

# Potential Applications of Music Research in the Race Towards Translating Cetacean Communication

Early Stage Development of Masters Thesis, HfM IMR (HAS)

Abigail Sanders 30.01.2026

# Introduction

## Topic, Research Question, Hypothesis

Topic: **Machine Learning Cetacean Translation Projects, in particular CETI**

Research Question: **How would such research benefit from musical perspectives?**

Hypotheses:

1. Projects like CETI would benefit from expanding their definition of language to include music
2. Musicians and musicologists have valuable skills to offer and improve this research  
(In particular interspecies musicking as an alternative to playback experiments)

# Methods

- Discourse Analysis
  - CETI Publications (Critical posthumanist lens)
  - Interdisciplinary Perspectives
- Interviews?

Philosophy and Ethics

Scientific Research

**Research Areas**

Critical Posthumanism

Interspecies Musicking

Evolutionary Musicology

# CETI Publications

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Volume 9 2025

November 02 2025

**Vowel- and Diphthong-Like Spectral Patterns in Sperm Whale Codas**

In Special Collection: CogNet

Gašper Beguš, Ronald L. Sprouse, Andrej Leban, Miles Silva, Shane Gero

Check for updates

Author and Article Information

Open Mind (2025) 9: 1849–1874.

https://doi.org/10.1162/OPMI.a.252 Article history

Cite PDF Permissions Share Views

**Abstract**

The sperm whale communication system, consisting of groups of clicks called *codas*, has been primarily analyzed in terms of the number of clicks and their inter-click timing. This paper reports spectral properties in sperm whale vocalizations and demonstrates that spectral properties are highly structured, discretely distributed across codas, and uttered in dialogues, rather than being a physical artefact of whale movement. We report formant structure in whale codas and uncover previously unobserved spectral patterns. We argue that these spectral properties freely combine with the traditionally analyzed properties. We present a visualization technique that allows the description of several previously unobserved patterns. Codas are on many levels analogous to human vowels and diphthongs and can be conceptualized in terms of the source-filter theory: vowel duration and pitch correspond to the number of clicks and their timing (traditional coda types), while spectral properties

Article Contents

- Abstract
- INTRODUCTION
- RESULTS
- DISCUSSION
- CONCLUSION

Previous Article

**Related Articles**

- Natural Language From Artificial Life *Artif Life* (April,2002)
- The View From Elsewhere: Perspectives on ALife Modeling *Artif Life* (January,2002)

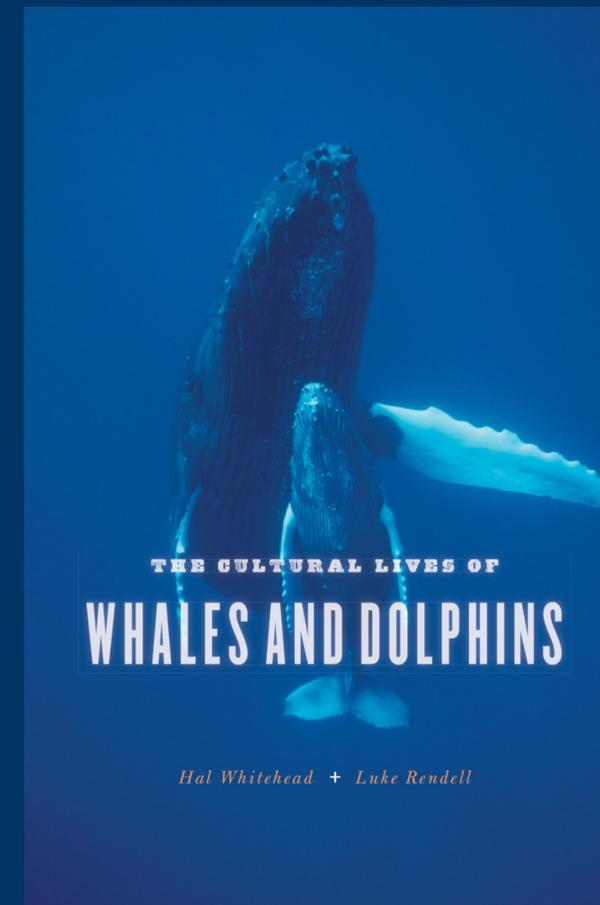
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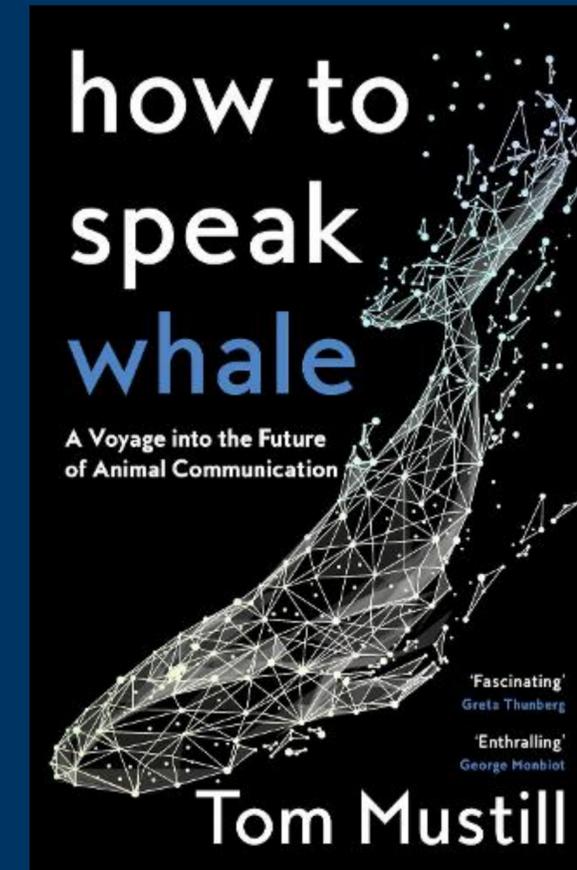
View Metrics

**Cited By**

Google Scholar



Whitehead and Rendell, The Cultural Lives of Whales and Dolphins.



Mustill, Tom. How to Speak Whale: A Voyage into the Future of Animal Communication. William Collins, 2022.

# Scientific Research



Contents lists available at [ScienceDirect](#)

**Biological Conservation**

journal homepage: [www.elsevier.com/locate/biocon](http://www.elsevier.com/locate/biocon)



## Dr. Doolittle uses AI: Ethical challenges of trying to speak whale

Mark Ryan<sup>a,\*</sup>, Leonie N. Bossert<sup>b</sup>

<sup>a</sup> Wageningen University and Research, the Netherlands

<sup>b</sup> University of Tübingen, Germany

### ARTICLE INFO

*Keywords:*

Animal ethics  
Whale conservation  
Whale vocalisation  
Artificial intelligence  
AI ethics

### ABSTRACT

Artificial intelligence (AI) technologies are increasingly used in conservation practices, e.g., to prevent poaching or inventory wildlife. Another area of application is using AI to decode animal vocalisations to understand better—and subsequently better protect—the animals. It has already been applied to different species, including various whale species.

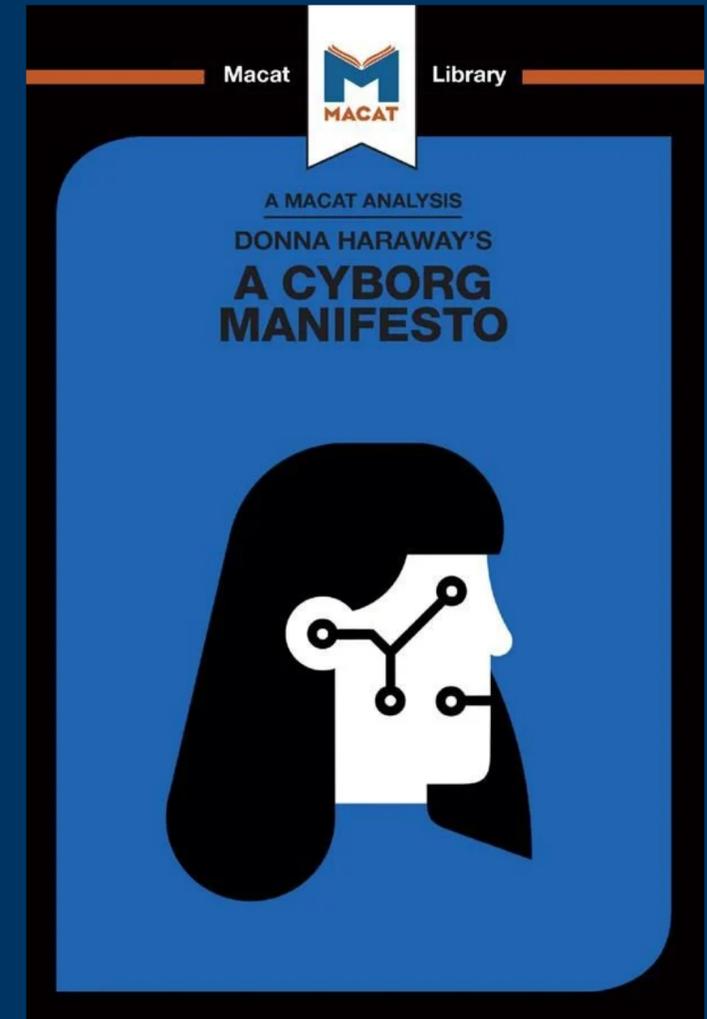
Whales have complex vocalisations that are used for sexual selection, to soothe their young, for echolocation, and as a form of communication. Scientists are deploying underwater microphones (hydrophones), robotic fish, and tags to record whale vocalisation. AI is used to identify whale vocalisation patterns, understand their meaning, and digitally recreate these sounds to communicate with them. Understanding and translating whale vocalisations into something humanly understandable aims at helping to identify their movements to protect them from ship strikes and bycatch and prevent or reduce sonar that interferes with their echolocation.

Using AI holds potential benefits, but it also comes with several risks. We describe current projects that use AI

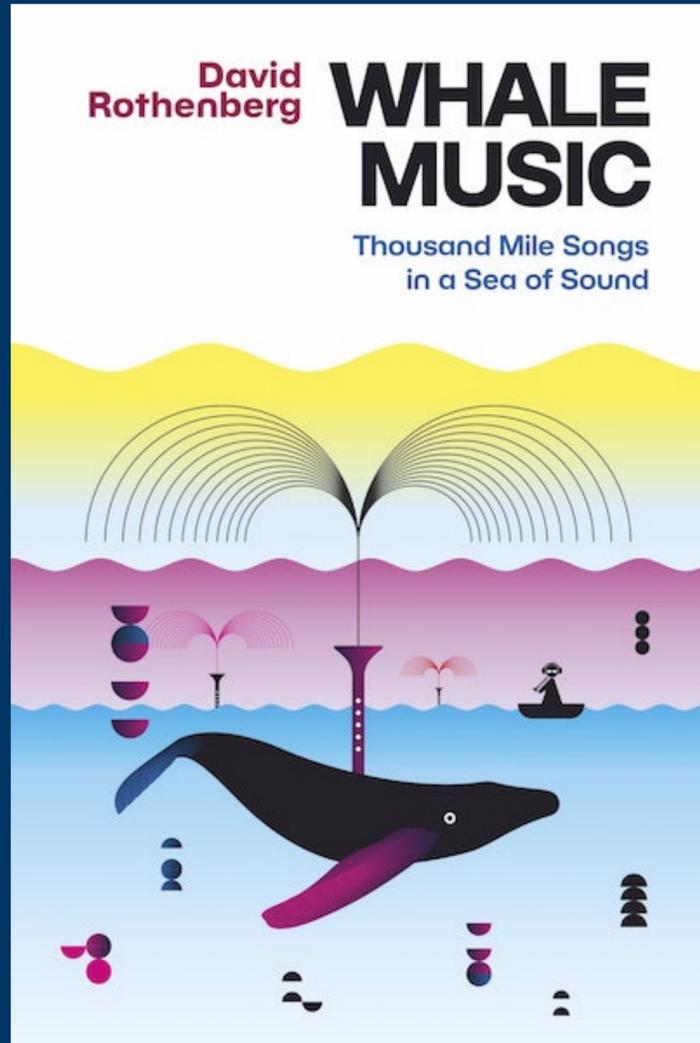
# Philosophy and Ethics

Ryan and Bossert, “Dr. Doolittle Uses AI.”

# Critical Posthumanism



Philopedia. "A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century | Work." Philopedia. Accessed January 29, 2026. <https://philopedia.org/works/a-cyborg-manifesto-science-technology-and-socialist-feminism-in-the-late-twentieth-century/>.



Rothenberg, David. 2023. *Whale Music: Thousand Mile Songs in a Sea of Sound*. MIT Press.

## TALKING TO THE ANIMALS

JIM NOLLMAN

Interspecies Communication



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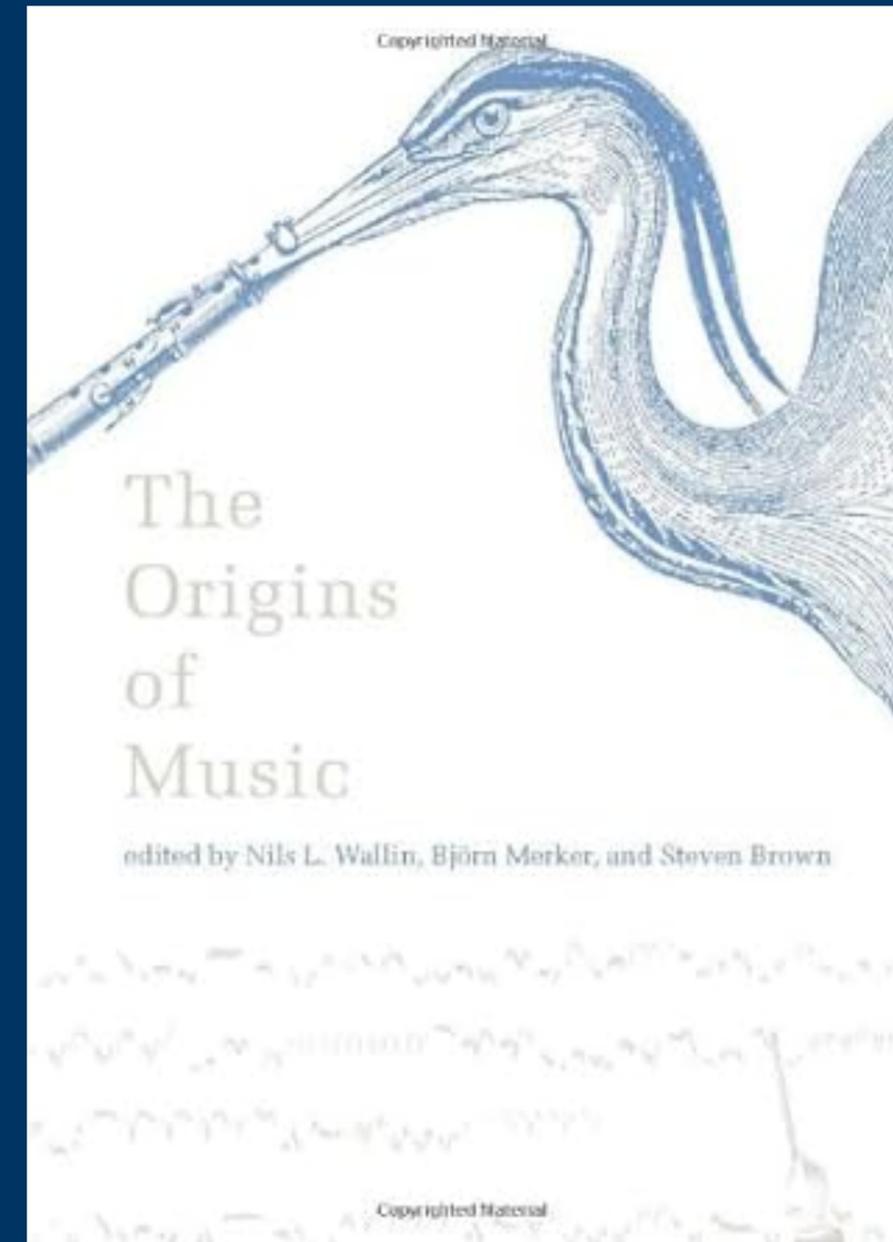
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But unlike the Indians (and, of course, our own children), we adults no longer accept the supposition that animals, plants, and rocks can, or for that matter, ever could, talk. We look to science and find that there

Nollman, Jim. 1986. "Talking to the Animals." *Between the Species* 2 (1): 11.

# Interspecies Musicking

# Evolutionary Musicology



Wallin et al., The Origins of Music.

# Problems and Limitations

- There is no universal definition of music ( :
- Situated Knowledge: Western Classically Trained Horn Player
- Scope of the thesis: Only CETI

# My Approach

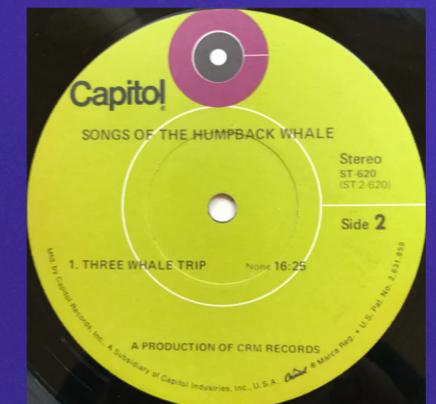
- Critical review of current methods
- Guidelines for machine learning cetacean translation projects
- Guidelines for musicians?
- Goal: To expand the perspectives and encourage a more interdisciplinary approach

# Main Section

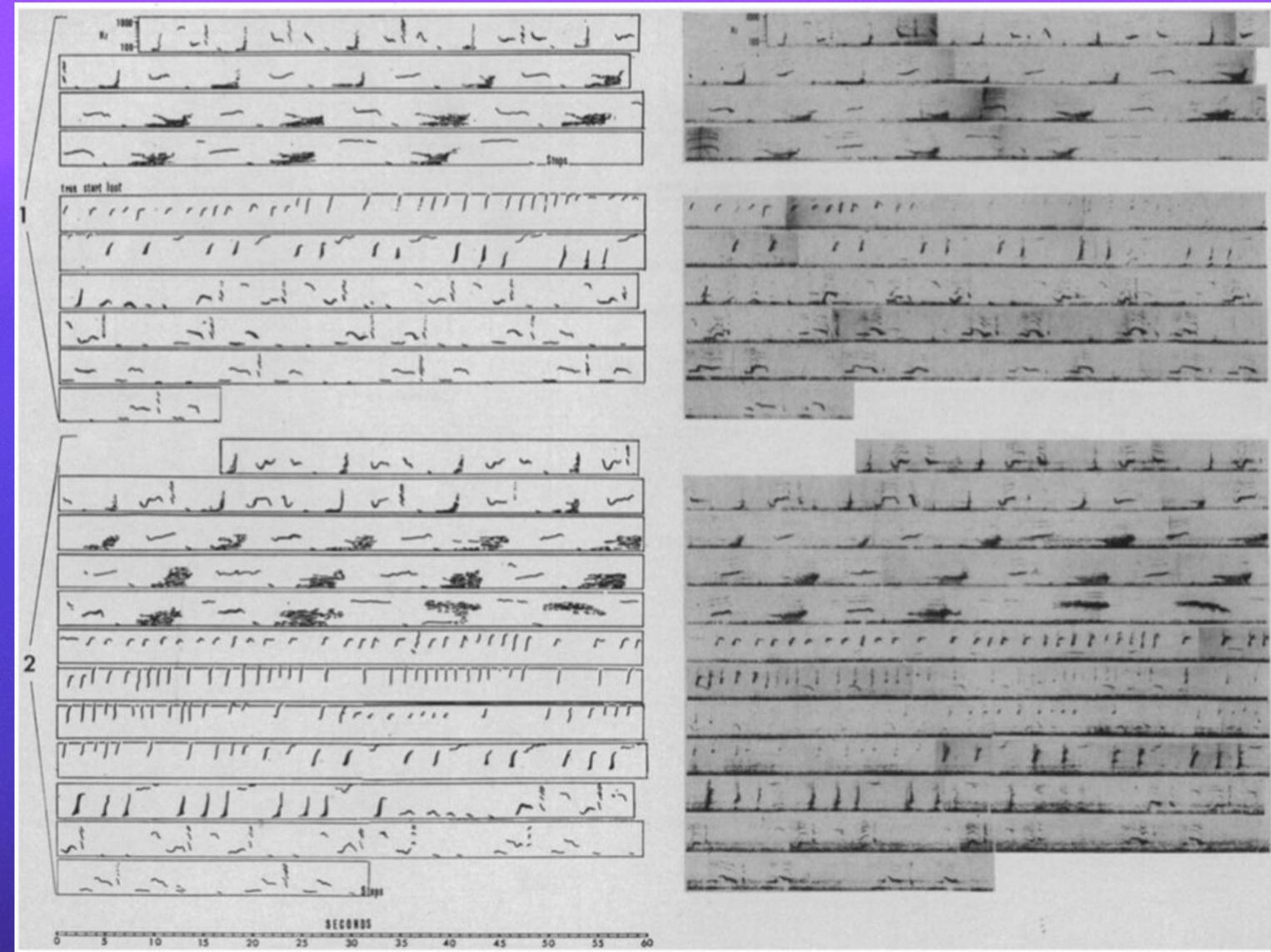
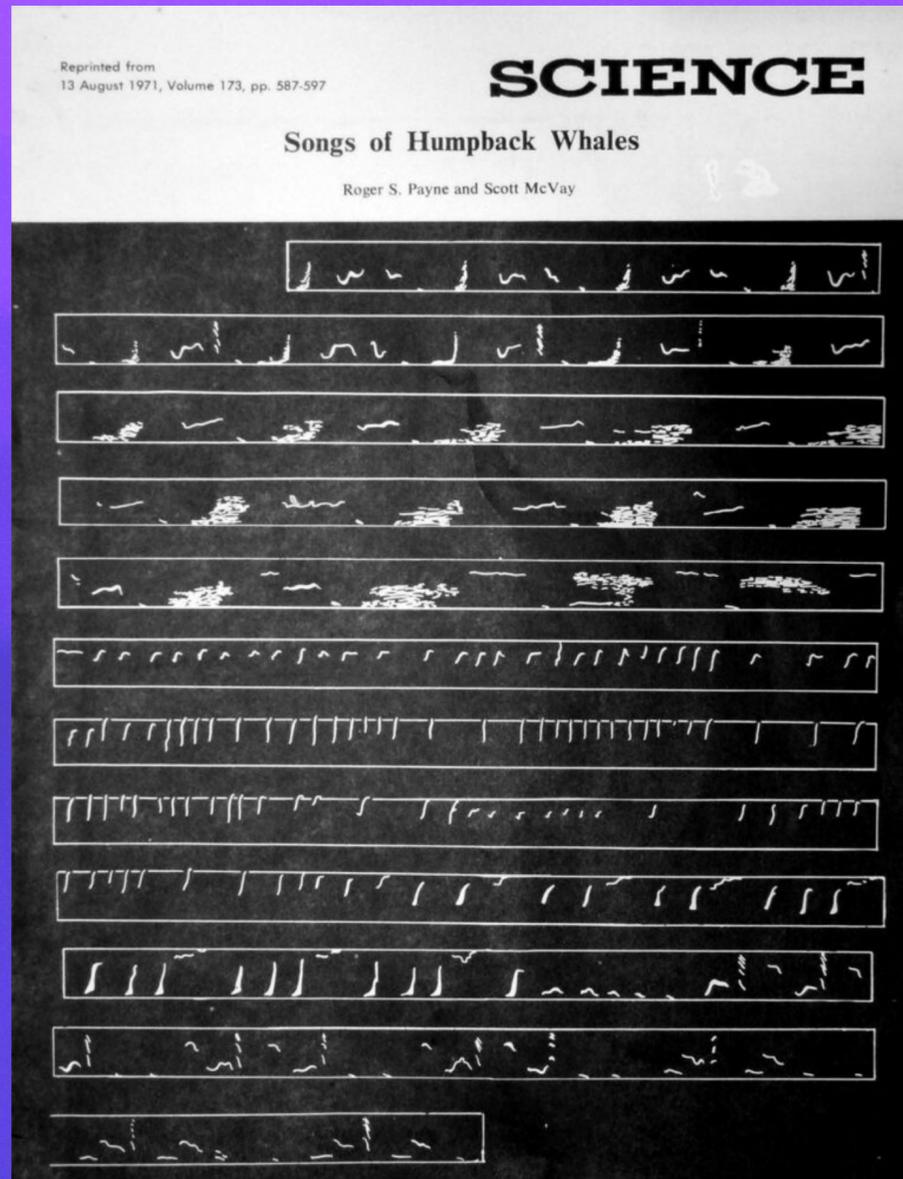
# Background

- The History of Music in Cetacean Science
- Who are CETI and what are their Goals?
- WHAM: Existing Music Research at CETI

# The History of Music in Cetacean Science



# The History of Music in Cetacean Science



# The History of Music in Cetacean Science

MAX CHERVIN BRIDGE\*

## Voices of Humpback Whales: A New History of Whale Song Science, 1856–1986

### ABSTRACT

The release of *Songs of the Humpback Whale* in 1970 helped galvanize a torrent of North American activism to save the whale from commercial whaling. Whale song quickly became a cornerstone of environmentalist and New Age political culture. This article places humpback whale song science in the larger context of acoustic science and technology, arguing that the history of whale song science is a history of the voice. Recovering and drawing on an array of sources—from sound recordings, to whaling narratives, to archived research notebooks, correspondence, and funding reports—this article seeks to place whale song science in an interdisciplinary context that binds acoustic and naval engineers, speech scientists, ornithologists, and cetologists together in a web of vocal technologies, techniques, and representational formats. Blending these stories into a single narrative, this article broadens the historiography of whale song science by placing it back into the hands, eyes, and ears of the diverse workers who generated the conditions of its possibilities and sustained its development—from academic scientists and sonar engineers to research assistants and whalers.

KEY WORDS: humpback whale song, cetology, acoustics, bioacoustics, sound spectrography, voice, ethology, scientific representation, sound studies, history of technology

\*Brown University, Department of History, 32 Meadow Ln., Apt. 3, Bridgewater, MA 02324, maximilian\_bridge@brown.edu.

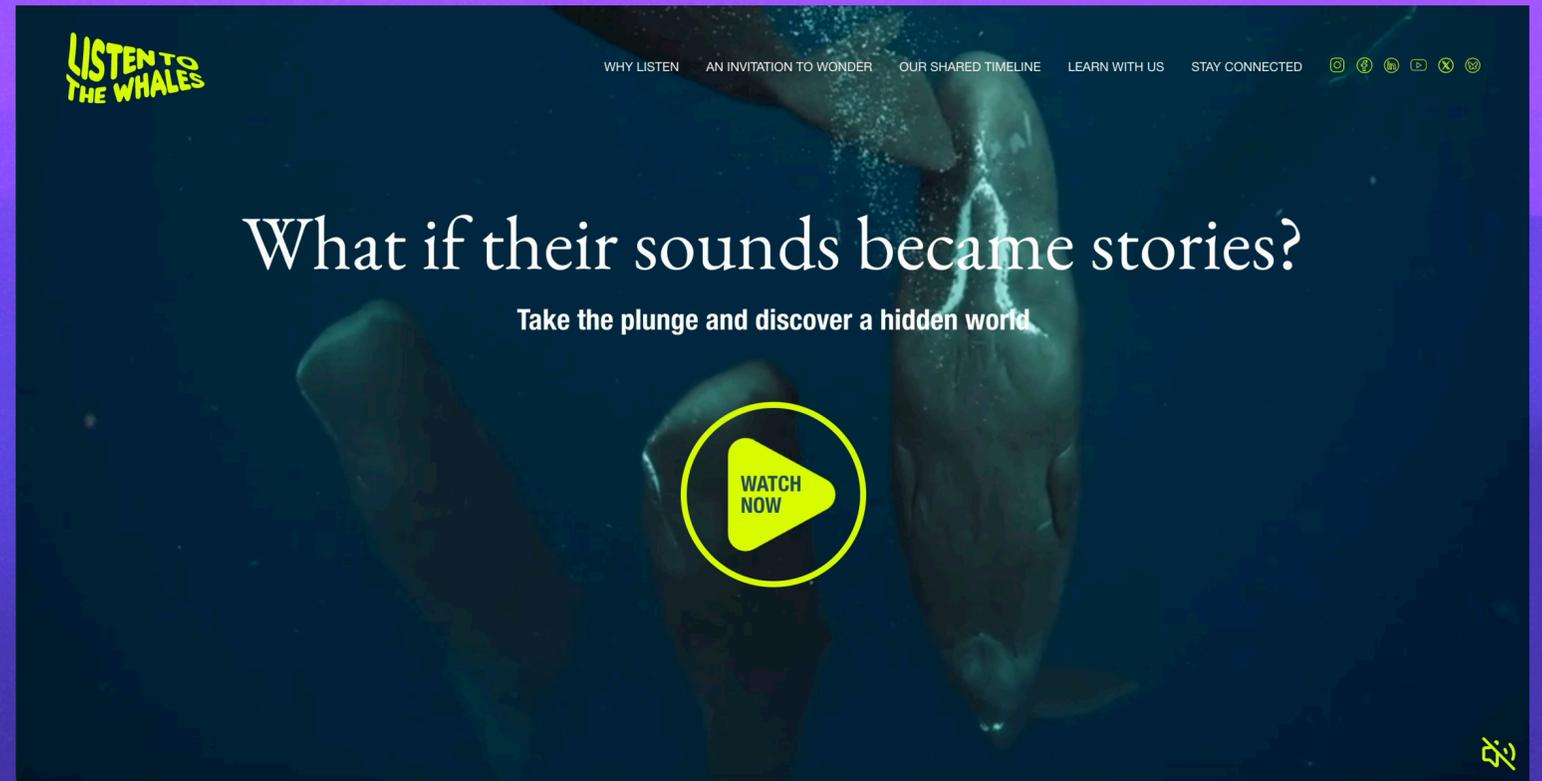
The following abbreviations are used: AT&T, American Telephone and Telegraph Company; NDRC, National Defense Research Committee; Marler Correspondence, Peter Marler Correspondence, University of California, Davis, Special Collections, D-483; ONR, Office of Naval Research; SOFAR, Sound Fixing and Ranging; URI-GSO, University of Rhode Island University Archives, Graduate School of Oceanography, Record group 80; WCS, Wildlife

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# Who are CETI and what are their Goals?



<https://www.projectceti.org/>



<https://listen.projectceti.org/>

# Who are CETI and what are their Goals?

The screenshot shows the CETI website homepage. At the top left is the CETI logo, which includes a whale silhouette and the text 'ceti'. To the right of the logo is a navigation menu with the following items: 'ABOUT' (with a dropdown arrow), 'GET INVOLVED', 'DOMINICA', 'NEWS & RESEARCH' (with a dropdown arrow), 'DONATE', and 'SHOP'. On the far right of the header are social media icons for Instagram, YouTube, LinkedIn, and Twitter.

Below the navigation, the main content area features a large illustration of a sperm whale's head in profile, facing left. The whale is rendered in a detailed, stippled style. Text boxes are connected to the whale by thin lines: one points to the brain area, another to the mouth area, and a third to the eye area.

On the left side of the main content area, there is a vertical list of four goals, each preceded by a large number in a circle:

- 1** **Achieve** breakthroughs in decoding sperm whale communication
- 2** **Share** our learnings with the world
- 3** **Transform** human understanding & connectivity
- 4** **Leverage** our findings to protect our oceans and planet

Below the list of goals is a purple button labeled 'Our Vision'.

Text boxes on the right side of the whale illustration provide additional information:

- THE LARGEST KNOWN BRAIN IN THE UNIVERSE**  
With a brain six times the size of humans, untapped potential could be vast
- MORSE CODE STYLE COMMUNICATION**  
The codas of clicks vary by different groups showing possible culture

# Who are CETI and what are their Goals?



Pressure testing suction cup for Project CETI Whale Tag at Harvard Microrobotics Laboratory

Photo: Spencer Lowell

## Robotics/Engineering



We are deploying state-of-the-art, gentle robotics, including aerial drones, whale tags with bioinspired suction cups, and underwater autonomous gliders with machine learning-based "backseat driving" capabilities that allow us to record the sound and movements of sperm whales.

## Machine Learning

We analyzed new whale data, uncovering behavior patterns linked to their vocalizations, and uncovered a "sperm whale phonetic alphabet." Our interdisciplinary team is making significant progress in deciphering whale communication, with key publications in top journals like Nature Communications and NeurIPS Proceedings. We published nine papers in 2024, with seven more under peer review.

## Linguistics

We've identified meaningful units of whale communication, tested for grammatical structures, and uncovered vowels and diphthongs in sperm whale sounds.

## Field Operations

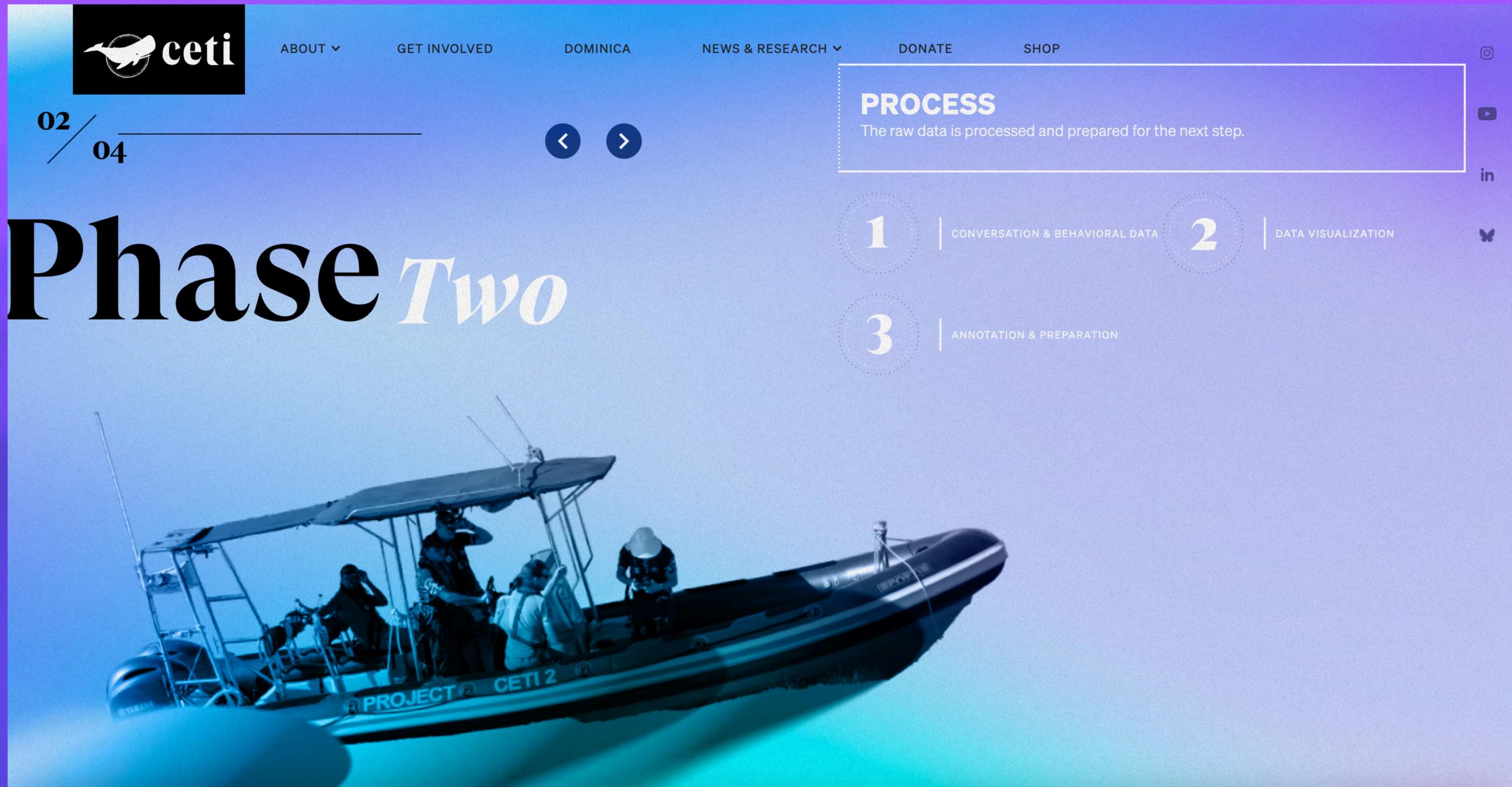
Our team continues to track, tag, and study sperm whales, maintaining CETI's Core Whale Listening Stations and underwater sensors.

# Who are CETI and what are their Goals?

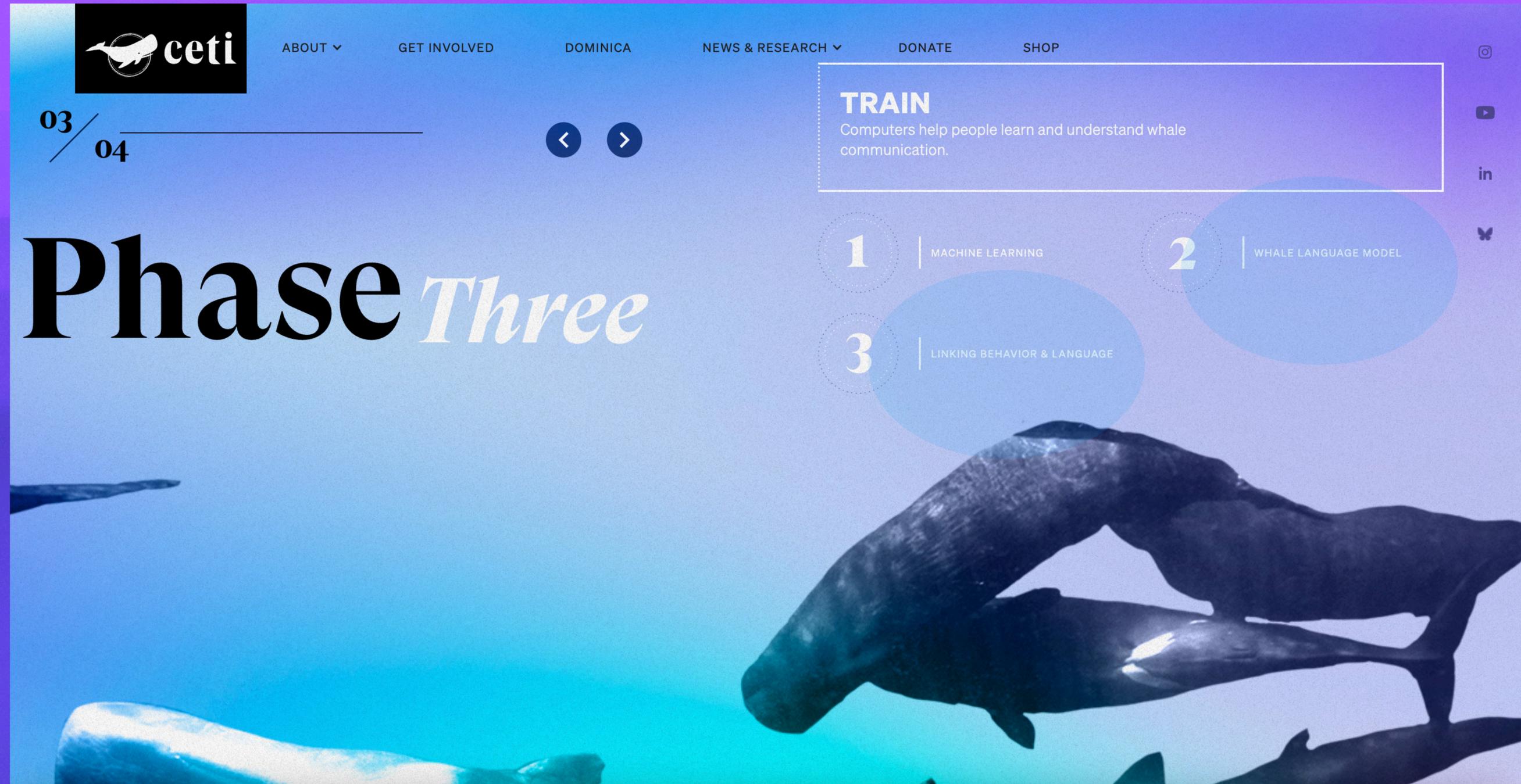
The screenshot shows the CETI website with a navigation bar containing: ABOUT, GET INVOLVED, DOMINICA, NEWS & RESEARCH, DONATE, and SHOP. A progress indicator shows 01/04. The main heading is "Phase One". A "MONITOR" section is highlighted, with the text "Record the movements and sounds of sperm whales." Below this are four technology icons: Aerial Drones, Small High-Tech Suction-Cup Attached Computers, Hundreds of Synced Underwater Microphones, and Swimming Robots. A large image of a sperm whale is at the bottom.

<https://www.projectceti.org/>

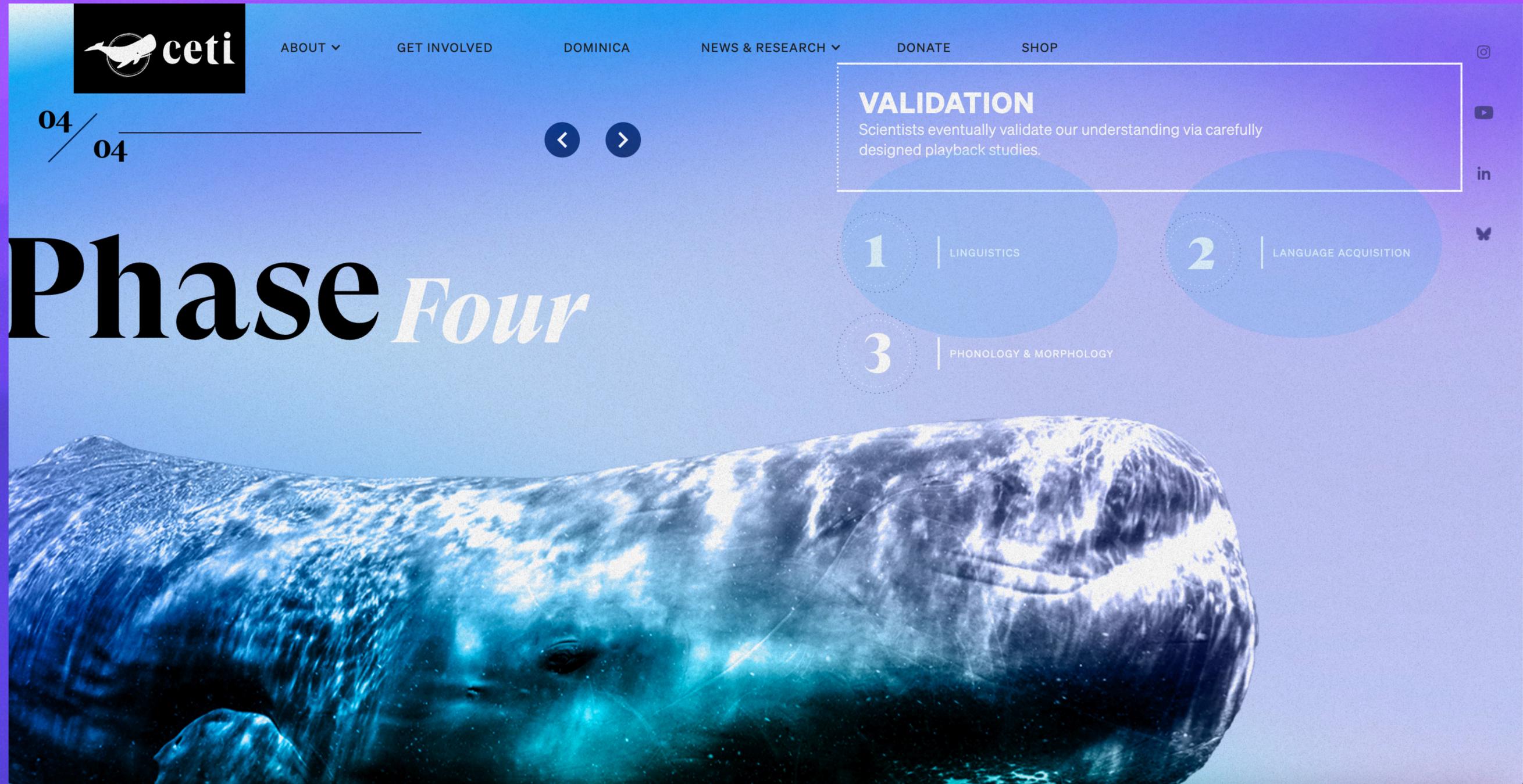
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# 1.2 Who are CETI and what are their Goals?

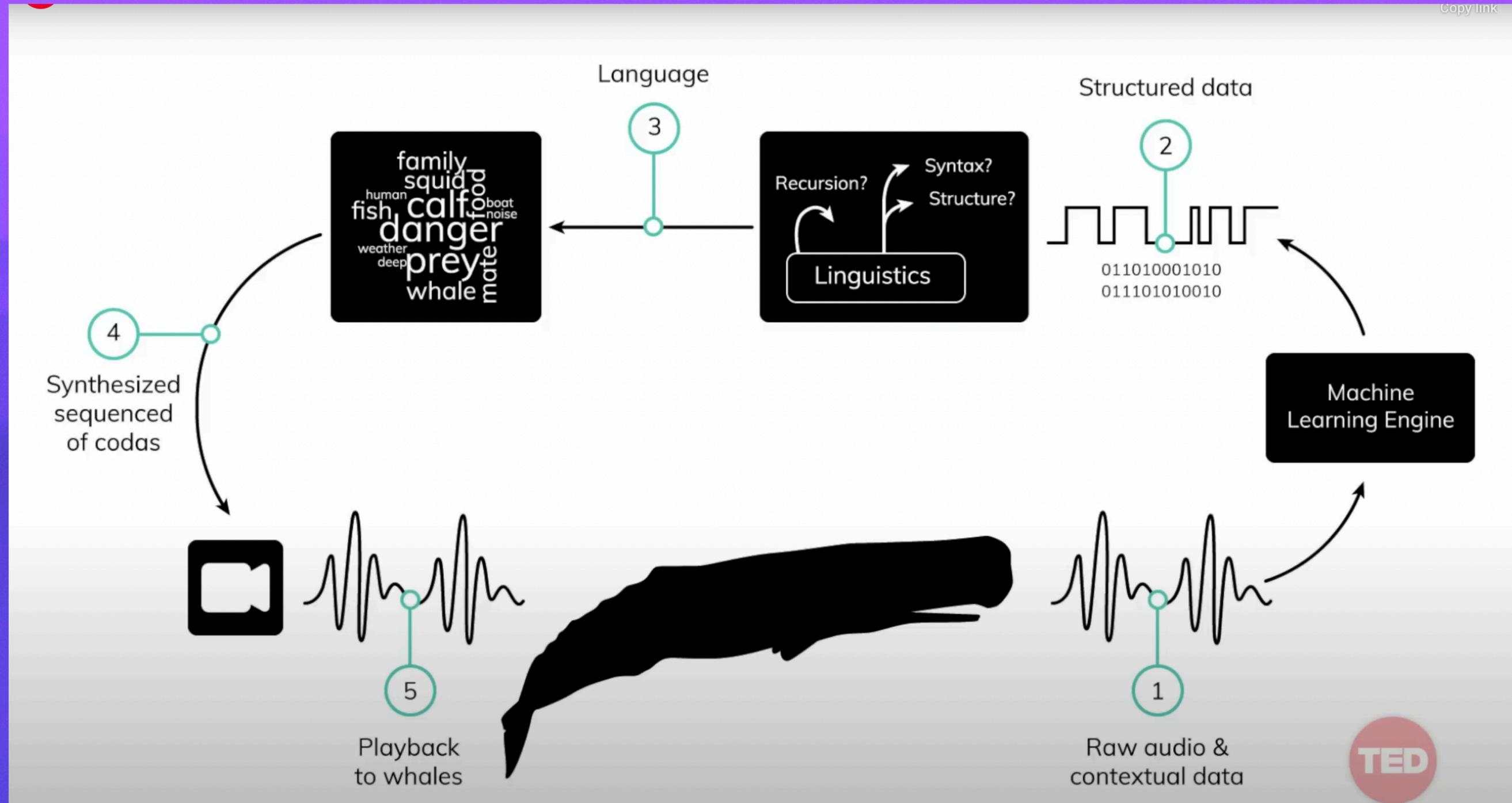


# Who are CETI and what are their Goals?



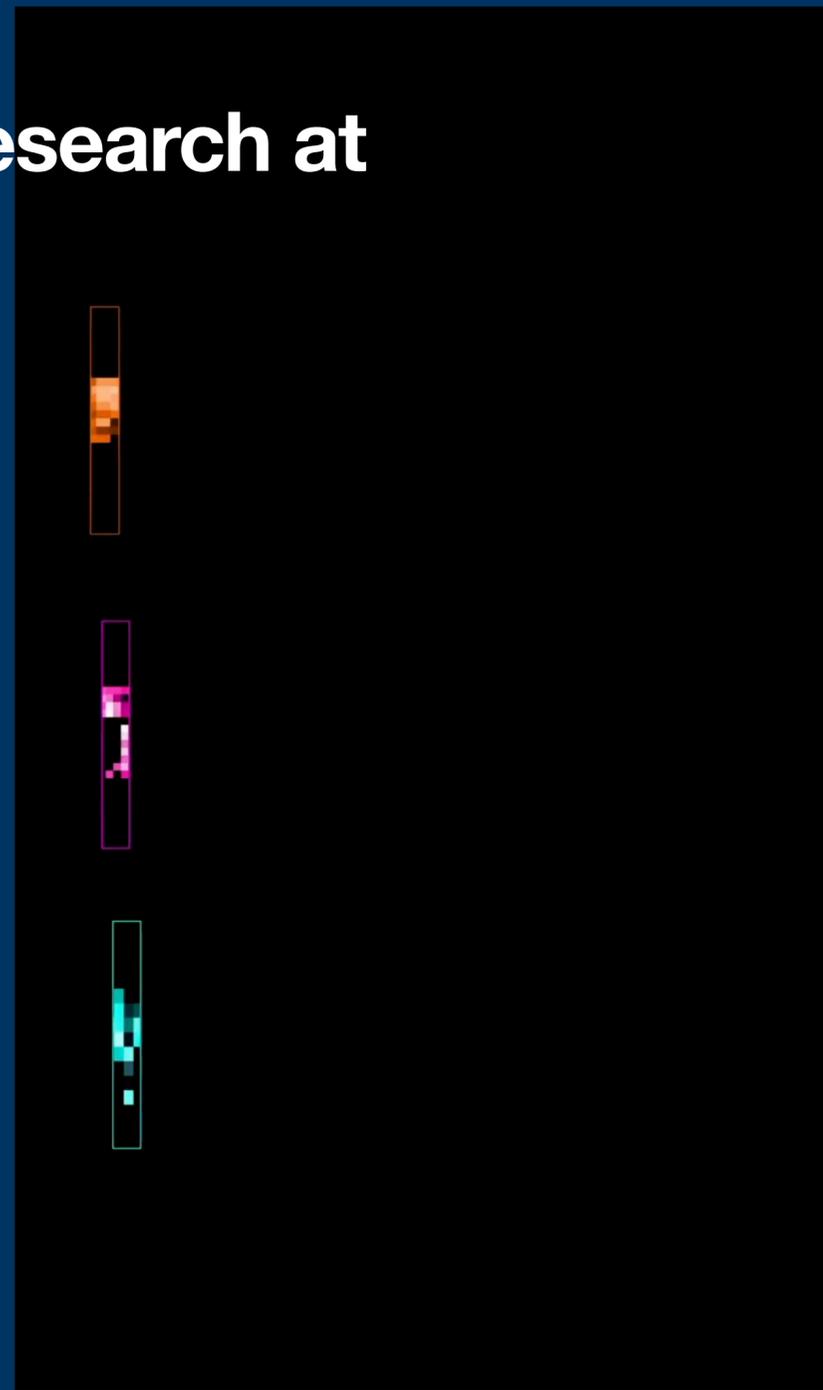
<https://www.projectceti.org/>

# Who are CETI and what are their Goals?



<https://youtu.be/Qm02X0aE8uU>

# WHAM: Existing Music Research at CETI



<https://www.instagram.com/projectceti/>

[https://www.instagram.com/p/DRw\\_Qb5CGPY/](https://www.instagram.com/p/DRw_Qb5CGPY/)

Paradise, Orr, Pranav Muralikrishnan, Liangyuan Chen, et al. 2025. "WhAM: Towards A Translative Model of Sperm Whale Vocalization." arXiv:2512.02206. Preprint, arXiv, December 1. <https://doi.org/10.48550/arXiv.2512.02206>.

# Theoretical Framework

- Critical Posthumanism
- Donna Haraway's Cyborg Concept
- Situated Knowledge
- Defining Music

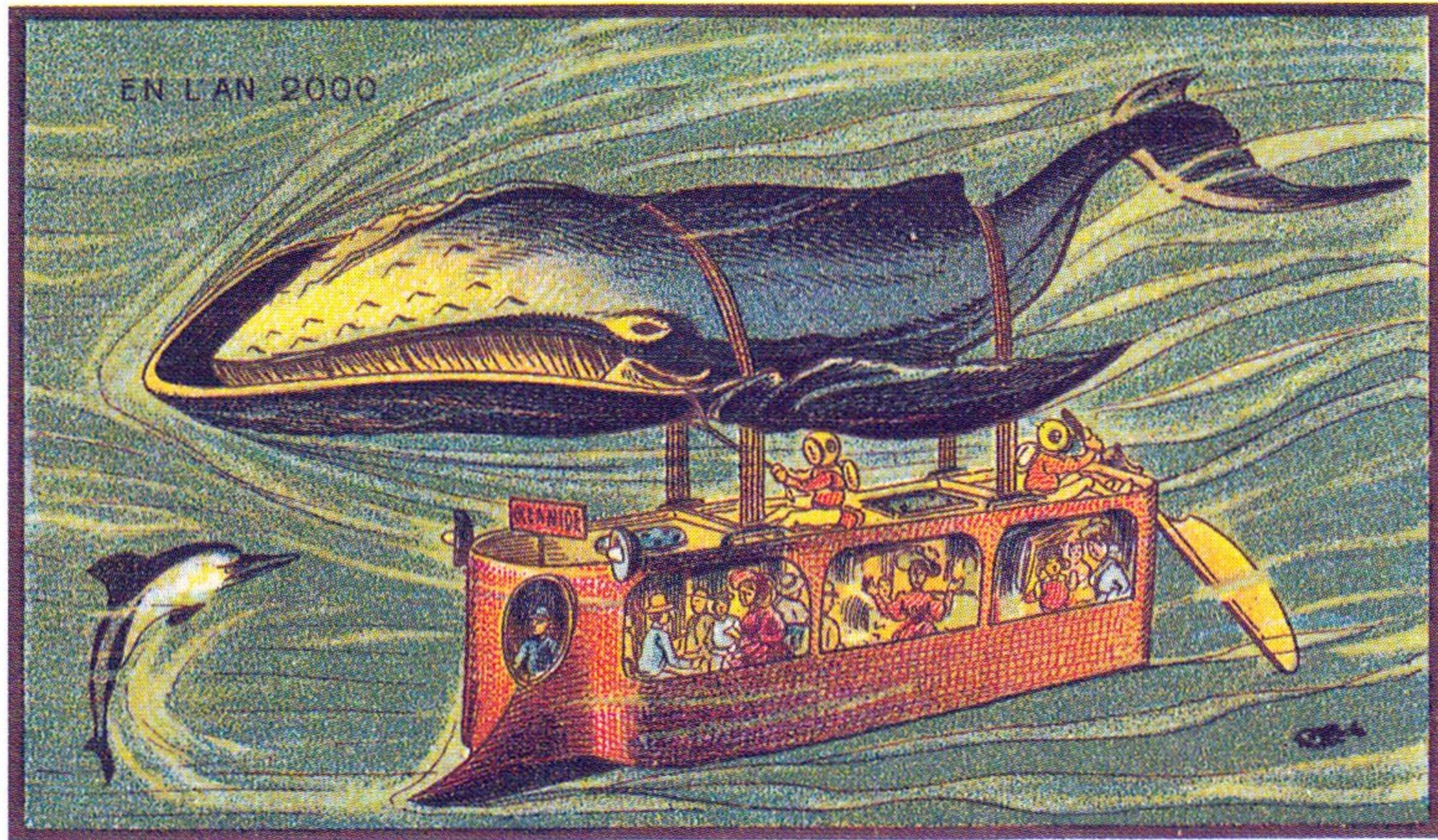
# Donna Haraway's Cyborg Concept



“A cyborg is a cybernetic organism, a hybrid of machine and organism, a creature of social reality as well as a creature of fiction.”

Philopedia. “A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century | Work.” Philopedia. Accessed January 29, 2026. <https://philopedia.org/works/a-cyborg-manifesto-science-technology-and-socialist-feminism-in-the-late-twentieth-century/>.

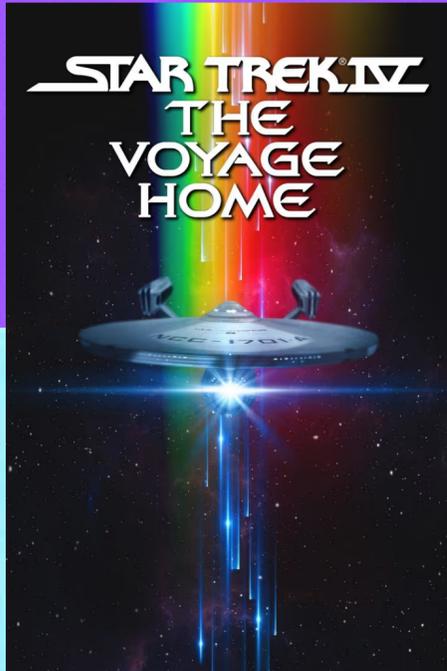
# Donna Harraway's Cyborg Concept



A Whale-Bus

English: France in 2000 year (XXI century). Whale-bus. France, paper card by Jean-Marc Côté.

# Donna Harraway's Cyborg Concept



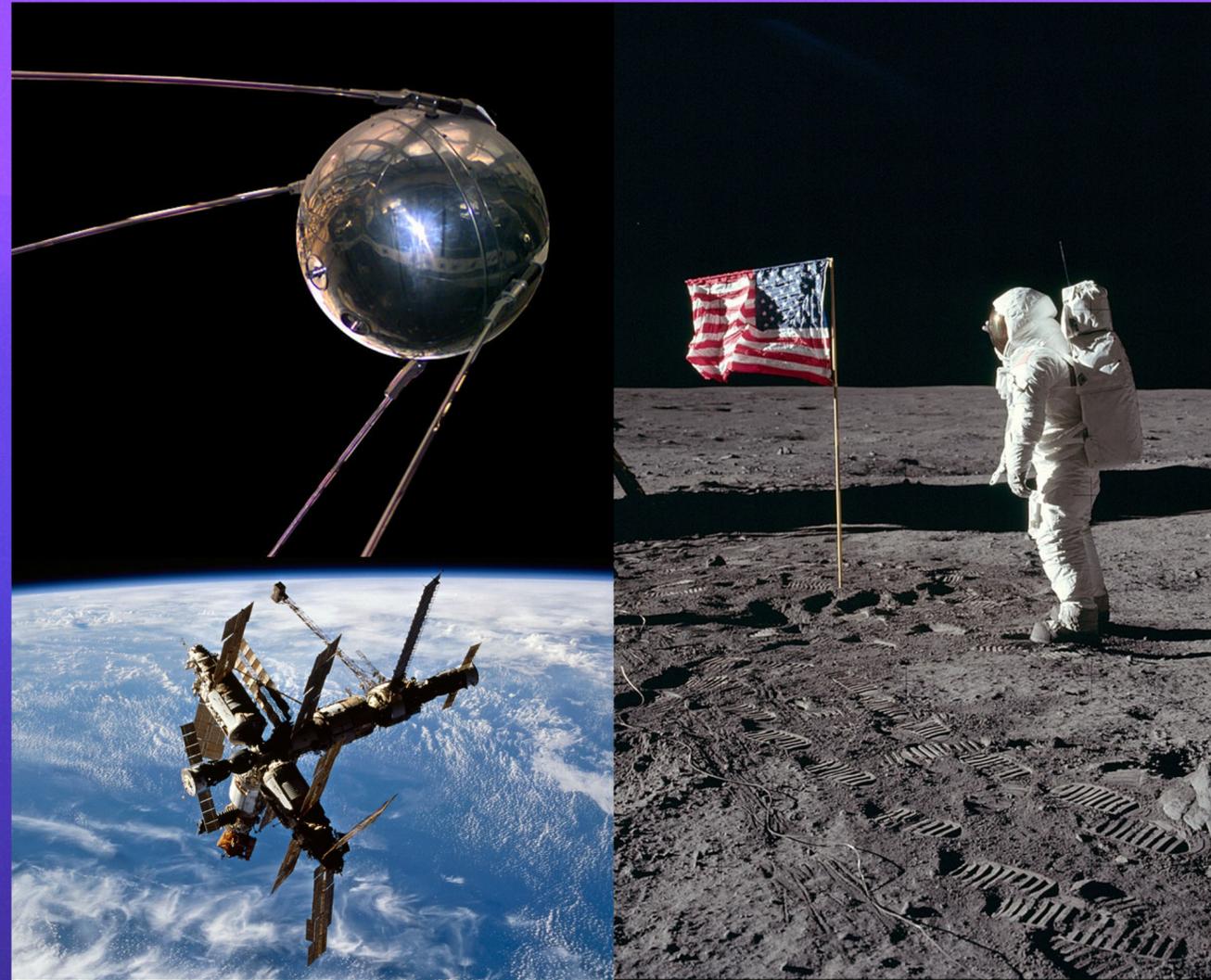
# Donna Harraway's Cyborg Concept



# 1. Introduction



In the 2260s, Spock used a universal translator to communicate with non-corporeal Varkans intent on taking over the *USS Enterprise*. (TOS comic: "Thorpex")

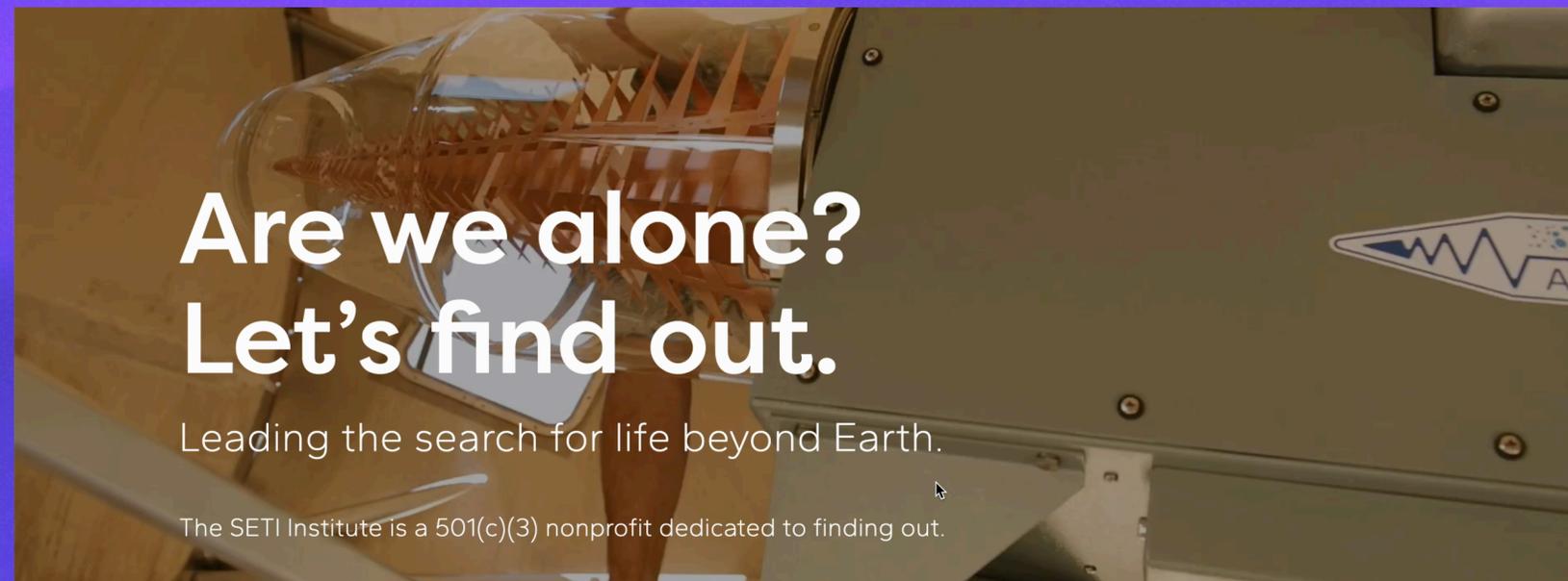


*Sputnik 1*, humanity's first artificial satellite, the United States directed the Space Race to landing humans on the Moon, the Soviet Union concentrated on low Earth orbit space stations such as *Mir*

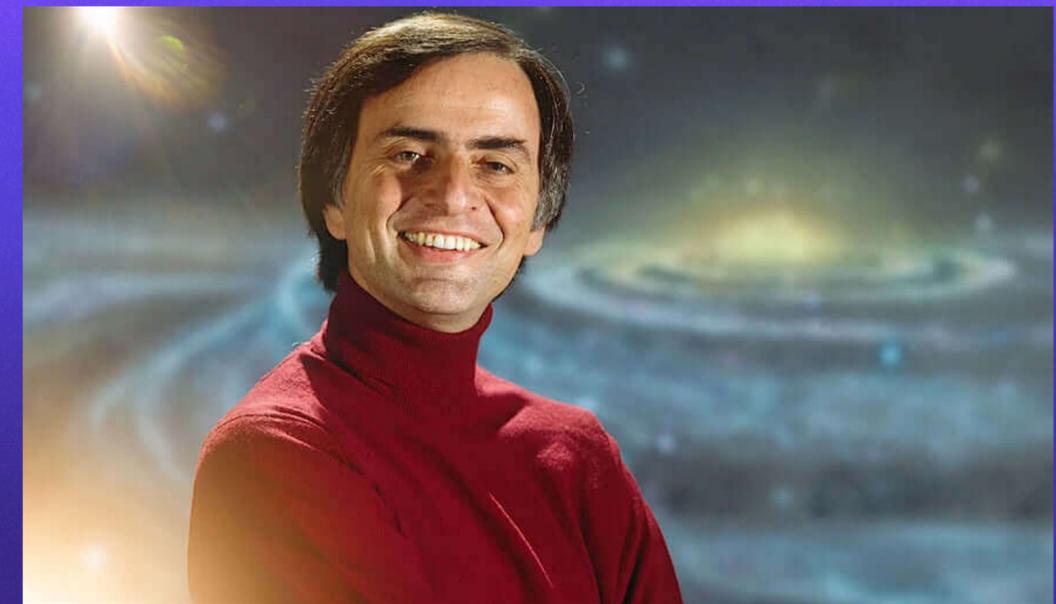
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<https://www.seti.org/>



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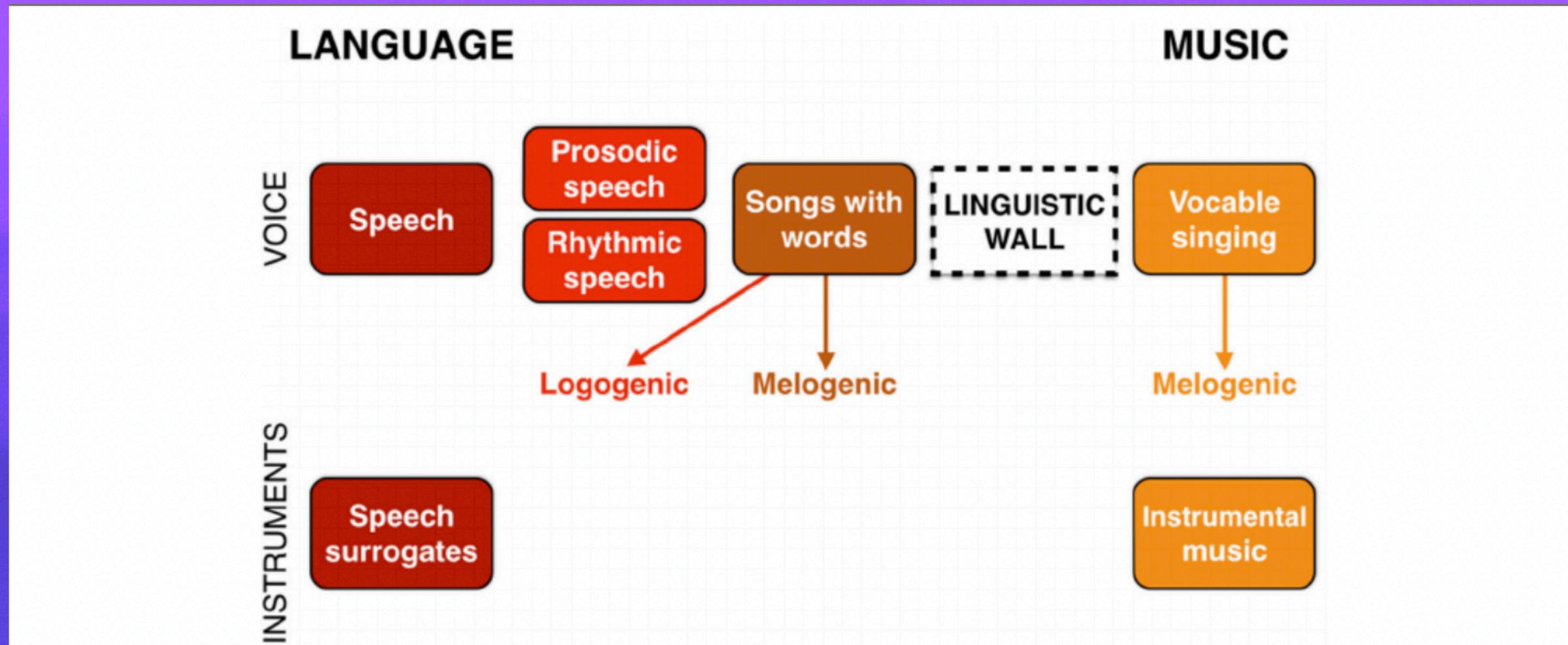
Carl Sagan

## Problems / Why Music?

### *Good title?*

- The Use of the Terms “Language” and “Music” when Discussing Nonhuman Animal Communication
- Steven Brown’s “Musilanguage Continuum”
- The Importance of Interdisciplinarity
- Decentering the Human: Anthropocentrism and Logocentrism in LLMs

# Steven Brown's "Musilanguage Continuum"



**FIGURE 10 |** The musilinguistic continuum. At the extremes of the continuum are language and music, represented both vocally and instrumentally. In the middle of the continuum is the most interactive function of songs with words. This can be accomplished in either a logogenic or melogenic manner. Sitting in between standard speech and songs with words are intermediate functions in which the lexicality of speech is maintained but in which the acoustic properties of the production lean in the direction of music, such as rhythmic speech and prosodic speech. There are no comparable intermediate functions on the music side of the continuum since a “linguistic wall” ensures that lexicality is a categorical feature, rather than a continuous acoustic feature like musicality. Vocale singing is shown here as being in the melogenic style. It need not be, but is most commonly found in this form in world musics.

# Decentering the Human: Anthropocentrism and Logocentrism in LLMs



admin. "McLuhan.Org | Understanding Media: The Extension of Man (1964)." *McLuhan.Org*, November 1, 2023. <https://mcluhan.org/understanding-media/>.

# Decentering the Human: Anthropocentrism and Logocentrism in LLMs

## TALKING TO THE ANIMALS

JIM NOLLMAN

Interspecies Communication



The American Indians held nature to be a conscious entity; everything from rocks to grass to coyotes was thought to possess a clear voice and the ability to speak and be understood. Today, we peruse the traditions and wonder how in Heaven's name could a people who, otherwise, seemed to understand nature so well, have so exaggerated the intellectual prowess of the animals. At best, we relegate the matter to our anthropologists, who tend to persuasively explain the matter as a religious myth constructed to explain an otherwise unfathomable environment. The problem with this line of reasoning lies in the fact that the environment was, indeed, not unfathomable; that the Indians possessed an admirably deep knowledge about the natural world. Yet, their concept of the talking animals was quite universal. Could we be missing something? Is there any possibility whatsoever that the Indians' intimacy within nature also included some "secret doorway" into the recesses of animal consciousness?

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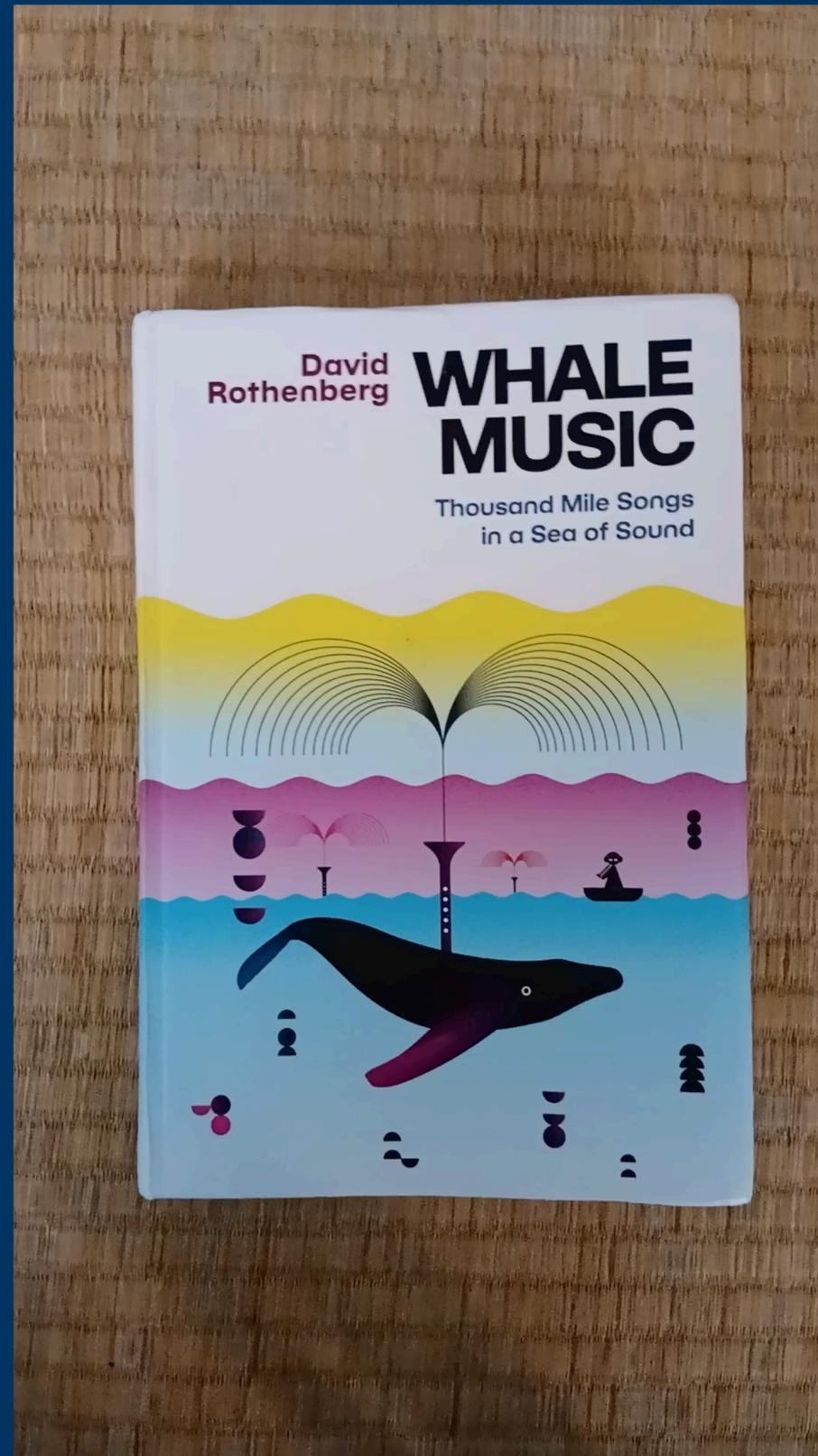
But unlike the Indians (and, of course, our own children), we adults no longer accept the supposition that animals, plants, and rocks can, or for that matter, ever could, talk. We look to science and find that there

Nollman, Jim. 1986. "Talking to the Animals." *Between the Species* 2 (1): 11.

# Research Question: How Would Such Research Benefit from Musical Perspectives?

- Analysis
- Playback Experiments
  - Ethical Problems
  - Possible Alternative: Humans Musicking with Animals
  - Developing a 3rd Language Between Species
- Public Engagement
  - The Crucial Role of Music in the *Save the Whales* Movement
  - The Applied Aspects of Music

# Analysis



Rothenberg, David. 2023. Whale Music: Thousand Mile Songs in a Sea of Sound. MIT Press.

# Playback Experiments: Ethical Problems

Biological Conservation 295 (2024) 110648



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Biological Conservation

journal homepage: [www.elsevier.com/locate/biocon](https://www.elsevier.com/locate/biocon)



## Dr. Doolittle uses AI: Ethical challenges of trying to speak whale

Mark Ryan<sup>a,\*</sup>, Leonie N. Bossert<sup>b</sup>

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Whales have complex vocalisations that are used for sexual selection, to coo their young, for echolocation, and as a form of communication. Scientists are deploying underwater microphones (hydrophones), robotic fish, and tags to record whale vocalisation. AI is used to identify whale vocalisation patterns, understand their meaning, and digitally recreate these sounds to communicate with them. Understanding and translating whale vocalisations into something humanly understandable aims at helping to identify their movements to protect them from ship strikes and bycatch and prevent or reduce sonar that interferes with their echolocation.

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# Playback Experiments: Ethical Problems

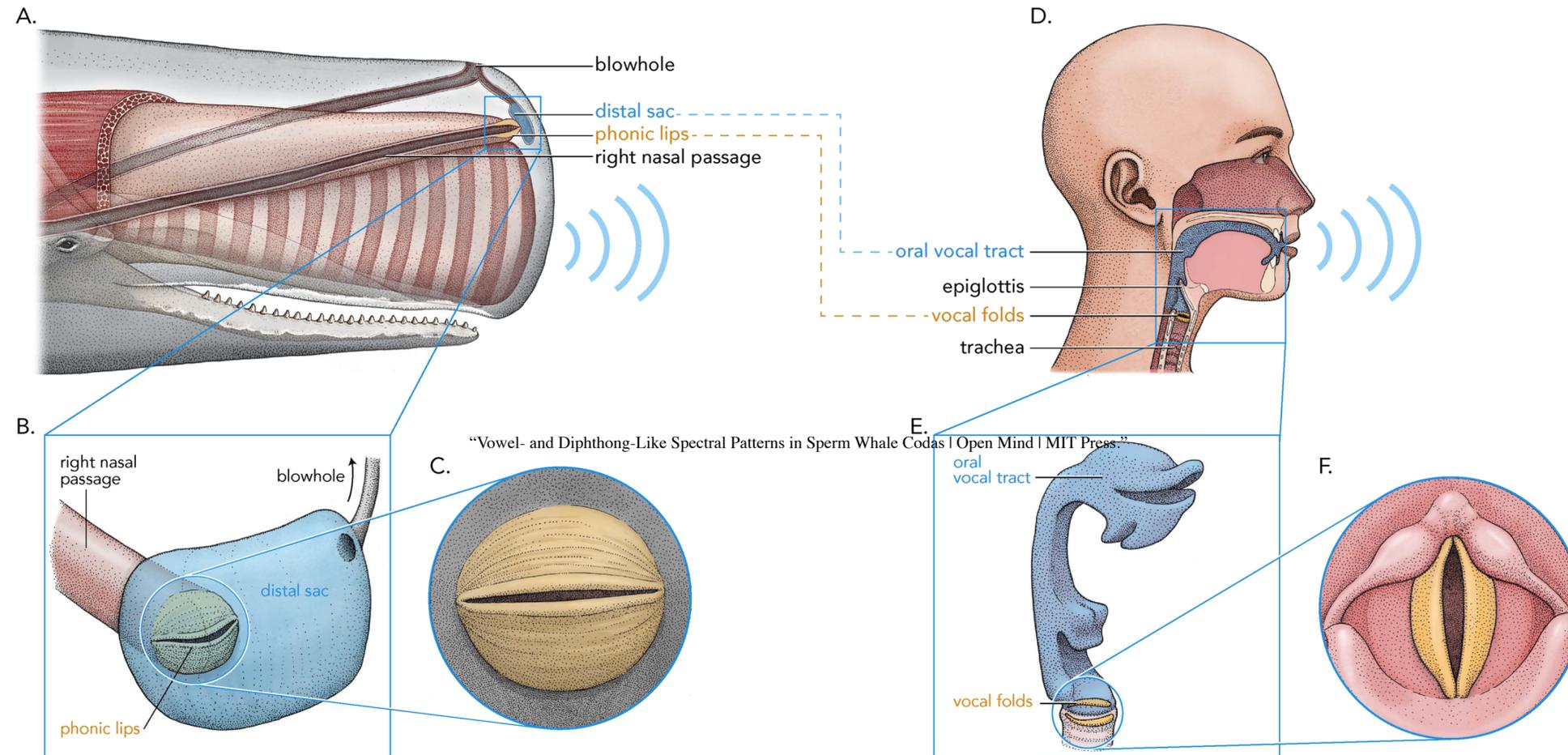
Challenges of using AI to decode whale vocalisation:

1. Anthropomorphism
2. Privacy Rights
- 3. Emotional and Cultural Harm**
4. Technological Solutionism
5. Ineffectiveness for Whale Conservation
6. Gender Bias

Challenges of using AI to decode whale vocalisation

# Possible Alternative: Humans Musicking with Animals



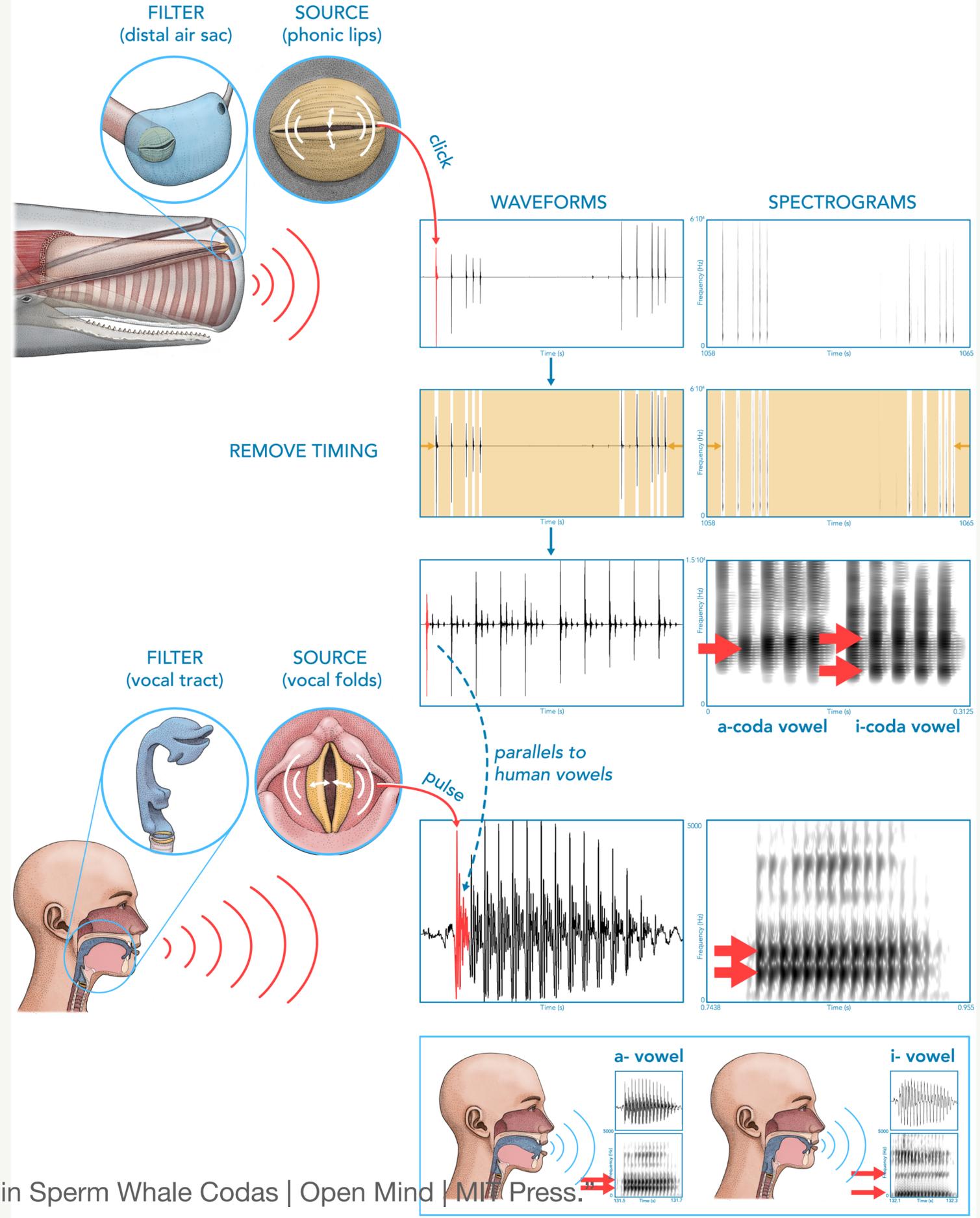


**Figure Legend:**

Parallels in human vowel (D) and sperm whale coda (A) vowel production. The source articulators, the phonic lips (C) correspond to human vocal folds (F). We hypothesize that the filter articulators, the distal air sac (B), corresponds to the vocal tract (E). CC 4.0 BY © Alex Boersma.



*Trompete Lernen: Richtige Position Des Mundstücks (Trumpet Embouchure and Mouthpiece Placement).* (2014).  
[https://www.youtube.com/watch?v=2gFGmfGA\\_3k](https://www.youtube.com/watch?v=2gFGmfGA_3k)

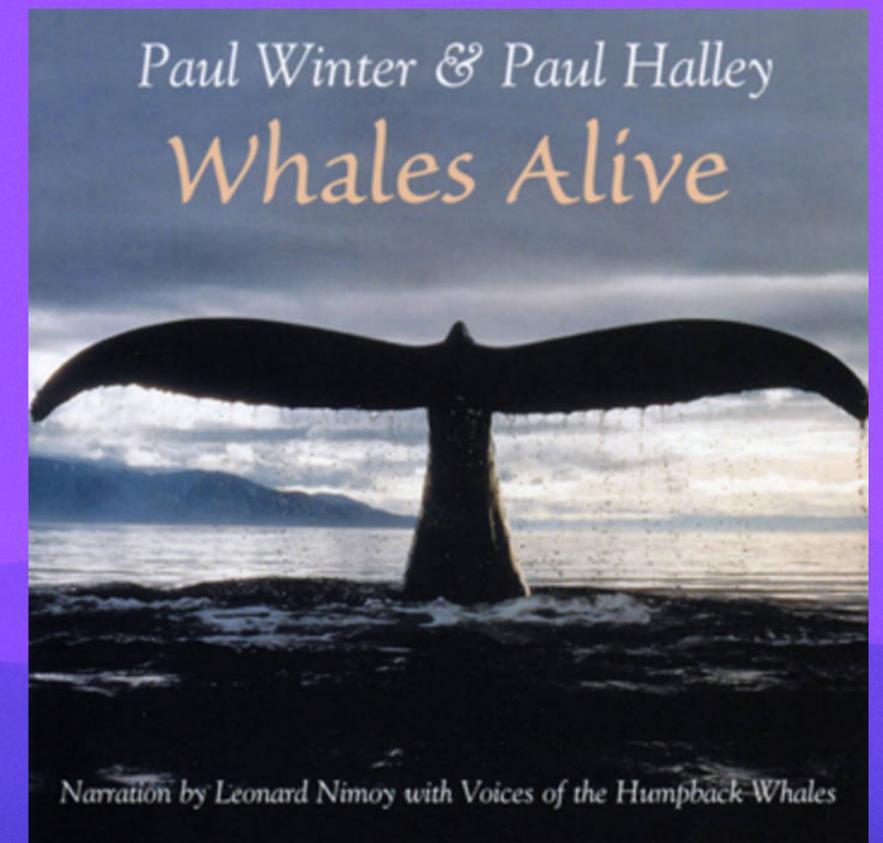
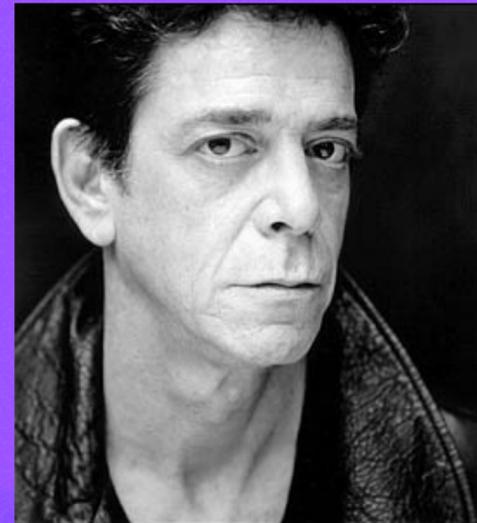


“Vowel- and Diphthong-Like Spectral Patterns in Sperm Whale Codas | Open Mind | MIT Press.”

# Public Engagement: The Crucial Role of Music in the Save *the Whales Movement*



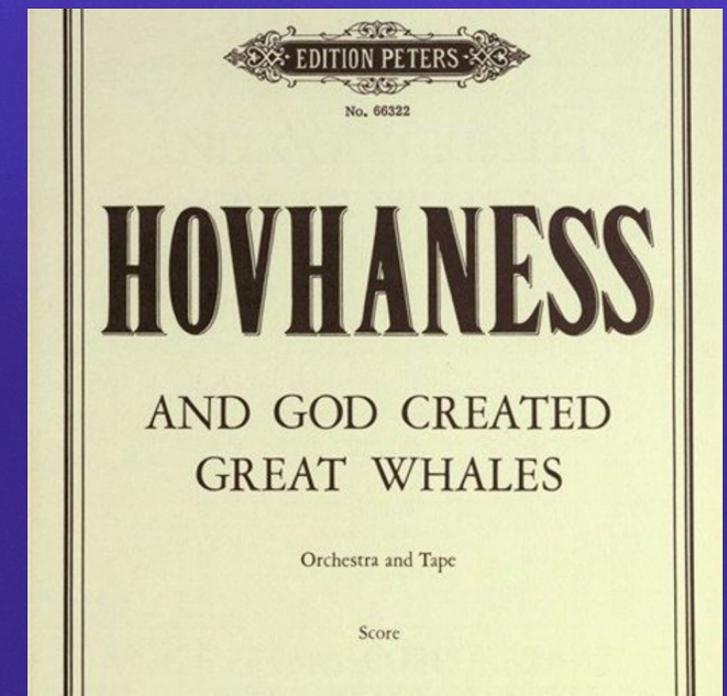
Kate Bush *Symphony in Blue*



<https://paulwinter.bandcamp.com/album/whales-alive>



Lou Reed *The World's Last Great American Whale*



Alan Hovhaness *And God Created Whales*



# Guidelines for Incorporating Music into Machine Learning Cetacean Translation Projects

Get rid of the distinction between Music and Language

Publish Audio Files

# The Benefits to Musicians of Getting Involved with Cetacean Science

Biomimetics of Music

Listening and Finding Inspiration for New Music's

# Conclusion

Summary

Potential Future Research

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