Podcast: The archaeology of democracy, new additions to the uncanny valley, and the discovery of antibiotics

screspi@aaas.org

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Sarah Crespi: Welcome to the Science Podcast for March 17th, 2017. I'm Sarah Crespi. In this week's show, news writer Lizzie Wade joins me to talk about archaeological evidence for democracies in pre-modern Mesoamerica. And David Grimm is here with a roundup of stories from our daily news site.

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SC: Now we have David Grimm, editor for our daily news site. He's here to talk about some recent online stories. First up, we have a story on bear cams. I first found out about the story because of the footage. There's video from bear collar cams, and the research is about what they eat. So I braced myself for the gore and there was some, a few sad caribou calves up close and some too-close-for-comfort munching. But because there was so much footage, I also got to see bears playing with their cubs, and even a bear slowly entering a frozen lake. Why don't we start with where all this footage came from, Dave?

DG: Well, this comes from a study where researchers actually put cameras, they put collared cameras and GPS trackers around bears' necks. And the reason they did this is because they really wanted to try to get a better sense of how much bears eat and how many animals they kill and surprisingly, that's something we don't know a lot about. And the reason is, is because some bears kill lots, some don't kill very much. One bear might spend a couple of days eating a moose and another might spend 40 minutes eating a calf, and if you're just trying to do all of this with satellite imaging or aerial cameras, you're really gonna miss a lot. And so researchers really wanted the bear's eye view of what's going on, and so they put these cameras in collars on them and they actually followed bears for a few months over the course of actually a couple of years, so it's sort of during the seasons the bears were pretty active from mid-May to late June.

SC: And the footage is in fragments, right? So it's 10 seconds of film and then it turns off, and then five minutes later you get another little piece. And it jumps from the point of view of a bear walking around to, "Oh, now the bear is eating something." With this kind of jumpiness, were they able to reconstruct their day? And what kind of numbers were they able to glean from that process?

DG: Yeah. They ended up with all these little clips and actually about 36,000 clips in total, so a lot of videos, lot of little videos to go through. But yeah, they were actually able to figure out some interesting stats. One was that more than half of these bears' meals came from calves,
vegetation only made up about 20% of their diet, and adult moose only about 12% of their diet. But
the really big shocker was that the bears kill an average of about 34 moose and caribou calves over
45 days, and that's a lot more kills than researchers previously thought the bears were making.

03:23 SC: So they ended up being able to collect this data only from a few bears actually, under 10.
Why so few? And then is this a good enough sample or do we need even more bear cams?

03:34 DG: Well, the study didn't always go as planned. Some of the cameras fell off, some didn't
work properly, some were actually chewed off, especially mothers having their collars chewed off
by some meddlesome bear cubs. So we've got some pretty small sample sizes here. Also apparently
the bears the researchers chose were known calf-killers, and so that may have biased a sample a bit.
The experts are saying that this needs to be done on a larger sample. And ultimately, the reason this
is all important is because when you're doing wildlife management, you've gotta figure out who's
killing what, what the diets are, and knowing specifically how many bears are killing how many
animals really will help wildlife managers manage some of these areas.

04:16 SC: So there will be more bear cams in the future?

04:19 DG: One would hope.

[chuckle]

04:21 SC: Now we have a story on mixologist ants. Ants do all sorts of things that we think of as
uniquely human, acting as little tiny architects, farming, and even ruling the roost. Now they're
getting into the pharmaceutical business. What kinds of drugs do ants need, Dave? Something to
keep the workers awake, perhaps? Or some kind of bodybuilding?

[chuckle]

04:47 DG: No. We're not talking about caffeine here, and we're actually talking about a specific
type of ant, called a wood ant. Now, these ants live in very dense groups. Their colonies can number
in the hundreds of thousands, and that's a real problem when it comes to disease because you can
imagine a fungus, a bacteria gets in there into maybe just a couple of individuals, it could spread
very quickly in the colonies, so these ants really need to find a way to really protect themselves
against this.

05:14 SC: Where does the idea come from that they're using medicines or some kind of strategy to
combat these things?

05:21 DG: Well, one thing the ants do is they obsessively groom each other, that sort of keeps them
disease-free. But another thing the wood ants do is they collect anti-microbial tree resin. And for a
long time scientists thought well, that tree resin's really the key to everything. They bring this tree
resin into their nests, that helps them protect against these dangerous funguses. But in this new
study, scientists suspected maybe something else was going on. And what they found was when
they compare the ability of the tree resin alone to fight a common fungus that attacks these ant colonies to resin that had been stored with the ants themselves for a couple of weeks. The resin that had been stored with the ants was actually about 50% more effective in fighting the fungus, and that suggested the ants are actually doing something to this tree resin to make it a more powerful anti-microbial.

06:12 SC: Right. How did they figure out what the secret ingredient was that was being provided by the ants?

[chuckle]

06:18 DG: Well, they knew that the ants produce formic acid, and this is a very caustic substance. And they usually do this to fight threats, subdue prey, maybe even clean their offspring. And so they suspected maybe the formic acid was somehow mixing with the resin, and that's what they found. They found that when they mixed formic acid with the tree resin, it did a much better job of warding off fungus than the resin alone or even than the formic acid alone.

06:44 SC: Any chance this potent combo could help us with out antibiotic resistance problems?

06:50 DG: Well, yeah, we're having a big antibiotic resistance problem. Seems to get worse every year. And this is an example of a very natural way ants have found to become what the researchers call "defensive mixologists." And so maybe humans could take a cue from that as well.

07:06 SC: Last up we have a story on some new residents for uncanny valley. This story opens with a mention of the new Star Wars movie. Did you notice there was a digitally-constructed character in the mix, Dave?

07:20 DG: I haven't seen it. [laughter]


07:23 DG: But I have heard about it. And for those of you who haven't seen the movie, one of the characters, Grand Moff Tarkin who was in the original Star Wars movies, the actor who played him has since passed away and so the filmmakers reconstructed his face using CGI. And those who sort of were aware of that change found themselves, or at least a lot of them, found themselves a little creeped out by it. He seemed human but not quite human enough, and it gave some viewers a bit of the heebie-jeebies.

07:53 SC: And this is what has been referred to as "uncanny valley," right?

07:58 DG: Right. So this is this idea that when a CGI creation or a robot doesn't look very human, then we're totally fine with it. But as it gets very close to resembling people but not quite there yet, it starts to kinda creep us out a bit.
08:15 SC: Okay. So this term is usually used in reference to the look of something, is it close to human but not close enough. But this new study that we're gonna talk about today applies it to another aspect of these types of constructs, and in this case it's personality, like an artificial personality. So how did they make this like a person but not too much like a person in a creepy way?

08:39 DG: So they were really interested here in the mind of an artificial creation rather than the look of it. And what they did was they had about a hundred people, actually about 92 to be specific, volunteers wear virtual reality headsets. When they put them on, they saw a short conversation between two virtual people, a man and a woman in a public plaza. And the conversation involved the characters discussing their exhaustion from hot weather, the woman expressed frustration about her lack of free time, and the man conveyed sympathy for the woman's annoyance at waiting for a friend. Now, everybody watched the same scene, but some of the volunteers were told that the avatars were controlled by humans, some were told that they were controlled by computers, and within those groups some were told the conversation was scripted while others were told it was a spontaneous conversation.

09:32 SC: So in that last case is the one I think would weird me out, is if I happened upon two characters in a video game who were just talking to each other and didn't care about me. Is that what they saw in the data?

09:43 DG: That's exactly what the researchers found. They found that when the people were thinking that this was controlled by people, that these virtual avatars were controlled by people, they were totally fine with it. But when the volunteers believed these avatars were controlling themselves and were sort of developing their own script and acting very spontaneously, that's when they started to get creeped out.

10:03 SC: So when are we gonna get a good definition of "creeped out?" [chuckle] How can we kind of use that to make things better? Should we stop making things so much like humans?

10:14 DG: The researchers are referring to this as the uncanny valley of the mind. And yeah, that's the suggestion of at least one expert is to say maybe we shouldn't make these things so human-like. It's okay to have these virtual beings have a conversation, but maybe not make the conversation so deep. Maybe make it kind of superficial, so it doesn't feel like they're trying to replicate human emotion or personality.

10:37 SC: As I alluded to before, is there a definition of "creeped out?" And what does that mean more broadly about what's going on with people in these situations?

10:46 DG: Yeah, one of the speculations the researchers have is that when robots or virtual creations start to act a lot like us, it threatens our superiority. It makes us feel like human uniqueness is under threat. That may be behind why we find these things so uncomfortable to observe.
11:06 SC: What else is on the site this week, Dave?

11:07 DG: We've got a story about trying to combat the bug behind drug-resistant tuberculosis by making it self-destruct, also a story about how vibrating your body might be just as good as exercise in some cases. For Science Insider our policy blog, we've got a story about the battle over climate change in the Trump administration, also a story about how the looming Brexit in Europe is going to affect science there. So be sure to check out all of these stories on the site.

11:38 SC: Thanks, Dave.

11:39 DG: Thanks, Sarah.

11:39 SC: David Grimm is the editor for our online daily news. I'm Sarah Crespi. You can check out the latest news and the policy blog, Science Insider, at news.sciencemag.org.

[music]

11:55 SC: For decades, the conventional wisdom has been that pre-modern societies in Mesoamerica, think Olmec and Mayans, were ruled by despots, the bulk of the people subjugated and just scraping by. Now archaeologists are starting to build a convincing case that collectives also existed during this time. News writer Lizzie Wade is here to talk us through these findings. Hi, Lizzie!

12:20 Lizzie Wade: Hi, Sarah.

12:21 SC: So let's start with the time and place. When and where are we talking about?

12:26 LW: The "where" is mostly Mesoamerica, although there are examples of pre-modern democracies or republics in other places. I think classical Athens or Venice had a really famous one during the Renaissance, but the new research, the one that really brings us out of a European context, is mostly happening in Mesoamerica which is Central and Southern Mexico, extending a little bit into Guatemala in this case. And the "when" is quite a broad range of time, actually. The Olmec were sort of the first large-scale society in Mesoamerica according to most people, and they arose 1000 BC, I think. And so this really extends throughout the common era. These examples that the archaeologists are finding from about 1 CE from a little before and until basically when the Spanish arrived in the 1500s.

13:20 SC: And it was thought these societies were ruled by powerful rulers, and the materials they left behind, giant pyramids and statues seemed to confirm it. What were some of the first clues that maybe some of these societies were different?

13:35 LW: I think to start with, you have to understand what archaeologists were first looking at. So when archaeologists came to Mesoamerica or started working in Mesoamerica, they were really attracted to gigantic pyramids, [chuckle] huge statues as you said. The Maya had, for example, a
really complex writing system that recorded centuries of history, and dynasties, and royal marriages, and things like that. The Olmec had these huge gargantuan stone heads that most people think were portraits of the kings that ruled there. And those were very attractive things for archaeologists to go look at. They're super cool. They're easy to find, relatively. Those kind of things sort of emphasized this kind of monarchy, despotic, autocratic rule where one person was at the center.

14:22 LW: The city plans also kind of indicated that with a monumental center of pyramids and temples and everybody else kind of living around it however they could manage to get by. But there were still kind of these sites that had some of those features that just didn't seem to fit these king models. Monte Alban and Oaxaca was an early one. It has a lot of pyramids but it didn't really seem to have a lot of palaces. There weren't a lot of elite residences, there weren't a lot of exotic goods. There weren't any depictions of rulers in the art, and so that seemed kind of weird. They couldn't quite understand that with the models that they had. And Teotihuacan, which is just outside of Mexico City and also has a bunch of really big and famous pyramids, also sort of puzzling-ly has never turned up a royal tomb or a portrait or an artistic depiction of a king even though they have extensive and very detailed murals. So people were kind of like, "Well, we think all of these societies had kings but there are these weird ones that we can't quite understand."

15:22 SC: And that's the absence of evidence for a king. Did they find evidence that maybe some other power structure was in place?

15:28 LW: Yeah, so basically they needed a new theoretical model to kind of make sense of these absence of evidence, as you say. And that came along in the '90s. And an archaeologist named Richard Blanton wrote an article with a couple of co-authors laying out what a more collective society would look like, kind of drawing on, first of all, these absence of evidences by kind of then expanding it. Later, other archaeologists took it on and expanded it. One of the biggest ones is the urban layout. We talked about how in a society ruled by a king, you'll have sort of a downtown with huge pyramids, royal tombs, palaces, huge temples. That's where the government is and that's the only place where the government is. And they started also finding these more distributed layouts, so you'll have in a just post-Olmec site in Veracruz called Tres Zapotes. Instead of having one monumental center, there are four plaza groups throughout the city one kilometer apart from each other, and they all look exactly the same and they were all occupied at exactly the same time. And the archaeologist who excavated there, Chris Pool, thinks that the structure of the city implies that four different factions were cooperating to rule Tres Zapotes rather than one person in the center, and then sort of secondary centers around it.

16:46 SC: And so what we come to now is these two categories of societal organization. Some people called them autocratic and collective. What are some of the other differences that have been seen between places that have been designated this way?

17:00 LW: Sure. Starting with the urban plan, you'll see this distributed layout of power centers. You'll also often see in the bigger sites like Teotihuacan, you'll see a grid. Streets are laid out in a grid and often times the houses will be identical. Like in Teotihuacan, people lived in apartment buildings and that's extremely unusual for the ancient world.
17:21 SC: That means that a lot of people all worked together to build something for a lot of people, not just a single godlike king, right?

17:29 LW: Yeah, so there is a tension there in that you'll see... You could interpret that as exactly what you said, kind of at a grassroots organization. And there are many people who see that at work in a place like Teotihuacan, a government providing public goods funded probably by taxes or something similar. Or you can see these huge public works projects also take a level of perhaps unprecedented centralized control. So you can sort of see it in there are sort of two competing ways to see something of architecture projects on grand scale like that. But some of the other things that are more always associated with collective societies are things like taxes, which I mentioned. Those are the best predictor according to the archaeologists behind this theory of whether you'll have a collective society or an autocratic society, if your resources come from outside, like a trade route or a natural resource.

18:21 LW: You see this in oil states today. In Saudi Arabia the royal family controls oil money, and that's how they fund the state and fund themselves, and they don't really need to worry about what people think of what they're doing 'cause they have this external source of wealth. But if you have a state that runs on taxes, the leaders really have to be aware of what the people want and make sure that people are gonna continue to pay into this system, they need to make sure that they're getting something out of it. Another thing that pops up in many of these societies is a high level of immigration. They seem to be really attractive places for people from other places or other ethnic groups to come in. Like in Teotihuacan, you'll see there's many ethnic enclaves scattered throughout the city where the artifacts are in the styles of other places but made with local materials suggesting that people continued their cultural practices even once they got into the city.

19:16 LW: One reason for this might be that if you are, depending on the taxpayer base to fund your activities of your state, you actually want more people there so you can get more taxes, so you're open to this idea of immigration. And one particularly interesting place which is sort of the central example of my story is a place called Tlaxcalan that people are just starting to understand, really. It's kind of just on the other side of the mountains from Mexico City and it was a republic primarily composed of refugees that were fleeing the Aztec empire, basically. Aztec is kind of a modern term and I call them the Mexica Empire in my story which is a little more correct name for the time. They were conquering vast, lots of territory. They controlled all of central and southern Mexico except for Tlaxcalan where people fought them for centuries. And lots of people who didn't wanna live under Mexica domination came to the Tlaxcalan and they were successfully integrated into the society as long as they agreed to defend it in these sort of perpetual wars that were going on.

20:17 SC: So in the beginning of your story, you really paint a picture of what it might have been like to participate in this political process in a collective type society. You're standing naked in the center of a plaza, people are throwing things at you, hitting you, screaming, and that's just the beginning of the process of going up for becoming a participant in the government. How can we get this level of detail about events that happened so long ago and we really don't know much from material culture at this point?
20:48 LW: Sure. In Tlaxcalan, that example comes from Tlaxcalan which is sort of how they elected there the men who would represent them in the senate. This wasn't a democracy in the sense that people didn't cast votes, but there was sort of this initiation right where you've sort of had to prove your valor in war and then stand up to a variety of physical trials to prove that you were capable of upholding Tlaxcalan's moral code. The benefit with Tlaxcalan was that it was only built around 1250 AD, and it lasted until the arrival of the Spanish. And the Spanish were really tight with Tlaxcalans actually because the Spanish also wanted to fight Mexica, and the Tlaxcalans were like, "Oh great, we'll help you. We'll take them down forever." Which is just what they did. The Spanish spent, especially very early on, they spent a lot of time in Tlaxcalan, years. And so they got this sort of look into the society that was really unprecedented, and they recorded it in ways that we can understand now very easily. They wrote down these chronicles. Lots of them are by priests with sort of religious, highly-religious overtones, and not the way we would write an ethnographic text now. But they recorded rituals like this and sort of give us a really detailed look into what life in Tlaxcalan was like even though it was destroyed and basically forgotten in the centuries after the conquest.

22:12 SC: So listening to you, this really just makes me think that no one is digging up any new evidence here. This really seems to be the result of a change in the thinking and about how people perceive what they've already found.

22:25 LW: Yeah, I would say so. The importance of this new theory in the '90s was really, before this, people really thought Europeans invented democracy, like that was the starting point for everything. And now we see that as kind of a racist and definitely a Eurocentric idea, but that was all that people had to work with. And now with these different examples, you have a new tool for interpreting data from around the world in a new way. And you also have... It draws your attention to new places to excavate, so at the beginning when you were like, "Oh, we'll look for a king," you went to the downtown, you went to the pyramids, you went to the temples, and that's what you found, you found kings.

23:03 LW: So with this new theory, Tlaxcalan for example, it doesn't have a monumental center. The government met a kilometer outside of the city in this really weird building that nobody lived in. It's kind of neutral territory and the actual city is all these residential terraces and plazas scattered throughout. So there's no downtown Tlaxcalan, it was just organized a completely different way. And with this new theory, you can think about excavating households in a new way. It becomes more interesting what people were doing in the outlying areas in the city. Did they have a grid that extended out that far? Did they live in collective housing like in Teotihuacan? It sort of directs your attention to something different, and I think that is really the ongoing value of this theory and this research.

23:50 SC: Thank you so much, Lizzie.

23:51 LW: Thank you.
Lizzie Wade is a contributing correspondent based in Mexico City. She writes about early democracy in Mesoamerica this week in Science.

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