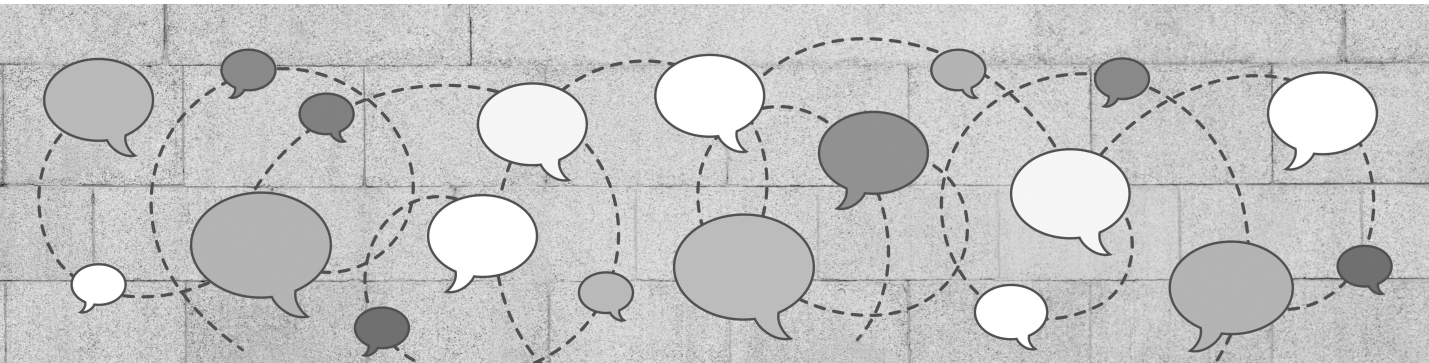
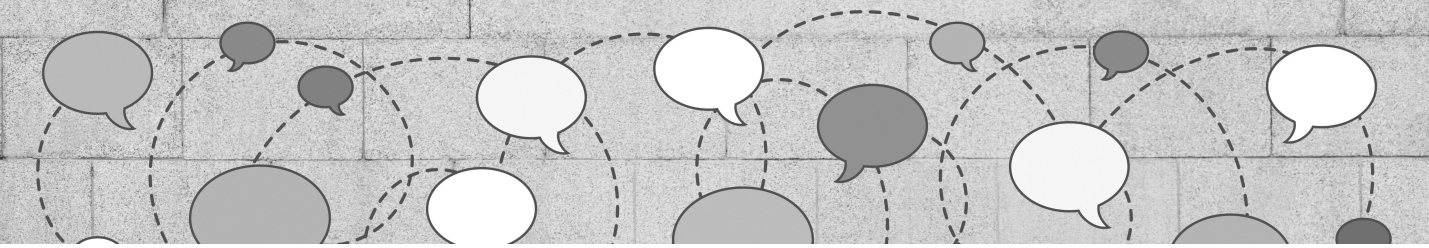
PART 8

BRIEF CHAPTERS ON THE COMPANION WEBSITE





16 Animal Communication and Language

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OVERVIEW

In this chapter, you will develop an understanding of animal communication and animal language, including:

- **the difference between communication and language;**
- **the information conveyed in animal communication;**
- **ways of decoding animal languages;**
- **design criteria for animal languages;**
- **prairie dog and honeybee languages;** and
- **linguistics and the future of animal language research.**

Some 400 years ago, the French philosopher René Descartes explained why he thought the human species was superior to all other life forms on earth. "*Cogito, ergo sum*," he said – "I think, therefore I am." With that one sentence, a chasm was dug between humans and all other animal species. According to this premise, only humans can think, only humans can be self-aware, can create, can make tools. And most important of all, only humans have language. All other species, according to Descartes, are like wind-up toys – they move, they act, but they have no awareness of themselves or what they're doing. Many biologists, philosophers, and linguists have subsequently assumed that Descartes' view was true, and believed that there was a gulf between *us* humans and *them*, the rest of the animals.

In the past 50 years, scientists have been steadily chipping away at this paradigm. Not that long ago, anthropology textbooks were telling students that humans were the only ones who could make tools. Then, scientists discovered that several animals could make tools as well. More recently, scientists have been finding that animals are individuals who are self-aware and even have friends. And now, we are finding that the last bastion giving our species superiority is falling at last. We are learning that animals have language, too.

16.1 What Is the Difference between Language and Communication?

In the past, biologists studying communication in animals assumed that animals were incapable of language. The prevailing thought has been that humans are the only species with the self-awareness and cognitive ability to develop an open-ended linguistic system. However, increasing evidence shows that many species are indeed capable of language, but we just haven't yet figured out how to decode animal languages. Let's first look at the difference between communication and language.

LINGUISTIC TIDBITS BOX: INTEREST IN ANIMAL COMMUNICATION IS NOTHING NEW

Interest in animal communication has always been extensive, but research into animal language has been stymied by scientists' assumptions that animals lacked the capacity for language.

For example, a Web of Science search in 2016 of scientific papers that dealt with animal communication going back to 1874 revealed a total of 258,864 papers addressing communication versus just 83 papers on animal language.

The term animal communication, as used in the scientific literature, makes the assumption that through natural selection, animals are hardwired to make specific responses to certain signals just as we are hardwired to kick when a certain spot in our knee is tapped. In this view, there is no flexibility on an animal's part and also no intention to send any information. It just happens purely through instinct.

Animals cross the line into language when they intentionally send particular signals to other animals, when they create new signals for changing circumstances, and when the signals that they use have a certain structure that is analogous to our concept of grammar.

16.2 Information Conveyed in Animal Communication

In animal communication, signals can be passed from one animal to another along several principal sensory channels:

- **Visual channel**: Signals involving movement of body parts, body posture, and coloration.
- **Auditory channel**: Signals involving the sending and reception of vibratory information, usually in the form of sound.
- **Chemosensory channel**: Signals involving the production and reception of odors, as well as taste.
- **Mechanoreception channel**: Signals involving a sense of touch, where an animal may be nudging, stroking, or touching another one to send a signal.
- **Electromagnetic channel**: Signals involving the sending and detection of electrical pulses. The magnetic field around an animal can also be used for signaling purposes.

The functions of these varied signals include:

- **Alarm**: Alerting animals to the presence of danger. Alarm signals are most common within a species, but also could be used between different species which have learned to associate a particular call with danger.
- **Food signals**: Letting other animals know about the location of food.
- **Mating signals**: Conveying to other animals of the same species the readiness to mate.
- **Aggressive signals**: Letting other animals know that a particular animal is feeling aggressive and might be ready to fight.

Many of the signals in animal communication have evolved into complex behavior patterns. These patterns are essentially a series of stimulus-response movements where Animal A's signal triggers an automatic response in Animal B, which then produces another signal behavior in A, which then stimulates the next response in B, and so on. This can be a totally hardwired set of behaviors requiring no thought or innovation.

16.3 Decoding Animal Signals

Decoding animal signals is not easy, because unlike humans, animals won't answer questions. You can't go up to an animal with an apple and say, *Excuse me, but do you have a word for this? And if so, what is that word?* Instead, we must figure this out from observations and experiments.

One of the basic experimental approaches is the use of context. This approach entails observing what sort of signals animals make and then looking at the context of those signals. Who else is present? Is it members of the same sex or the same age, or even the same species? Is it another species which might be a dangerous predator? The context is the clue to the meaning of the signal.

16.4 Design Criteria for Animal Language

But learning the meaning of animal signals is not enough to call this communication system a language; much more is required.

In 1960, a linguist by the name of Charles Hockett published a list of 13 design features of human language that would be important to find in animals if we were to argue that animals have language. Some of these design features are found in any system that produces signals. However, seven of the design features are key elements that distinguish language from mere communication. These seven are as follows:

- **Semantics**: Just as each word in a human language has a distinct meaning, the signals that animals produce also have to have distinct meanings.
- **Arbitrary**: An arbitrary symbol has no direct connection to what it represents, like the word *green* doesn't tell you anything about what the color green actually looks like. This is in contrast to an **iconic symbol**, which represents some attribute of the

object that it is describing. When you say *bow-wow* to describe a dog, the *bow-wow* is an iconic symbol for dog, because it represents an attribute of dogs, namely barking.

- **Discrete**: Each symbol must be a discrete unit, just like the words in a sentence are all discrete units.
- **Displacement**: A language has to provide information about events that occur in different locations from the speaker or in different time periods, in other words, displacement in either space or time.
- **Productivity**: A language must be able to make up new words. For example, the word *cell phone* did not exist in the English language until recently.
- **Duality**: A language must have smaller units that can be combined into bigger units. Think of how phonemes can be combined into morphemes, or words into sentences.
- **Cultural transmission**: There must be a strong component of learning in a language. We aren't born knowing the language that we speak.

More recent additions to these criteria include the concepts of syntax, recursion, and grammar.

- **Syntax**: as you read in Chapter 5 Syntax, this refers to the order of words in a sentence. For example, we can say *The man robbed the bank*. That has a specific meaning that reflects what the man did to the bank. We can then change the words around in the sentence and say *The bank robbed the man*. We haven't added any new words, but we have changed the meaning so that now it is something that the bank did to the man.
- **Recursion**: involves putting extra clauses into a sentence. You also read about recursion in Chapter 5 Syntax. For example, we can say a basic sentence, such as *Sam went to the store*. Then we can apply recursion: *Sam, who is George's brother, went to the store*. This recursion can keep adding more clauses, such as: *Sam, who is George's brother and Sally's cousin, went to the store*.
- **Grammar**: is a set of organized rules for how words are assembled into sentences. Look back at Chapter 1 Introducing Linguistics to read more about how grammar is defined in the field of linguistics.

As we uncover more and more knowledge about animals, we are finding some or all of these design features in several animal species.

PAUSE AND REFLECT 16.1

Not all human languages are spoken with words. American Sign Language (ASL) and other sign languages use visual signals in the form of hand gestures and facial expressions. There are other languages that have been described as whistle languages, where people communicate by changing the tones of their whistles. Another set of languages are known as click languages (often expressed by the symbol "!", such as the !Kung language, spoken by approximately 16,000 people in countries in Southern Africa.).

If you cannot communicate with people who speak these languages, how would you go about proving that they use *language*?

And a more basic question is: Would you even assume that they had a language? Hint: Do an Internet search on what linguists thought about American Sign Language until recently.

16.5 Prairie Dog Language

One language that has been decoded is the one used in the alarm calls of prairie dogs. Prairie dogs are burrowing ground squirrels that live in large colonies called towns. When a predator appears, one or more prairie dogs will give an alarm call alerting the other members of the town to the presence of danger. The rest of the animals in the town scramble to take evasive action, running toward the safety of their burrows. Depending on the predator, what the animals do once they reach their burrows is different. If the predator is a coyote or a domestic dog, the prairie dogs will stand at the lip of their burrow and watch the progress of the coyote or the dog through the colony. If the predator is a human (people shoot prairie dogs for sport) or a hawk, the prairie dogs will dive into their burrows and disappear.

This behavior offers a Rosetta Stone for decoding prairie dog language. You read about the Rosetta Stone in Chapter 11 Writing Systems. The stone was found in 1799 by French soldiers in an Egyptian village that was then called Rosetta. The stone had three sets of inscriptions on it, one in ancient Greek, one in the form of written Egyptian called Demotic, and one using hieroglyphics. At the time, nobody could decipher hieroglyphics. However, because people knew how to read ancient Greek, they eventually figured out that the same message was written in all three sets of inscriptions. This set the stage for being able to figure out the meaning of each hieroglyphic symbol, and after that people could read the hieroglyphic messages throughout the ruins of ancient Egypt.

The same sort of process is applied to decoding animal language. If we know the context of a particular signal, we can set up experiments to see if that signal appears consistently within that context. Also, through observations, we can catalog the different contexts in which animals make specific signals, and compile a dictionary of meanings for that animal language.

One technique that is used for the decoding of vocal signals is the playback technique. Once an experimenter determines the context of the vocal signal and the specific response that an animal makes to that signal, then the experimenter can play back a recording of the vocal signal when the context isn't present. If the animals respond in exactly the same way as they do when the context is there, then the experimenter knows that the signal contains semantic meaning about the context.

Let's walk through this in a hypothetical example. Suppose that you are in a house with a lot of people, and suddenly a snake appears. Someone in the house yells, *Run*! and everybody runs out of the house. Now suppose that there is no snake, but our experimenter plays a recording of someone in the house yelling *Run!* If everyone in the house runs out, we know that the word run is somehow associated with making people run out of the house. Many more experiments would need to be conducted to fine-tune the meaning of *run* because it could have meant *snake* in our example. This shows the difficulty of deciphering meanings and documenting a language.

With prairie dogs, we can record on video the approach of the predator and the evasive behavior of the animals. We can also record the alarm calls that the prairie dogs make in response to the predator. Then we can take the alarm calls that we have

recorded and play them back when the predator is not present, and record on video the behavior of the prairie dogs in response to the playback. If the behavior during playback matches the escape behavior when the predator is actually present, we know that there is semantic information about the predator contained in the alarm calls.

We can then set up experiments to tease apart the meaningful information that the prairie dogs are incorporating into their alarm calls. For example, we could see if they differentiate color in their alarm calls. We can have a person walk through the prairie dogs' town wearing a yellow shirt, and then have the same person walk through the town wearing a blue shirt. We can then analyze the structure of the calls to see if there are any differences between the calls for the person wearing the yellow shirt versus the calls for the same person wearing the blue shirt. All of this is done through painstaking analysis of the sound waveforms, measuring how different acoustic frequencies change in the alarm calls for different contexts.

This kind of analysis has shown that prairie dog alarm calls can incorporate the following information:

- The species of predator, such as human, coyote, domestic dog, or hawk.
- The physical description of the predator, such as the size and shape and color of the clothes of the human (as in our example above), or the color and size and shape of a coyote.
- New words in their alarm calls for objects that they have never seen before.
- The ability of prairie dogs to produce words for abstract objects such as a circle or a triangle.
- The ability of prairie dogs to talk about predators that are spatially distant from them.
- The ability of prairie dogs to talk about objects that they have seen in the past, such as a person who once carried a gun but now no longer carries a gun.
- The presence of phonemes which can be combined in various ways to produce different alarm calls.
- The ability of prairie dogs to learn aspects of the calls about different predators.

The experiments with prairie dogs have shown that it is a tonal language, involving small changes in acoustic frequencies to provide the meaning of different words.

EYES ON WORLD LANGUAGES: HUMAN TONAL LANGUAGES

When animals use vocalizations for their language, the signals are often tonal, in that changes in acoustic frequencies within the signal change the meaning of the signal. We can look at it from this standpoint: How the animal pronounces a word changes the meaning of that word.

This tonality is similar to what is found in some human languages that you read about in Chapter 2 Phonetics. Some human languages in the world are also tonal, where a change in tones alters the meaning of a word. Many East Asian languages are tonal, such as Mandarin, Vietnamese, and Thai. Also, a number of sub-Saharan languages in Africa are tonal, as are some in New Guinea and a few in North and South America.

In Mandarin, *ma* and *ma* can be several words, depending on how they are pronounced. The following bullets are two examples.

EYES ON WORLD LANGUAGES: (*cont.*)

- If you say *ma* with a slightly long *a*, it means "mother".
- If you say *ma* in a way that sounds like *maha*, it means "horse".

So if you're speaking Mandarin to somebody's mother, be sure not to call her a horse!

16.6 Honeybee Language

Another language that has been decoded is that of honeybees. When honeybees find a food source they fly back to their hive and do a dance on the vertical combs of the hive.

If the food source is greater than 100 meters (328 feet) from the hive, a bee returning to the hive does a dance indicating the direction and the distance to the food. This dance is known as a figure-8, because the bee moves around in the form of two loops. The straight part of the figure-8 shows the angle to the food source with respect to the position of the sun in the hive, while the duration of time the bee spends waggling its abdomen by running along this straight part indicates the distance to the food source. Shorter waggle times mean that the food source is closer to the hive, while longer waggle times indicate that it is farther from the hive.

The dancing bee also makes a series of piping noises which contain information about the distance to the food source. More frequent piping sounds indicate that the food source is closer, while less frequent piping sounds indicate a greater distance to the food source.

If the food source is less than 100 meters from the hive, the returning forager bee does a round dance, where it goes around and around with no indication of the direction to the food source. The bees in the hive have an excellent sense of smell, and when they are armed with the information that the food source is nearby, they can use their sense of smell to locate the food.

The waggling and piping indicate a major constituent of animal language systems: the same message often can be found along different signal channels. This is a principle called **redundancy**.

For example, humans use spoken words and body language to convey their message. Studies have shown that when spoken words and body signals conflict, listeners pay more attention to the body signals than they do to the spoken words. One study has shown that in face-to-face encounters between people, around 90 percent of messages are understood through body language and only approximately 10 percent of messages are understood through spoken words.

PAUSE AND REFLECT 16.2

Should human body language be considered as a language? Look back at Section 16.4 on design criteria for animal language and see how many of the design features are satisfied by human body language. There is no question that body language is important for conveying information to others. If we don't define it as a language, what should we call it? Or, should we modify the design criteria to include body language?

16.7 Linguistics and the Future of Animal Language Research

For many years linguists, biologists, and philosophers have insisted that humans were the only ones capable of language, and that animals were only capable of communication. As we have seen, this view is now changing. Recently, linguists have started applying linguistic research methods to the syntax of primate calls, and in the foreseeable future we will have a productive merging of linguistic concepts and animal language research.

SUMMARY

In this chapter we have identified the difference between communication and language. With respect to animal communication, we have looked at what information is conveyed and how we can decode this information. We also discussed the design criteria for animal languages and as examples, examined the communication of prairie dogs and honeybees. Studying how animals communicate and how complex (or simple) their communication is continues to be of great interest to researchers in this area.

EXERCISES

16.1 Go out and observe a group of animals of the same species (it might be pigeons, squirrels, or some other animal group) and see if you can identify the information that they are conveying to each other. Notice particularly which communication channels are being used, and the context in which these channels are used.

16.2 What is the difference between animal language and animal communication?

16.3 How does human spoken language and human body language fit the redundancy concept? Closely watch the body language of someone who is speaking to you, and see what kinds of messages you can pick up through the body language of the speaker.

16.4 List and define Hockett's design criteria for language.

16.5 Can body language be considered a genuine language? Why/why not?

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FURTHER READING

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