

A sperm whale swims with calves near Dominica, where scientists have been studying the animals' communication for decades.

PHOTOGRAPH BY AMANDA COTTON

PREMIUM ANIMALS

How scientists are piecing together a sperm whale 'alphabet'

"Little by little, the sperm whales are divulging their secrets of how they're communicating to us," one expert says.

By Jason Bittel
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Any scientist will tell you that sperm whales are long-lived, highly intelligent, and super social animals.

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lead complex lives, they sure don't seem to have very much to say.

(Why Tilikum, SeaWorld's Killer Orca, Was Infamous)

"If you were to listen to the sounds of sperm whales, or even plot them, like how they're traditionally plotted, it could look like the whales just make the same sounds over and over again," says **Pratyusha Sharma**, a Ph.D. student at the Computer Science and Artificial Intelligence Lab at MIT.

But now, in a **study** published in *Nature Communications*, Sharma and her co-authors have invented an entirely new way to look at sperm whale communication—a method that reveals far more complexity that has ever been seen before. ***(Read about a groundbreaking effort to decode whale language.)***

Sperm whale vocalizations are arranged in at least 150 known repeatable patterns, known as codas. Previously, scientists analyzed these codas in isolation. But by plotting the codas in relation to each other, and zeroing in on new variables including rhythm, tempo, the length of sounds, and extra sounds that might change a coda's meaning, the new research has for the first time revealed what the scientists call a "sperm whale phonetic alphabet."

No one knows yet what the whales are saying—but this discovery may open the door.

"It's an incredibly important first step in kind of understanding the basic building blocks of the sperm whale communication system," says co-author

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"We're not all of a sudden going to be speaking fluent sperm whale-ese, but we're kind of learning. Like little by little, the sperm whales are divulging their secrets of how they're communicating to us."

EXAMPLE OF FOUR-PLUS CLAN 4+3 CODA FROM THE GALAPAGOS

THE WHITEHEAD LAB

0:00 / 0:07

THE EC2 CLAN IDENTITY CODA

THE DOMINICA SPERM WHALE PROJECT

0:00 / 0:11

THE EASTERN CARIBBEAN CLAN IDENTITY CODA

THE DOMINICA SPERM WHALE PROJECT

0:00 / 0:06

Context matters

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between 2005 and 2018 via a combination of underwater listening stations and acoustic tags placed on individual animals. Sperm whales, which inhabit many deep waters around the world, can hold their breath for more than an hour in search of prey, which include squid, sharks, skates, and fish.



Scientists created a "whale listening station" that allowed them to record sperm whale vocalizations off Dominica.

PHOTOGRAPH BY PROJECT CETI

"The luxury of the Dominica Sperm Whale Project," founded in 2005, "is that we've known these sperm whales for so long," says project founder Shane Gero, a National Geographic Explorer and co-author on the new study.

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biology lead for **Project CETI**, or the Cetacean Translation Initiative, which aims to understand what whales are saying.

“And that's when you really start being able to turn towards, what are these whales needing to say to each other? What information might be being shared?”



However, even with reams of data at his disposal, Gero says, the ability to extract information from the codas is limited. This is because each call must be attributed to an individual whale and then categorized manually—a process that can take eight to 12 minutes per minute of recording.

(Behold Livyatan: the sperm whale that killed other whales)

Even with this limitation, Gero and his colleagues have previously used such recordings to determine that sperm whale codas differ depending on the group or region. This is why they believe sperm whales have their own societies and cultures, each of which can be differentiated by the dialect of those clicks. *(Related: “The hidden world of whale culture.”)*

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Sperm whales are already known to have different dialects, a form of culture.

PHOTOGRAPH BY AMANDA COTTON

But the study's novel plotting technique, called an exchange plot, has shown sperm whales frequently change the speed of their codas—a quality known as rubato in musical terms—and that other whales producing the same coda mimic the change "basically instantaneously," says Gero.

TWO WHALES OVERLAP DIFFERENT RHTYHM TYPES (1+1+3 AND 7D)

PROJECT CETI

0:00 / 0:02

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To get a sense of what all of this might mean, or the complexity the variations could convey, think about how many ways you can say a particular phrase to invoke slightly different meanings, says Gero.

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conversationally between whales."

"Once we see it, we can't unsee it," adds Gruber, who founded Project CETI, which provided the data for the new research. "It's just beautiful."



'Fascinating place to be'

Perhaps most exciting of all is that sperm whales may be capable of what's called duality of patterning. This is when individually meaningless elements are combined to communicate more and more complex ideas.

In English, the sounds *ba* and *na* mean nothing, for instance, but can be combined to create the word *banana*, says Sharma. In turn, words can be arranged to create sentences.

And while Sharma wouldn't go as far as to call sperm whale codas and their variations *sentences*, there are hints that their sounds may encode more than one meaning. *(Related: "Dolphins recorded having a 'conversation?' Not so fast.")*

"Caution should always be taken when comparing non-human to human behavior, including comparing animal communication systems to human

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"While the comparison of sperm whale codas to human words may now seem tempting, we don't really know ... whether these codas actually have different meanings like words do," says Huijser, who was not part of the study. "But the authors clearly acknowledge that limitation of their study."

Caveats aside, Huijser called the findings "exciting rather than surprising," since it was already clear there was something missing about sperm whale codas.

Overall, sperm whale communication now seems capable of "almost an infinite amount of possibilities," Gero says.

"We're looking at really detailed exchanges between whales when they're talking to one another, and that is sort of a really exciting and fascinating new place to be," he says.

*The National Geographic Society, committed to illuminating and protecting the wonder of our world, funded **Shane Gero** and **David Gruber**'s work. **Learn more** about the Society's support of Explorers highlighting and protecting critical species.*

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