

How to Talk to Aliens

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Abstract

Start by figuring out the patterns in their language, says SETI researcher John Elliott.

If we ever make contact with an alien civilization, how will we understand what they're saying? That's the question that preoccupies John Elliott of Leeds Metropolitan University, one of a dozen scientists collaborating in the newly formed UK SETI Research Network. Elliott would begin by trying to verify that "they" are in fact using language—a tricky problem in itself. Thinking about such matters has led him to consider other questions, including how humans might communicate with dolphins, and the language abilities of robots. He spoke with Air & Space Senior Editor Tony Reichhardt in August.

Air & Space: How did you get into this area?

Elliott: I started in computational linguistics and artificial intelligence. One day I was thinking What's the worst case scenario to understand what language is? What if you got a message from outer space? How the hell would you tell it's language? It was more of an academic thought experiment, to see if language structure could be identified as distinguishable from any other type of phenomenon.

What are some of the rules and patterns of a language?

One of the slides I show in my talks is loaded with zeros and ones—a binary bit stream. And the audience just goes, "uhhhhh...." They have no idea how to interpret it. But by using algorithms, some of which are adapted from information theory, you can tell if you've got a language. Signals that are either random or very predictable like a pulsar would not be interesting. But if the pattern has a certain level of complexity and internal structure, where it's broken into chunks, we're into the communication/ intelligence ball game.

Take even very low forms of communication in the animal kingdom, like ants using chemicals to communicate, or bees doing their dance. No matter what the cognitive level, it has a particular signature. The patterns have a relationship to each other. This is something common to any information exchange. So if we were hearing something from outside our own planet, that sort of signature would be an immediate flag to say there's an intelligence behind it.

Originally, SETI was not focused on looking for "intelligence" in a signal. It was just looking for technology—a beacon from a distant world. But if you've picked up a signal, the first thing anybody is going to say is "What the hell is it saying?" There's going to be an incredible curiosity to know what it means.

The only examples we've got for sure are from our own planet. So I looked at over 60 languages to cover all the different ways we communicate as human beings. There are different language morphologies. Finnish and Turkish are agglutinating languages, gluing all the words together. The Aboriginal language is an extreme example. English is very much an isolating language. Each word is an isolated semantic unit. But underneath this veneer—the different sounds we make, or the different ways of ordering the parts of speech—a common signature keeps coming out.

It goes across different animal species as well. Dolphins are an immediate example, because they are next down on the intelligence scale. They've got a complex social structure, so there's a similar social interaction going on. They have about 140 distinguishable types of sounds they make, and the way they use them to exchange information—the relationship of the patterns—has the same signature as ours.

And how close are we to decrypting dolphin language?

There's been work going on for a while, maybe since the late 1990s. But it's sporadic, and the problem is gathering data. With human language, we've now got the Internet, and billions of words to analyze. I'm working with the Wild Dolphin Project in Florida when I can. They're trying to get enough data to have comparable analysis to what we do with human beings. Up to now, we've seen enough [of dolphin language] to realize that the system they're using to communicate is just like ours in the sense of internal structures.

What they're actually saying is a mystery still. There was a recent report that confirmed something we knew ten years ago—that dolphins have their own names that they blurt out at the beginning of an exchange to say "this is me." They have identifiable call

signs as individuals.

If you listen to language, the same rhythms and structures come out. It doesn't matter what language you've got. You know it's language being spoken.

What are some of the structures?

There are two major classes of words that humans use. Function words—the ifs and buts that act as the glue. Then you have content words, the nouns and verbs that describe the world around you. If you go across languages, the relationship between the two types has a pattern. You never have more than about nine content words put together in a chunk like a phrase. Our brain has a limit in cognition. We can hold seven to nine pieces of information at a given moment.

I compared that with dolphins, and the limit was coming out about five-ninths of our own. That reflects exactly their encephalization quotient—the relation of brain size to body mass. So the language reflects brain size, and therefore cognition. I haven't gone through the whole animal kingdom, but I'd love to. The small amount of evidence up to now suggests a relationship between the complexity of an animal's communication system and brain power.

If we were to receive an unknown extraterrestrial communication, we'd be able to do that kind of analysis. Short, frequent "words" are usually a type of glue for a language, but larger, more complex ones are the semantic content. So looking at the ratios of those two could tell you about the cognition of the author, their level of intelligence.

Have you already got the software to do that analysis?

I've got a suite of small programs, though not a single application that will analyze everything at a single push of a button. Collectively I call it Natural Language Learner for SETI. If you pulled in a binary bit stream [of an extraterrestrial signal], you could immediately analyze and show the complexity and internal structure. Then you could analyze the relationships of the identified patterns, to help assign categories of linguistic behavior. In addition, I have programs that could categorize analog signals by analyzing their overall structure and rhythm.

I've also written papers on the decipherment strategy, post-detection. Assuming there's no "crib" or Rosetta Stone to help us decipher [the message]. In that worst-case scenario, everyone in the world would be saying "Can you tell what it is yet?" I've considered what the steps would be, how long it might take, and the network that would be needed to support and disseminate the findings. I call it DISC: Decipherment and Impact of a Signal of Content.

If you haven't got anything to explicitly map the patterns to its semantic equivalent, you're in a nightmare situation. In the movies they just send it to the national security agencies to decipher. That was alright in the Second World War, when we had the Enigma code. But we knew [the original messages] were in German. Here you don't. You have no idea what's going on. Standard cryptology is not going to do it. If we had an army of people and an unlimited budget, we might be able to.

What kinds of people, and what would their strategy be?

I'd have a team of software engineers, and I'd also plow money into looking intensively at creatures like dolphins. So you'd need marine biologists collecting data. It's all well and good having theories in place [for how to recognize language patterns], but getting data—and dolphins would be a good test—is the only way to determine whether alien languages might follow these templates.

What about studying other primates?

I have looked at apes and chimpanzees. They're nowhere near as complex as dolphins. In fact, their encephalization quotient is something like half of dolphins. Dolphins equate to something like Homo erectus. They are very complex social animals that are communicating all the time. They develop their language in the same way humans do—young dolphins go through about a year's worth of babble until they've refined the way they communicate. There are many parallels—they're almost aliens on our own planet, living in a completely different environment.

There could also be a post-biological intelligence out there, or a sentinel communicating, like in 2001: A Space Odyssey. Would there be differences in the way an artificial life form communicates? Yes. They haven't got the same limitations as we do with our brains. I'm starting to move from thinking about humans and dolphins to robots. There are examples of robots making their own language, so I can analyze that structure.

Are there any new developments in SETI that you're excited about?

We're still looking at the sky through a straw. But the Chinese are constructing a radio telescope 50 percent larger than the Arecibo telescope. Then you've got other projects like the Square Kilometer Array. So our capability for listening to the whole sky is increasing. And people are looking for pulsed light, neutrinos, you name it—different mediums for transmission.

It's really early days, though. We've only just come out of the primeval ooze as far as technology is concerned.

What about sending messages out? That has been controversial.

Yes. At the Royal Society recently, we had a panel to discuss the METI [Messages to Extraterrestrial Intelligence] issue. It splits the community down the center. It's not a mild discussion, either. You can get some very heated opinions. One camp says "Don't let them know we're here." And the other camp, which I'm in, says, "Hold on a minute, if they're that advanced, they already know we're here from our [radio and TV signal] leakage. So don't get too wound up about it." They'd only travel distances like that, take all the time and trouble to come here, if it were a matter of survival.

Having said that, you get people who are transmitting messages regardless. One member of the SETI community who is director of a Ukrainian telescope now and again decides to send out a message. We sent out the Arecibo message in 1974 with a digital representation of where we are in the solar system, plus the human shape and DNA structure. And of course, on Voyager, there was a disk. But this split opinion has created a situation where not much has happened lately.

If they asked you to send a message out, what would you send?

I wouldn't do it all in one chunk. The first bit would be very small: "Hello." The typical greeting you would give if you found a tribe in the Amazon. You'd point to yourself and give your name, something very concise, and you'd include a crib. After that, I'd send an Encyclopedia Galactica—a lot of information they could process after they got the original primer. I came to that conclusion from thinking "what would I want to receive?"

References

1. Originally published in Smithsonian Air & Space Magazine August 18 2013
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