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. So first up, Dave, we have a story on the social fabric of elephant herds. For anyone who's seen the Disney movie *Dumbo*, it may come as no surprise that elephants feel sad sometimes but has yet to be scientifically quantified.

Interviewee - David Grimm

Well Sarah, you know, it is a good question, you know, what emotions other animals feel. This study isn't so much about whether elephants feel sad but more about what sort of impact traumatic events have on elephants that witness these events early in their lives.

Interviewer - Sarah Crespi

So this is actually about a practice called culling. What is culling and why would we do it?

Interviewee - David Grimm

Well, culling has been used in South Africa from about the 1960s to the 1990s, and basically what it is is a tool to thin elephant herds. And the reason you'd want to do that is because when there's too many elephants on a piece of land they can be very destructive to the habitat, especially if they're in a fenced reserve. And so what wildlife managers would do is they would get in a helicopter which would herd an elephant family into a tight bunch, and then hunters would shoot as many of the animals as possible as quickly as possible, leaving only the young elephants—elephants from about four to 10 years of age—alive, and then these young elephants would be shipped to other parks that didn't have as many elephants. And researchers have known for a while that this isn't good for the young elephants. They seem to suffer from posttraumatic stress disorder. Elephants that have grown up with such trauma tend to be a lot more aggressive, they kill rhinoceroses, they attack tourist vehicles. But nobody's really looked at how this sort of impacts more fundamental aspects of these animals' lives. Social learning is really important for elephants and the question has been, does this early life trauma impact their social learning?

Interviewer - Sarah Crespi
Right. So how did they end up looking at this in more detail?

Interviewee - David Grimm
Well, Sarah, they compared two populations of elephants. One was from Kenya's Amboseli National Park, and the elephants here really haven't been through a whole lot of trauma in their lives. And they compared them to elephants that grew up on the Pilanesberg Reserve, and these elephants…a lot of them were exposed to this early culling trauma. And then what they did was they played a few calls from other elephants and they manipulated these calls so they would sound like they came from a dominant, strange female. And strange means a female that neither group knew. And usually when elephants hear this call, they get really cautious because calls from these dominant stranger females can indicate that maybe a female is approaching that can pose a danger to the family. And here's what one of those calls sounds like. <*elephant call*> And when they played this call for the Amboseli elephants—the elephants that really hadn't been exposed to trauma early in their lives—the elephants acted appropriately. They froze, they bunched together, and sometimes they even charge towards where the sound was coming from maybe in an attempt to scare off this intruding female. But the Pilanesberg elephants, the ones that had been exposed to trauma early in life, didn't react appropriately at all. In fact, their reactions were really random. Sometimes they left the area, sometimes they didn't do anything at all, they just sort of sat there relaxed. And this indicates that these elephants really aren't sharing this social knowledge that's so important for not only their survival but really understanding how to react to other elephants in their midst.

Interviewer - Sarah Crespi
Why do they think that this is due to the culling trauma?

Interviewee - David Grimm
Well, when these young elephants are relocated to new reserves, they form family units again. So that indicates that it's not the fact that they haven't interacted with adults in their lives, it's that maybe they're not able to learn for some reason from these interactions. There's something that's become very messed up about them that they're just not able to engage socially or learn socially like they usually do.

Interviewer - Sarah Crespi
And so what does it mean when an elephant doesn't know how to behave socially? What are the consequences?

Interviewee - David Grimm
Well, one of the big consequences is it can actually interfere with their reproductive success. You can imagine if you don't really understand the signals of another elephant,

you're not going to be able to mate with that elephant and you're not going to be able to sire offspring. So even though these young elephants were spared early in their lives from culling, they may actually have a very bleak future.

Interviewer - Sarah Crespi
Next up we have a story on newborn infections. Babies are particularly prone to cold, flu, infections in general. But the question is, why are their immune systems so weak at that time in their lives?

Interviewee - David Grimm
Right. It's been a really big question and obviously it's a very important question, because actually newborns are much more likely to die than older babies of these types of infections. And, for some reason, having a weak immune system at birth must serve some sort of important function. And scientists have had a few hypotheses. They've thought, well maybe just like everything else, when a newborn is born, you know, not everything is fully developed yet and the immune system might just be one of those things. You know, it's just not as developed as it will be later on. The other idea has been that because the baby spends so much time in the mother's uterus that it must suppress its immune system otherwise it will reject the mother and also the mother may do the same thing—she suppresses her immune system so she doesn't reject the baby. But this new study actually has a different conclusion.

Interviewer - Sarah Crespi
So what's the third option?

Interviewee - David Grimm
Well, the third option— according to this new research— is that infants may actually suppress their immune system because they are trying to build up this, what scientists call microbiome in their guts. And this is the population of bacteria that's been shown to be really important for everything from our weight to our metabolism to even things like arthritis and potentially even behavior.

Interviewer - Sarah Crespi
So how did they figure out that the third option might be the right one?

Interviewee - David Grimm
They did all these experiments in mice. And the first thing they did was they gave strong immune cells—they injected them into newborn mice. And they found that these immune cells just kind of turned off in the newborn mice. But when they did the opposite and they took the newborn mice's immune cells and placed them into adults, those cells which had been dormant turned on. So they figured there must be something going on in the body of the newborns that's shutting their immune system down or at least really muting it. When they looked a little bit closer, they found that there was this

particular class of immune cells that eventually develop into red blood cells. They express a surface receptor called CD71, which causes the immune suppression of other cells. When they knocked out these cells, they found that young mice started to get a lot of inflammation in their intestines. But as the mice grew older, there were fewer and fewer cells that had these CD71 receptors, suggesting that the mice were somehow over time ramping up their immune system or activating their immune system, but that very early on they were deactivating it. And the researchers take all this together and they basically think what's happening is that this is something that's done on purpose as the mice are developing this gut microbiome, they don't want to be killing off all the bacteria that are growing in their guts which is what the immune system would do. And so they have to keep their immune systems suppressed early on, and they only ramp it up later once that microbiome has fully established itself.

Interviewer - Sarah Crespi
So this is a really interesting finding for how we get that gut microbiome that seems to stick with us for quite a long time. Are there any other implications for this finding?

Interviewee - David Grimm
Well, the researchers are hoping that this could provide a way to make sure that newborns, even though they have reduced immune systems, are still protected from infection. And one idea was actually giving them immune cells that they wouldn't be able to turn off that would protect them early on in life and that maybe these cells would disappear once the baby's immune system became a lot stronger.

Interviewer - Sarah Crespi
Finally we have a story on virtual arms. Last year, a paralyzed person was able to move a mechanical arm with just her mind. Now a research group is trying to top that by controlling two arms with a brain-machine interface. So Dave, why are two arms so much better than one?

Interviewee - David Grimm
Well, try to hug a person with one arm, try to shop at the grocery store, pull items off the shelf with one arm. It's actually a lot more complicated than it seems. And it's been an incredibly tricky problem for researchers developing so-called brain–machine interfaces or BMIs. These are ways for paralyzed people to still be able to pick stuff up when either they don't have limbs or they don't have the use of their limbs. But using both arms is not as simple as, okay, we figured out how to get a person to use one arm, then we just add another arm to the equation because, as you can imagine, there is a complex interplay when we move both arms. Each arm has to sort of know what the other arm is doing; they have to act in concert and that's really incredibly complicated at a neurological level. And that's why this new study is such an advance, because what the researchers were able

to do is they were able to take monkeys and train them how to use two virtual arms on a computer.

Interviewer - Sarah Crespi
Well, let's step back for a second. How exactly does a brain–machine interface work?

Interviewee - David Grimm
Well, usually when you can't—especially if you're paralyzed and you can't move your arm—for some reason the signals from your brain are no longer getting to your arm. And so what these BMIs do is they basically take the signals from your brain directly and then they translate those signals into the movement of either a robotic arm or, in this case, a virtual arm.

Interviewer - Sarah Crespi
So for the monkeys, what were they moving with their minds?

Interviewee - David Grimm
They actually looked at two monkeys and they implanted electrodes into both the left and the right side of their brains to pick up on these signals that tell limbs to move. And what the monkeys were trying to do was they had to control two virtual arms—you can actually see a picture of this, actually a video as well, on the site—and their goal was to place both hands over two virtual circles and hold them there for 100 milliseconds. Now that may not sound hard, but when you're trying to move virtual objects with your mind, it's pretty tricky. But the researchers found that over time, the monkeys were able to do this. They first train them how to do this using joysticks, actual joysticks. Then they took the joysticks away, they strapped the monkeys down so they couldn't use their arms—their real arms—anymore, and then they wanted to see could the monkeys learn how to use these virtual arms. And in most cases, over time, they were able to do that.

Interviewer - Sarah Crespi
So this would actually work for a person who couldn't practice with a joystick or a keyboard, they'd just be able to watch what happened and then learn to use their mind to do the same thing?

Interviewee - David Grimm
Right. Well, one of the monkeys, she was trained first with the joysticks. But the other monkey had to do without that training because they wanted to find something that would be analogous to a person that didn't have the use of their limbs from the very beginning. You know, this monkey took longer and wasn't as successful, but eventually he was also able to control these virtual arms.

Interviewer - Sarah Crespi
So this study not only demonstrates something amazing that we can now do with brain–

machine interfaces but it also was able to tell us something new about how the brain works. Can you talk about that?

Interviewee - David Grimm
Well, yeah, as you say Sarah, it's not just a cool advance. It's actually teaching us a lot more about how the mind works. And it turns out that by measuring all of these signals in the brain, the researchers are also figuring out how exactly the brain coordinates the movement, even in people that aren't paralyzed in the first place. And that could really shed some light into how the brain works.

Interviewer - Sarah Crespi
So what are the next steps for this research? We've got two arms. What's next?

Interviewee - David Grimm
Well, two legs, of course. In fact, the scientist who led this research is hoping - and indeed promised on the *Daily Show* - that by the 2014 Brazil World Cup he will have created a robotic body suit that will enable a paralyzed person to kick a soccer ball. And that's only a year away.

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

Interviewee - David Grimm
Well, Sarah, for *Science*NOW we've got a story about a giant ancient platypus, the first ever evidence of insect sex, and also—speaking of the microbiome—how the bacteria in our guts may cause arthritis. For *Science*Insider, our policy blog, we've got a story about how science is faring in the United States Senate. Also a story about why a U.S. court invalidated a patent for a Down syndrome test. Finally for *Science*LIVE, our weekly chat on the hottest talks in science, this week's *Science*LIVE is about unraveling the mysteries of dark matter. And next week's *Science*LIVE is—speaking of neuroprosthetics—all about neuroprosthetics. 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.sciencemag.org.

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