Paper ID: 21749
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43rd SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIALINTELLIGENCE (SETI) – The Next Steps (A4)
SETI 2: SETI and Society (2)

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NONHUMAN COMMUNICATION SIGNALS AND DECODING TECHNIQUES: IMPLICATIONS FOR ASTROBIOLOGY

Abstract

Nonhuman communication signals have been studied in many taxa and across different sensory systems. Methodologies and technologies have evolved over the decades and we will compare earlier techniques to modern day techniques and compare the pros and cons of each, as well as address the effect of human-centric the tests on their interpretations.

The most common technique for studying animal communication is to decode and analyze the repertoire of a species. This might include the development of an ethogram or a list of acoustic signal types to be later correlated with behavioral context. Another technique is through experimental work including the use of two-way interfaces or new frameworks of protocol. Historical examples include keyboards (primates, dolphins), and sophisticated cognitive frameworks such as social-rivalry (birds, dolphins). We will review a variety of modalities used in nonhuman communication including acoustic, visual, chemical and the taxa best represented by these studies.

Studying a system of communication can be extended far beyond the animal kingdom. Communication among microorganisms is displayed through chemical signaling in large scale, quorum sensing, and beyond species boundaries. The same has been demonstrated to occur among certain types of plants. Different organisms have adapted to as many divergent environments as there are examples of on Earth. Referencing the human-centric term, Extremophiles, organisms live in other conditions not considered "optimal" yet these alternative environments are more common than what humans call "optimal". Plants communicate with each other, and Bacteria and Archaea all communicate with each other and with Eukaryotes. Quorum sensing has also been used to explain social insects supra-organismic behavior. Organisms have proven to be adaptable to conditions available to them, so we might expect that an organism in space would use the environment and evolve what it needs to both survive and communicate.

Advanced methods in both theoretical frameworks and the computer sciences have provided sophisticated new techniques capable of objectively decoding complex information. Techniques include automated acoustic analysis, neural networks, information theory, and activity/discovery techniques, and liquid chromatography. Complex patterns and grammar have been suggested for a few social species (prairie dogs, dolphins) but many other species repertoires remain unexplored. Interspecies communication remains an uncharted territory despite ample evidence that organisms living in close proximity develop new communication repertoire to interpret and transmit information using different modes of communication. It is these intra and interspecies communication decoding techniques that may be most relevant for SETI, and METI, purposes.