

actually only reproduce once during their life, and if it has to happen at a specific time, you don't want to have that chance to reproduce and all of a sudden your sex organs are melted. So it could be that's one of the reasons that some of these organisms have evolved not to be able to regenerate their head.

Interviewer – Sarah Crespi
So the Wnt system is very common throughout many, many organisms, and it looks like head regeneration is. Is this something that we all were able to do at one point?

Interviewee – David Grimm
Well, the researchers think at some point, the common ancestor of all of us was able to do this, and it's something that some species, although very few species have retained and most of us have ditched. And the question is why? Maybe it had to do with sex with us as well – our reproduction. Maybe there were other reasons, but clearly, for some reason, it was more of a benefit for us not to be able to regenerate than to be able to do it.

Interviewer – Sarah Crespi
Finally, we have a story on the function of the X chromosome in male mammals. If the Y chromosome determines maleness, what is the X chromosome up to?

Interviewee – David Grimm
It's a good question, and for a long time and actually until very recently, researchers didn't think the X chromosome played that much of a role in what we call maleness. An X chromosome, obviously, has a lot of important functions in men and women, but in terms of determining what it is that makes men how they develop, what determines what sex we are, even our fertility, all that was chalked up to the Y chromosome, which is the big genetic thing that separates men from women. But this new study suggests that the X chromosome may actually play an important role in maleness as well.

Interviewer – Sarah Crespi
So sex determination isn't just up to the Y. The X is playing some role regardless of which sex you are. This study actually took the sequence of the X chromosome in humans and mice. Why did they do that?

Interviewee – David Grimm
Well, we already had a sequence, if you can remember back more than a decade ago to the human genome project. That sequenced the entire human genome. But a lot of it was pretty crude, and in this new study, the researchers went in there with a lot more detail. And they didn't just look at the human X chromosome; they also looked at the mouse X chromosome as well. And they found some really interesting differences. Although both chromosomes have a lot in common, which is to be expected, I mean, we aren't that distantly related to mice as we are to a bunch of other organisms, there were some really intriguing differences. There were 144 human X chromosome genes with no counterparts in mice and 197 X chromosome genes in mice with no counterparts in humans. And of the 144 human ones, a lot of them were changing very rapidly, suggesting that this part of our X chromosome is actually evolving very quickly.

Interviewer – Sarah Crespi
So are these unshared genes the ones that we have that mice don't have in X chromosomes specifically expressed in men?

Interviewee – David Grimm
Well, that's what the researchers found. They found that these genes are particularly active in the testes, primarily in tissue that's destined to become sperm, which indicates that the X chromosome may play actually a very significant role in male fertility and maleness. And what's even more interesting is this is a very rapidly evolving part of our genome.

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

Interviewee – David Grimm
Well, Sarah, for ScienceNOW, we've got a story about a shrew with a spine of steel. You can actually stand on this animal without breaking its back. Also, a story about how the phase of the moon might be affecting whether you get a good night's sleep. For ScienceInsider, we've got a story about a one million dollar DNA prize contest that's run into a lot of controversy. Also, the latest budget numbers being thrown about for U.S. science agencies – how various agencies are funding under some recent budget proposals. So be sure to check out all these stories on the site.

Interviewer – Sarah Crespi
Thanks, Dave.

Interviewee – David Grimm
Thanks, Sarah.

Interviewer – Sarah Crespi
David Grimm is the editor for Science's online daily news site. You can check out the latest news and the policy blog, ScienceInsider, at news.sciencemag.org.