Science Magazine Podcast

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Promo

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Music

Interviewer – Kerry Klein

Finally today, I'm here with online news editor David Grimm, who's here to give us a rundown of some of the recent stories from our online daily news site. So Dave, our first story discusses using DNA as a programming language.

Interviewee – David Grimm

Kerry, we don't really think of DNA for storing information, although I guess for genetic information, we do think about it. But we really don't think about storing our movies, our pictures, books on DNA, but that's just what scientists are doing. In fact, actually last year, a group of scientists showed that they could store a book in DNA. And now scientists have taken that a step further. They've actually stored 2.2 petabytes per gram in DNA. And actually at that concentration, you could store the information in 468,000 DVDs in just a single gram of DNA.

Interviewer – Kerry Klein

Wow. So this is a really fun proof of principle, that's amazing. But, you know, I don't know how to write information in DNA, and I don't own a DNA sequencer. How practical is this? Who would this be practical for?

Interviewee – David Grimm

Well, you know, it seems kind of a weird thing to do, and it seems not very practical. But it turns out, you know, with the massive amount of data we're generating these days – not just our home movies and home pictures – but when you think about giant science experiments like the Large Hadron Collider which produces 15 petabytes of data each year, these projects need massive amounts of storage capacity, and right now what they do is they store their data on magnetic tape. That's okay, but keeping data safe over many decades requires writing and rewriting on this tape and can get very expensive and onerous. The advantage of DNA is that it's stable for thousands of years. So once you're encoding it, you really don't have to do anything with it for a long, long time, and it's very, very stable.

Interviewer – Kerry Klein

Wow. So how does one actually encode information into DNA?

Interviewee – David Grimm

Well, the team developed a trinary code, in contrast to the binary code that a lot of us are familiar with – the code of ones and zeros. A trinary code is a code of ones, zeros, and twos, and they were able to translate that into the various chemical bases of DNA – the As, the Gs, the Cs, and the Ts – that make up our genetic code.

Interviewer – Kerry Klein
So how expensive is this whole process? When will this actually be economical to do? Or is it already?

Interviewee – David Grimm
Well, it's actually not very economical right now just because the cost of synthesizing DNA and sequencing DNA is actually still very high. And so right now, it's only cost effective if you want to store data for 600 years or more because otherwise it's actually cheaper to just keep writing and rewriting magnetic tape. But the cost of DNA synthesis and reading continue to go down, and researchers suspect that very soon, it will be cost effective to store in DNA versus magnetic tape, even if you want to store something for only about 50 years.

Interviewer – Kerry Klein
So like you said, the biggest benefit here would be that DNA is really stable for long periods of time, but is it as versatile as other kinds of data storage media that we have now?

Interviewee – David Grimm
Well, Kerry, there's a couple downsides. One is that you can't change or rewrite the data once it's encoded, and that gives it a big disadvantage over other kinds of storage media. The other problem is you can't access, right now, a particular piece of information, so you can't sort of zoom in on a file like you would maybe on a DVD or a CD. What you would have to do is actually sequence large swaths of DNA to find the information that you want. So that's not very practical either, although one suspects that both of these hurdles will probably be overcome in the not too distant future.

Interviewer – Kerry Klein
This last one was kind of like having to fast forward or rewind through…

Interviewee – David Grimm
Exactly. It's like going back to the days of VHS tapes for those of you who remember what those are.

Interviewer – Kerry Klein
Well, great. I look forward to hearing more about this. And in another genetic story, we're taking a closer look at the evolution of man's best friend.

Interviewee – David Grimm
Right. We're looking at DNA, again, in this story, but we're looking at DNA for itssort of classical purpose, which is to show us what genes make up an organism and how an

organism changes over time. And the organism we're looking at right now is the dog – one of everybody's favorite or maybe two favorite organisms out there besides people. But anyway, there's been a lot of interest in how dogs became domesticated. People suspect that dogs became domesticated about 10,000 or more years ago when humans first began to settle down and start farming, although some say it was a lot longer ago than that. And dogs obviously aren't the same as the wolves they came from. They look different, and this new study shows that they actually digest a lot different than wolves do too.

Interviewer – Kerry Klein
So what kinds of foods are we talking about that dogs and wolves differ on?

Interviewee – David Grimm
Well, what the researchers found was there seemed to be a vast difference in the ability of dogs to digest starch. So we're talking about, you know, things that are present in grains like wheat and rice, which obviously would have been very important at the advent of farming. What the researchers found is they honed in on 36 regions of doggy DNA, and they found 122 genes that seemed different than what wolves have. They compared a few breeds of dogs to a few groups of wolves. And they found that 19 of these regions contain genes that are important for the brain, 8 of which are involved in the nervous system development, which makes sense if you think about that dogs are behaviorally different than wolves, so they may have had stuff differently going on in their brains. But what was really surprising were that these researchers found a lot of these differences had to do with genes that are important for digesting starch. Dogs, for example, have 4 to 30 copies of the gene for amylase, which is a protein that starts the breakdown of starch in the intestines, whereas wolves only had two copies. What it all comes down to is that dogs should be about five fold better than wolves at digesting starch.

Interviewer – Kerry Klein
And what would have necessitated this digestion of starch? Where would that have come from?

Interviewee – David Grimm
Well, you can imagine wolves in the wild are eating a lot of meat, but when we have dogs, we have animals that are feasting on our leftovers, feasting on the garbage piles that we're producing when we've really settled down. You know, in these garbage piles, you're seeing maybe a little bit of meat, but you're also seeing a lot of other waste products – wheat and rice, you know, just sort of the leftovers. And dogs that were more evolutionarily adapted to eat these other foods – these starchy foods – did a lot better, produced more offspring, and made it on to the next generation.

Interviewer – Kerry Klein
How interesting. So the evolution of these wolves' and dogs' diets sort of parallels the evolution of human diets.

Interviewee – David Grimm

Exactly.

Interviewer – Kerry Klein
So does this mean that I should be feeding my dog mashed potatoes?

Interviewee – David Grimm
That's a great question, because there's a lot of controversy right now in the dog feeding world about whether we should be feeding our dogs like wolves, whether they really need this raw meat ancestral diet. And this study suggests that they don't. This study suggests that dogs are not just wolves – that they are much different, that they've evolved differently, and that they are able to eat a lot of the variety of foods that we do. And so maybe a lot of the stuff we feed them now that has these grains, the rice, and the wheat in it may actually be very well adapted to their digestive system.

Interviewer – Kerry Klein
How interesting. And of course another parallel is the "paleo" diet and other things that go back to our own human roots.

Interviewee – David Grimm
Very much so.

Interviewer – Kerry Klein
And in our final story, what social media can tell us about our memory.

Interviewee – David Grimm
Right. We don't think, Kerry, about Facebook being very important to science. It's maybe a very important way for us to while away some of the hours of the day. But this new study suggest that there's some stuff going on on Facebook that actually tells a lot about how our brains form memories.

Interviewer – Kerry Klein
Tell me more.

Interviewee – David Grimm
Well, you know, think about the status updates on Facebook. They're not always the most, shall we say, novelistic writing, you know. In this study, they picked some choice phrases from status updates – things like, "Sometimes it makes me wonder," "The library is a place to study, not to talk on your phone," and, "I like the smell of clean bed sheets." Not exactly the type of sentences that are going to change world literature. But the interesting thing researchers found in this study, they actually showed some of these phrases to undergraduate students, and they compared them to phrases that had been taken from a few recent books. Phrases like, "Underneath a mass of facial hair beamed a large smile," and "Even honor had its limits." Things more of classic literature. And what they found that was really surprising was that these students actually had a much easier time remembering the phrases on Facebook than the sentences from novels.

Interviewer – Kerry Klein
So I wonder if there could be an emotional context there. When I'm reading status updates from friends, you know, they're people that I care about, and I care about their opinion.

Interviewee – David Grimm
Well, that's what the researchers thought at first, and what they did was they actually tried to see if people were just remembering these posts because they just, sort of, had more of a social connection with maybe the post writers. But when the researchers repeated this experiment and asked the subjects to rate the post based on how much the Facebook post sounded like somebody they knew, they didn't see any correlation. So the social aspect didn't really seem to enter into it. And the other idea they had was, well, maybe, you know, Facebook posts were more sort of self-contained thoughts than what you might see in a novel, but when they tested this, they also found that that wasn't the case.

Interviewer – Kerry Klein
Really. So what could it be then? What could be the key there?

Interviewee – David Grimm
Well, the researchers think that it really comes down to how unfiltered Facebook remarks are. Effortless chatter, they say, is better than well-crafted sentences at tapping into our minds' basic language capacity. So we don't tend to think in novelistic thoughts. We don't communicate in novelistic thoughts, so we're probably less likely to remember those types of thoughts than more conversational thoughts, which are also the kind of thoughts that you see on Facebook.

Interviewer – Kerry Klein
How interesting. So what else have we had on the site this week?

Interviewee – David Grimm
Well, Kerry, for *Science*NOW, we've got a story about how dung beetles use starlight to guide their way. Also a story about a group of whales that have adopted a deformed dolphin, and there's a very compelling slide show that goes along with that. For *Science*Insider, our policy blog, we've got a story about the future of the NIH's research chimps. Also, a story about whether men or women are more likely to engage in scientific misconduct. You'll have to check out the site to find the answer to that. And finally for *Science*Live, our weekly chat on the hottest topics in science, this week's chat is on the future of super computers, and next week's chat is about the science of gun research. What are scientific studies telling us about the impacts of guns and gun violence. So be sure to check out all these stories on the site.

Interviewer – Kerry Klein
Very timely. Thanks, Dave.

Interviewee – David Grimm

Thanks, Kerry.

Interviewer – Kerry Klein
David Grimm is the online news editor of *Science*. You can check out all of our news at news.sciencemag.org, including daily stories from *Science*NOW and science policy from *Science*Insider. And while you're there, be sure to check out *Science*Live – a live chat on the hottest science topics every Thursday at 3 p.m. U.S. Eastern time.