

A brown dog is lying on a light-colored carpet. In the foreground, a blue puzzle-piece mat is laid out. A person's hands are visible, with one hand pointing at a white button on the mat. The button has a green sun icon and the word "SUN" written on it. Another button with a green hand icon and the word "HAND" is also visible. The dog's head is resting on the carpet, and its body extends towards the top right of the frame. The text "Man's Best Friend Finally Talks Back: Bunny the 'Talking' Dog" is overlaid in large white font on the dog's body.

# Man's Best Friend Finally Talks Back: Bunny the "Talking" Dog

By Maeve Griffin



**Figure 1.** Bunny the “Talking Dog” with her FluentPet soundboard. Used with permission from © FluentPet 2022.

Language is perhaps the most influential cognitive ability to the development of human culture, society, and technology. As humans, we have the ability to produce an infinite number of phrases to communicate an infinite number of thoughts or ideas with one another. As a result, language is the primary way humans can transmit ideas and knowledge to one another. This may be the central ability that separates humans from non-human animals- that is, until now.

Bunny the “talking dog” is a 3 year-old Sheepdog from Washington, and has recently become a social media phenomenon (Figure 1). With over 9 million followers on TikTok and Instagram combined, Bunny has amazed her audience with her ability to communicate with her owner - Alexis Devine - using a set of soundboard buttons that play human words or phrases when pressed. This

technology is an Augmented and Interspecies Communication (AIC) device designed by the company FluentPet, with the intent of bridging the communication gap between pets and their owners (Figure 2). The soundboard consists of various, customizable buttons onto which a word or phrase can be recorded and subsequently activated when pressed. Pets can be taught to press these buttons and associate words with their respective meaning. This can be accomplished through the process of modeling the following sequence: vocalizing the word/phrase, pressing the button, and either engaging in an action or showing the object that corresponds to the word/phrase [1]. Dogs, cats, and even guinea pigs have been successfully trained to use the device.

Thousands of FluentPet users - including Bunny - have agreed to participate in a large-scale research project called “They Can Talk”. This is a collaborative

study between FluentPet and the Comparative Cognition Lab at UC San Diego, spearheaded by Dr. Federico Rossano - Associate Professor of Cognitive Science. As Dr. Rossano specializes in linguistics and communication studies, his research is focused on how pets use FluentPet soundboards to communicate with humans and how patterns in communication change over time and with continuous button use [2].

Although Bunny is not the only pet to use buttons, she is certainly the poster-child. She was first introduced to her soundboard when she was 2 months old, and has relied on it since to communicate with her owner - Alexis Devine - on a daily basis. Like many FluentPet users, Bunny first learned to press the word outside to indicate when she had to use the bathroom. Today, however, her vocabulary has expanded to 102 words, which she is capable of stringing together in up to

four-word phrases. Her language acquisition skills are considered to be similar to those of a human toddler [3].

At a basic level, Bunny uses her soundboard to communicate various wants and needs. She frequently uses her buttons to tell her owner when she wants to play, go for a walk, or get attention from her parents. Interestingly, Devine has avoided adding food related words to her board so that Bunny's motivation to use her soundboard isn't food related. Nevertheless, Bunny once creatively used the words bird-go-belly to ask Devine for her dinner.

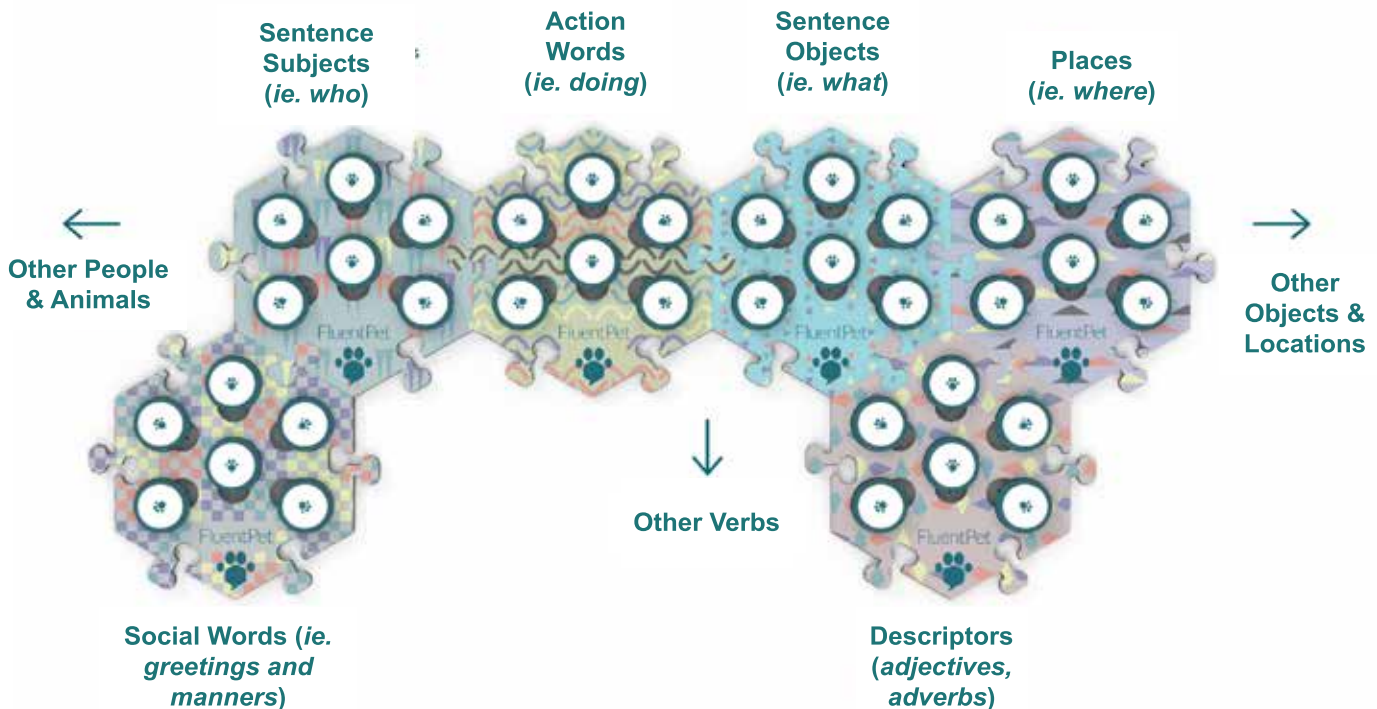
Bunny has also learned the word ouch, which she has used on multiple occasions to communicate when she's in pain. In one instance, she strung together the words mad-ouch-stranger-paw. After some investigation, her owner discovered that there was a painful foxtail lodged into her front paw. This anecdote reflects perhaps the most salient application of this technology: it allows pets to com-

municate when and where they experience pain. In Bunny's case, her source of pain was external and easily removable. However, for pets experiencing pain from internal sources (ear, stomach, etc.), it can be more difficult for human owners or vets to determine the exact location from which it stems. Therefore, this technology could promote animal welfare by providing pets a means of self-advocacy when they are in pain or distress.

As Bunny has continued to use the buttons, she's been capable of expressing a variety of abstract thoughts. For instance, she has communicated about her dreams on multiple occasions - describing them as dream-is-night-talk. Researchers in the field of canine cognition have known for a long time that dogs are capable of dreaming. During states of rest, dogs exhibit similar brain wave patterns and sleep stages as humans, including REM ('rapid-eye-movement') in which dreaming occurs [4]. If you've ever seen a dog twitch while they

were sleeping, they were likely in this stage of sleep. Although scientists know that dogs experience dreams, it has yet to be a reality in which they can ask dogs what they dream about—until Bunny, of course. Devine regularly asks Bunny about the contents of her dreams. Her responses have ranged from dad-tug-play to stranger-animal to night-water-ouch, all of which she could've conceivably dreamt about.

Bunny has also produced phrases indicative of self-recognition. For a few years, a mirror has sat on Devine's living-room floor adjacent to Bunny's favorite soundboard at eye-level. Since then, Bunny has referenced the mirror on multiple occasions. Early on, she appeared to struggle in recognizing herself. She once spontaneously pressed who-this after looking in the mirror. However, with regular exposure to the mirror, Bunny has seemingly grasped the idea that the mirror is a reflection of herself. When asked "Who is this?" by Devine,



**Figure 2:** Organization of buttons on the FluentPet soundboard. Used with permission from © FluentPet 2022.

Bunny responded with dog-Bunny two times in a row. This pattern of responses is not surprising.

Scientific evidence suggests that domestic dogs fail to spontaneously recognize themselves in the mirror. They may initially approach their reflection with nervousness or tension, viewing it as another dog rather than themselves. However, with repeated exposure to a mirror, dogs become habituated. Habituation is an associative process universal to animal species and occurs when repeated exposure to a non-harmful stimulus decreases an animal's responsiveness to that stimulus. For most dogs, this effect would manifest as decreased fear or curiosity towards a mirror. However, in Bunny's case, Devine has been able to directly explain that the reflection is herself. Therefore, Bunny's self-recognition is more likely to be a learned phenomenon, rather than a spontaneous identification [5].

Although Bunny has demonstrated some level of abstract thinking, she has also demonstrated obvious limitations in her cognitive abilities. For example, Bunny has repeatedly struggled to use the words human and dog to correctly categorize herself and others. She has regularly gone back and forth between the phrases I dog, Mom dog, I human, and Mom human. This pattern has persisted for multiple years, despite Devine's corrections of Bunny's misuse. Although I am speculating, it's possible that Bunny struggles to classify her mom and herself as different through these species-specific terms. Devine has attempted to ease Bunny's confusion by adding the words animal and family to the board - both of which can be simultaneously applied to Bunny and Devine. Interestingly enough, Bunny has no problem using these two buttons in the correct fashion. She has identified



From "Fluent Pet Starter Guide". Used with permission from © FluentPet 2022.

herself, her mom, her dog brother Otter, and her dog friend Selena as animals. She has used the term family to refer to her mom, her dad, and Otter on multiple occasions. So why does she specifically struggle with the species specific terms dog and human?

At first glance, it may appear as though Bunny is incapable of distinguishing between conspecifics and heterospecifics. A body of literature, however, suggests this is not the case - as dogs have no problem differentiating between conspecifics and other species. It's been shown that specific regions of the canine brain are more greatly active during conspecific vocalizations relative to humans or non-vocalization sounds [6]. This effect is not unique to audition, as another group of dogs discriminated between conspecifics relative to other domestic animals relying solely on visual stimuli [7].

Therefore, Bunny's misapplication of the words dog and

human likely doesn't reflect her inability to distinguish between dogs and other species. Rather, it may be that she struggles to conceptualize species differences through species-specific categorization terms.

It's worth noting that when it comes to these abstract concepts, modeling becomes much more difficult and potentially easier to obscure. When Bunny is talking about dreams, how do we know that her perception of that word's meaning accurately references what dreams are? How do we know when she says dream-is-night-talk, she isn't simply talking about hearing a voice in the middle of the night? This may also explain Bunny's inconsistency in using species-specific terms.

Nonetheless, Bunny has exhibited phenomenal use of her soundboard, exceeding many people's wildest dreams of what human-animal communication could be in the 21st century.

## Skepticism...

Despite the hundreds of videos online of Bunny using the soundboard, many people remain skeptical about the validity of her communication. I, too, often find myself disagreeing with Devine's interpretation of Bunny's button-pressing. Additionally, we - the audience - don't entirely know what goes on behind the scenes of Devine's videos. It is very possible that she is carefully picking and choosing what videos to post, and may only be posting instances in which Bunny's communication is seemingly significant. It is also possible that Devine has a stronger influence over Bunny's patterns of communication than it might appear.

In the field of animal cognition, researchers must be especially cautious of inducing a "Clever Hans effect" on behavior. Hans was a horse from Berlin that gained fame in the early 1900s

(Figure 3). His owner claimed he was capable of performing basic math equations. For example, if his owner asked "what's 3+3," Hans would stomp his foot six times. This stunned many people at the time and although it seemed as though Hans was capable of arithmetic, it was later revealed that this was not the case. Rather, he was observing subtle, unintentional cues from his owner and the audience. As Hans would approach the correct number of taps, the audience would tense up their bodies and facial expressions. This tension would be released when Hans made the final, correct tap [8]. This anecdote has inspired the term "Clever-Hans effect", used to describe instances in which unintentional cues by experimenters result in a desired behavior.

Since this phenomenon was first discovered, researchers in the field of animal cognition have made a collective effort to employ methods that remove human presence and influence. Of course, in Bunny's case, human presence and

influence is at the forefront of her button use- as spontaneous use of her buttons typically is a means to communicate with her owners. Therefore, we must be cautious in interpreting Bunny's communication and consider how Devine's presence influences button-use.

## What Neuroscience Can Teach Us

In order to definitively prove that dogs and other domesticated animals have the capacity to mimic human language, a neural basis of this ability must be demonstrated within the canine brain. Unfortunately, research directly regarding FluentPet's soundboard is still under way. Specifically, Dr. Rossano and his team are analyzing video footage of participants using their soundboards to investigate how communication is influenced by (a) memory aspects and (b) linguistic aspects (e.g. how words are combined, how quickly new words are learned, what topics they tend to communicate about, etc.) [2]. As these are behavioral and psychological aspects of AIC use, it may be multiple years before anyone experimentally probes the neural correlates of soundboard use.

Therefore, for this evaluation, we have to rely on existing neuroscientific evidence - most of which is focused on how the canine brain processes/comprehends (rather than produces) human speech. Although they may seem to be completely distinct from one another, language comprehension and production are extremely intertwined within the human brain. Neuroscientific evidence indicates that these two cognitive processes recruit overlapping neural regions and pathways [9]. From a psychological perspective, processing



**Figure 3:** "Clever" Hans and his audience in Leipzig, Germany in 1904. Image by Karl Krall licensed under CC0 via Wikimedia..

and comprehension serve as precursors to language production: one must first understand the meaning of a word before they can correctly produce speech.

Dogs and humans share quite a few striking similarities when it comes to speech processing, despite prominent differences in brain structure. One study identified three similarities of language processing between the dog and human brain [10]. This study measured activity in the dog brain to identify regions responsible for processing the meaning of words and tone of voice. They compared their results to those previously found in humans to identify analogous processes between species.

First, they found that both dogs and humans process tone of voice (intonation) in "lower-order" areas of the auditory cortex. These areas of the brain process sound based on their basic, acoustic properties - such as pitch, frequency, and timbre. In both species, these regions do not exclusively process speech. Rather, they process acoustical cues from both speech and nonspeech vocalizations for properties salient to emotional intonation. "Lower-order" sensory information is sent to "higher-order" regions of the brain for processing in a more complex fashion. High-order regions compile information from a variety of brain regions (those involved in sensory processing, memory, motor output, etc.) to more meaningfully process and respond to sensory stimuli. Researchers found that both dogs and humans process the meaning of words in these higher-order regions, with a hemispheric bias: that is, processing is restricted to one side of the brain. In humans, this processing occurs on the left side of the brain, while in dogs, processing occurs on the right side of the brain. Finally, they found that both dogs and humans consider both meaning and intonation to assess the reward value

of the word- shown by activity in brain regions associated with reward and dopamine release.

Another study published by this lab group identified analogous regions between dogs and humans for the processing of conspecific vocalizations. I previously mentioned that such a region exists within dogs. However, in both dogs and humans, conspecific voice areas are located in the anterior temporal regions. Although these regions may be more specialized in humans, this finding provides evidence that these voice areas may have a common ancient evolutionary origin [6].

Despite the many similarities, there are still numerous aspects of language processing that differ between dogs and humans. One difference was identified by a study that aimed to determine mechanisms of discrimination between words and non-words in the canine brain. Prior to experimentation, dogs were trained to retrieve two objects based on their names. During the experiment, researchers recorded brain activity of dogs when played (a) one of the two trained words or (b) an unfamiliar "pseudoword" - a string of letters that is pronounceable but has no meaning. They compared brain activity patterns between these two conditions to see how the canine brain discriminates between familiar and unfamiliar words. Results showed that one region of the brain - the parietotemporal cortex- activated more strongly in response to pseudowords relative to trained words. This provides evidence that novelty detection plays a role in dogs' processing of human speech. Authors suggest that novelty processing may promote association learning between a novel word and novel object. Alternatively, in the human brain, this region typically activates preferentially in response to real words relative to pseudowords. The authors of this study suggest

that novelty detection may be central to speech processing in dogs, as to facilitate learning of new associations [11]. This may be less important to humans, who readily learn words and generalize their meanings across contexts.

When collectively considering these findings, it's clear that dogs have - at least - some neural capacity to understand human language. Although many aspects of speech processing are analogous between humans and dogs, this process is not entirely identical between species. Therefore, it's not completely far-fetched that dogs can produce language in a less complex fashion than humans (e.g. through an AIC device).

## **Why are there these analogous regions?**

All of these findings beg the question: why would the dog brain have evolved in such a way that it can, even in part, process human language? The most obvious answer would be that it resulted from evolutionary forces present during domestication. In many ways, dogs have evolved to be especially sensitive to human signals of emotion and communication - resulting from artificial selection of "desirable" traits by humans. It's possible that these selective forces may have also promoted skills in interspecies communication and even produced changes in dogs' neural structures. Some of these abilities may have capitalized on pre-existing structures with evolutionary origins in the dog brain sensitive to vocalization. This may explain the lateralized processing of meaningful speech in the canine brain - as this unlikely rapidly



**Figure 4.** Alexis Devine and her dog, Otter, working with the FluentPet soundboard. Used with permission from © FluentPet 2022.

evolved during domestication [12].

## Barriers to Speech Production

The most obvious pre-existing barrier to nonhuman species producing human speech lies in anatomy. Humans have a highly developed throat, jaw, and vocal system - evolved to promote social signaling. This species-specific structure is known as the supralaryngeal vocal tract, which allows for specialized modulation of air flow to create a diverse array of unique sounds. This structure is unique to humans, and isn't even shared with closely related non-human primates [13]. As a result, no non-human animal is physically capable of producing the complex set of vocalizations implemented in human language. This provides a physical barrier to communication with nonhuman species.

This does not mean, however, that nonhuman animals are incapable of producing human language on a cognitive level.

## Ethical Considerations

FluentPet's soundboard provides an obvious advancement in animal welfare. It offers nonhuman animals - those anatomically incapable of physically producing human speech - a means of communication with humans. It also allows for non-humans to execute self-advocacy in a way unseen before. Many pets use their soundboards to communicate their wants and, more importantly, needs. In turn, owners are able to take better care of their pets and optimize their wellbeing. It's undeniable that Bunny and her language acquisition skills are remarkable, and likely very rare to see in dogs. Yet, if even some dogs have linguistic capacities sim-

ilar to Bunny's, isn't it their right to be able to communicate what they are feeling and thinking?

Beyond mere self-advocacy, there is some aspect of species-wide advocacy in nonhuman use of these devices. It's very easy for humans to assume that our species is one of a kind and superior to all other species in the realm of intelligence. However, nonhuman use of these buttons proves how intelligent other species truly are - showing how important it is not to underestimate the intelligence of non-human animals.

Finally, training pets to use these buttons represents a unique form of cognitive enrichment. It challenges them to express themselves, think about what and how they want to communicate, and utilize the board in creative ways. As pets and their owners work together during the learning process, their relationship is strengthened. Pets can place trust in their owners to understand them and respond to their communication with love and patience. Dogs and

humans have always had an unquestionably strong bond – which can only be bolstered by this technology.

## Conclusions

At this point in time, we cannot conclude with complete certainty that Bunny or other pets are capable of producing meaningful communication using AIC

devices. It appears that, at least in part, the dog brain processes speech similarly to the human brain. Indeed, there are striking anatomical differences that prevent this from occurring naturally. Future studies should aim to resolve this question by probing the neural correlates of speech production in dogs via soundboard use. Nonetheless, this technology has the potential to promote animal welfare by allowing pets to

communicate their thoughts and feelings.

As Bunny is only three-years-old, I am extremely excited to see how her communication skills grow over the course of her lifetime. Whether or not her communication patterns stay the same, she has demonstrated exceptional linguistic skills and has changed the way humans view canine cognition forever.

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