

# Do animals possess language?

## An investigation of the communication systems of primates and dolphins.

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**Aantal woorden:** 10.638  
**Datum:** 12-07-2021

Scriptie ter verkrijging van de graad “Master of arts” in de filosofie  
Radboud Universiteit Nijmegen

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## **Abstract**

In this thesis, the research question is whether animals such as primates and delphinids have a language when communicating. My answer to this question will be that when you teach these animals a version of human language, the results will indicate that the animals do not fully understand every aspect of it. However, if you analyze the communication system of delphinids instead, it shows that this system does satisfy the most important features of a language, while the communication system of primates does not. In order to answer the research question I will first elaborate on communication in general. Secondly, I will discuss the difference between communication and language. Thirdly, research on primate communication will be analyzed. Fourthly, I will discuss research on dolphin communication. And finally, I will compare all findings and elaborate on my answer to the research question.

## 1 Introduction

All animals communicate in some way or another. Some communicate via vocalizations, others via visual signs and some communication systems are based on smell. Communication can be very important to convey information about the environment, such as potential danger or prey. Communication may also be used to indicate territories. Besides an informative function, communication also has a social function. There are many reports about animals socially bonding when they communicate. A social species who live in packs will communicate more than species who live individually. Every species has their own specific communication system that suits their interaction and in some species, such as dolphins, even dialects exist. Sometimes, different species can communicate with each other. This happens in several monkey species, where the species react to the alarm calls of other species, without being able to produce the sounds themselves. Another example of communication between different species is between man and dog. Dogs can be trained exceptionally well to recognize different commands. Even though dogs are conditioned through a reward system and they might not be able to understand or produce the sounds themselves, communication does take place.

Most of the animal communication is multimodal. This entails that the communication system consists of different ways to communicate, such as vocalizations, gestures, body language and facial expressions. One of the modes might be used more excessively than others, but all the other components still matter for communication. In humans, the most important part of communication are vocalizations. Human vocalizations are called language which is a communication system that has semantics and syntax. Semantics are about meaning and syntax governs the internal structure of the system. For a long time, language was thought to be uniquely human. However, research on animal communication has shown that some communication systems do possess aspects of semantics and syntax. Even though these communication systems might not be as developed as human language, the comparison with language can still give insight into our own and animal communication systems.

In this thesis, it is examined whether animal communication systems can also be called a language. In order to answer this question, I will first elaborate on communication. Here, the different theories on communication and its function will be introduced. Then, the properties of language will be discussed. I will go into more depth about semantics and syntax in this part. Next, I will move to the research on animal communication systems and discuss non-human primate communication. Here, research where sign language was taught to the apes will be discussed, as well as research that investigates primate communication in the wild. Then, dolphin communication will be analyzed. Here, I will discuss several researches on dolphin communication and compare them to human language. Finally, I will conclude the discussion by stating that dolphin communication possesses the most important features of human language while non-human primate communication does not.

## 2 Communication

Traditionally, communication refers to the act of conveying information. Every form of communication requires at least one sender, a message and a receiver. There is a certain state of the world, expressed by the sender and interpreted by the receiver. The linear model of communication states that the sender encodes the message in a combination of utterances and non-verbal communication while the receiver decodes the message. The message is channeled through a certain medium, such as language. Communication is successful when the receiver understands the message that the sender conveyed. When I am speaking English to an individual who does not comprehend the English language, no successful communication is taking place. However, the receiver always needs to decode the message the sender conveyed. If there is one sender and two receivers it is possible that the receivers interpret the message slightly differently. Similarly, it is equally possible that the receiver interprets a message differently from how the sender intended it.

The interactional model of communication contains all the concepts of the linear model but also introduces feedback. Feedback can be regarded as a response from the receiver to the sender about the content of the message. Schramm (1954) was one of the first theorists to model communication as being interactional. Instead of a one-way interaction, such as in the linear model with a fixed sender and receiver, communication in the interactional model becomes a two-way interaction. This means that the roles of the encoder and decoder, or sender and receiver, become interchangeable in the interactional model. In most conversations, the receiver is not only listening to the message from the sender but also thinking about what to reply. So while decoding the message, the process of encoding a new message has already begun. Because the receiver can give feedback to the sender about the content of the message, the unclarity of the message also decreases. This allows for more successful communication and less misinterpretation, according to Schramm (1954). Imagine, for instance, that someone is talking about a president of the United States. You might, falsely, believe he referred to Donald Trump, but after asking the sender for clarification, it turns out he was actually discussing Joe Biden. Without the concept of feedback or clarification, someone might listen to the story while making the wrong references and thus not completely understanding the original intention of the message. With feedback, this unclarity gets eliminated which results in more fruitful interaction.

Human communication has two important aspects, a mentalistic and a coordinative one. Human communication is often described as the sharing of psychological intentions. The sender has a mental representation of the world which he communicates to the receiver. If the message is conveyed successfully, this results in the receiver understanding the representation that the sender has. Similarly, through communication, humans are also able to align their intentions to work towards the same goal. Grice (1957) is one of the early language theorists to include intentions in his analysis of language. First, Grice makes a distinction between what he calls sentence and speaker meaning. Some utterances will always mean the same thing, regardless of who says it, such as the sentence: "Those clouds mean rain". This semantic meaning of a sentence can be contrasted by the pragmatic meaning or speaker meaning. Semantics is about words and what they mean, while pragmatics is about speakers and what they do with language (McGinn, 2015).

Speaker meaning refers to a speaker who means something specific by that utterance, but which does not necessarily have to be true. For instance, when I say that: “with ‘Gouda’, my brother meant cheese”, I am referring to a certain utterance that my brother made, regarding Gouda as cheese. He could have also referred to the city Gouda, where the cheese has its origin, but on this occasion he meant something else by it. Thus, the first condition of speaker meaning is that there is a person or an agent involved in making the utterance. An agent has an intention to mean something by an utterance, while the clouds do not have a similar intention when they mean rain. The second condition of speaker meaning is that the utterance might mean something else. I might use my pragmatic meaning to make a certain point, but that does not entail that my meaning is the only possible one. Another person might mean something entirely different while uttering the exact same sentence. According to Grice (1957), the sentence meaning of the utterance is derivable from the meaning of the speaker and words get their semantic meaning because speakers intentionally use them to refer to their beliefs. This entails that the sentence meaning is ultimately psychological, a sentence means something because the speaker wanted to convey a specific message with that sentence (McGinn, 2015). According to Grice (1957), a speaker means something by an utterance if he intends to produce a certain psychological effect. When I assert that ‘Q’ and I intend you to believe ‘Q’ too, I will do so by stating it. Grice continues that the intention of the speaker has to be recognized by the audience in order for there to be successful communication. If the intention is not clear, wrong beliefs might be induced from the utterance. Therefore, clarity about the content of the intention from the speaker is necessary for the meaning of the sentence and ultimately, successful interaction.

The second aspect of human communication is the coordination of actions. Through communication humans are able to make plans and commitments. Note that coordination is not the same as cooperation, if I am driving my car in traffic, I am not cooperating with the other drivers towards some joint goal, but our actions are coordinated. There are traffic rules that we follow so we do not crash into one another, such as driving on one side of the road, but I do not need to explicitly collaborate with the other drivers. Geurts (2019) claims that the most important aspect of communication actually is the negotiating of commitments and the coordination of actions. He states that most of our communicative acts serve to plan ahead. In order to make plans for the future, it is necessary that we engage in commitments with other individuals. Without these commitments, the plans would also fail. Making commitments is a form of expectation management, it gives others a license that I can be relied on, so that they can coordinate their actions with me, according to Geurts. If someone does not honour commitments that he has made, others will be reluctant to engage in new commitments with that individual in the future. Geurts adds to this that the mentalistic and coordinative approach to communication are not mutually exclusive and an ideal theory of communication should combine both aspects into one coherent theory.

Communication is a multimodal system and many different forms of communication can be distinguished. The most common form in human interaction is verbal communication. Verbal communication includes spoken words and utterances. Verbal communication between two individuals is called face-to-face interaction, while media such as the television and radio counts as broadcasting. Non-verbal communication is often used in combination with verbal communication. Body-language, gestures, appearances and our scent count as forms of non-verbal communication. Non-verbal communication is a lot less explicit than verbal communication. It is often the case that we are not even aware that we are communicating non-

verbally, most of it happens automatically. A third form of communication that can be distinguished in human interaction is written communication. Written communication includes every message that has to be read by the receiver, from letters to books to the internet. For a long time, written communication was only accessible for the elites, the people who were able to read. Nowadays, most people have this skill and access to written information. Especially with the emergence of the internet, a medium that allows everyone to write information online, written communication became much more common in a very short period of time.

In summary, communication can be described as a system which has three elements, a sender, a message and a receiver. The roles of sender and receiver are not fixed and can be exchanged. Communication has two distinct functions, a mentalistic informative one, and a normative one. Mentalistically, communication serves to infer mental states in others. Normatively, communication makes cooperation possible. Most communication is multimodal and uses different forms of communication, therefore, it is important to note that the whole system cannot be defined as merely one of the modalities.

### **3 Language**

In the previous section, different theories on communication have been introduced. In this section, I will elaborate on a special means of communication, namely, human language. First, I will discuss different theories on what language is. Elements of language such as semantics and syntax will be introduced here. Then, I will debate how language has evolved from animal communication. In this section, certain evolutionary development and precursors to language will be discussed. And finally, the acquisition of language and its use will be debated. The cultural transmission of language will be discussed here, as well as voluntary control of utterances.

Humans communicate with each other with the use of language. Language is a tool of communication, a means that allows you to convey a message. While communication is static, language changes dynamically as new words can be added to it. With the use of language, we are able to communicate in a variety of ways. Language is also more specific than communication, most animals are able to communicate vocally or with gestures, but that does not entail that they are also using language. Every language consists of words that have semantic meaning, which can be put into a sentence with a syntactical structure. Without these semantics or syntax, the communication system does not suffice as a language. Semantics or reference exists when the particular sound is distinct from other sounds, is produced in response to an external stimulus and elicits a response in the receiver as if he would experience the stimulus himself. Syntax or grammar refers to the set of rules which govern the composition of words in a sentence. Grammar also allows for a different composition of the same words, causing the sentence to carry a different meaning. For instance, the sentence: 'Alex watched Lisa', is not the same as the sentence: 'Lisa watched Alex'. By putting words in a certain order in a sentence, it is possible to change the meaning of the sentence.

It has long been debated whether animals also possess their own language, albeit completely different from human language. In order to answer this question, it first needs to be defined what

constitutes a language. Many linguists, philosophers and psychologists have tried to define what language is. Some view language as a special means of interaction, unique to humans. Others claim that language has evolved slowly from animal communication to what we now call language. Because the first group of theorists already eliminates animals from having a language beforehand, I will evidently be focusing on the second group of theorists. These theorists divide language up into different essential features, some of these features might also exist in communication systems of animals. If an animal communication system consists of all of these features, it suffices to be called a language.

The first aspect of language that will be discussed is semantics. Semantics are about the meaning and references in language. Human language consists of symbols which represent real things in the world. Without the use of reference, we would not be able to refer to something which is not immediately present. Many theorists have discussed the properties of semantics, one of these is Hockett (1959). Hockett describes the relation between the symbol and its reference as arbitrary. This means there is a random relation between the two that needs to be learned and is not predictable. Hockett continues that semantics also allows for displacement of certain items, allowing us to refer to things we cannot directly observe.

Gärdenfors (2013), describes something similar to Hockett's notion of arbitrariness. According to Gärdenfors, language should have the ability to represent something in the real world. The symbols used in language correspond to a specific item or action. This representation is to be seen as a convention, because the relation between symbol and action is random and needs to be learned. In addition, Gärdenfors states that language allows for a detached representation because it uses symbols. Most animal communication systems only make use of signs, which are indicators of direct stimuli in the surroundings. This means that signs can only be used to refer to something which is in close proximity. Symbols, however, do allow representation of something which cannot be directly observed because of the detached relation between symbol and reference. Symbolic representation replaces the use of environmental cues in communication. This means that humans are able to refer to: "Johan who was here yesterday", while non-human primates can only refer to this tree, or that conspecific, which can be immediately observed.

The second element of language is syntax. Syntax is the same as grammatical rules in a language. It governs the places of words in a sentence and how words should be spelled. Compositionality is another aspect of syntax and relates to the ability to make a great amount of words with a fixed number of letters. Hockett describes the compositionality of human language as the duality of patterning. He states that the letters in human language are meaningless in themselves but become meaningful when words and sentences are created. According to Gärdenfors, the semantic meaning of an utterance derives its meaning from the composition of the meaning of the individual parts. In addition, Gärdenfors states that without the syntactic rules and positions human language would become a mishmash of words in a random order. The grammar and high compositionality allows us to nuance our messages to a certain degree.

It is very plausible that language evolved slowly instead of appearing overnight. Several theorists have argued in favor of the evolution of language, one of these is Hurford (2003). According to Hurford, several pre-adaptations were necessary for language to emerge. These pre-adaptations are not adaptive in themselves but allow for other adaptations to arise. The pre-adaptations probably already existed in our ancestors which gave us a certain readiness for language use.



These pre-adaptations might not fully explain how language has emerged, but they do give us insight into what must have happened at the basis of language evolution. Hurford then goes on to say that if a certain capacity is found in a species distantly related to humans, we can conclude it is an ancient, primitive capacity. However, if a capacity is only found in apes, our closest relative, then the capacity will have emerged fairly recently.

Hurford (2003) states that one of the pre-adaptations was the pre-semantic one. This pre-adaptation allowed our ancestors to form basic concepts and from them more complex ones. The ability to mentally represent something is necessary in order to have reference in language, without it, semantics would not be possible. The second pre-adaptation for language is the pre-syntactic one. The pre-syntactic ability relates to the capacity to organize longer sequences of sounds or gestures. According to Hurford, the most important aspect of syntax is the stringing together of independent subunits into a larger signal. Primate research has indicated that non-human primates are able to combine different gestures into a new signal that has a distinct meaning. This entails that this pre-syntactic capacity already existed in our ancestors.

According to Gärdenfors, language slowly evolved from animal communication via signs to human symbolic language. Most animal communication systems consist only of the ability to map the signs directly with individual experience, while human language allows for detached representations. The transition from a signaling system to a symbolic language was not made in one step. In this transition, there was a stage where a protolanguage, which only contained the semantic components of language, was used. A protolanguage incorporates some features of language, like semantics, but also excludes others, such as syntax. Once syntax had been implemented into the system of protolanguage, it would suffice to be called a language. According to Gärdenfors, human language is also the only communication system in existence that has a complete semantics and syntax.

Now, we move to how language is acquired and how it is used. As opposed to most animal communication systems, language needs to be learned and is not innately present. According to Hockett, language is acquired through cultural transmission. This entails that culture plays a bigger role in the acquisition of language than biology does. In addition, Hockett states that language is productive. We can understand novel utterances by breaking them down into smaller parts. This means we can derive meaning from utterances we have never heard before. Without this productive character, it would take a lot more time for someone to fully acquire language. According to Hurford, there was a pre-adaptive elementary symbolic capacity to link sounds or gestures with basic concepts, such that the perception of the action activates the concept. In wild animals, there is no evidence which suggests that animals need to learn the relation between sign and reference. However, animals in captivity do show understanding of these relations when it is taught to them.

Language use requires a certain voluntary control of behaviour, while most animal communication is a direct consequence of a reaction to a certain stimulus. Voluntary control is a matter of degree. Hurford claims that probably all vertebrates have at least some kind of voluntary control over their actions. Humans are unique in the sense that they can acquire automatic control of speaking and understanding language, in the space of a few years. Language is therefore not automatic or innate, according to Hurford, but rather needs to be learned and mastered. The more plastic a species is, the more complex its traditions become. Plasticity

combined with voluntary control, leads to even more complexity and unpredictable behaviour. According to Hurford much of the difference between humans and other species is due to increased plasticity and voluntary control of the pre-adaptive capacities. Similarly, Gärdenfors states that the communicative signs should be used willingly, otherwise the signs would be used at random and there would be no communicative function.

Hockett, Gärdenfors and Hurford agree that language is not composed of merely one aspect, but rather is the combination of many different features. Language is usually defined as a communication system which has semantics and syntax. Some of the discussed language features overlap as both Hockett and Gärdenfors state that the relation between symbol and reference is arbitrary and needs to be learned. They also both describe the internal structure of human language as well as the high compositionality as unique to human interaction. When looking at language evolution, Hurford and Gärdenfors both argue that language evolved slowly from animal communication to human language. While Hurford claims that several pre-adaptations were necessary to create a readiness for language use, Gärdenfors states that language evolved from communication with signals to a symbolic language. In the acquisition of language, Hockett states that culture plays a bigger role than biology. And when it comes to language use, Hurford's description of voluntary control of communicative actions is comparable to Gärdenfors' notion of volition.

It is very plausible that there probably existed some sort of precursor to our language in our ancestors where some of the language features already existed. This means that some of the features of human language might be found in animal's communication systems and some might not. Just like human language might consist of certain features that are not present in every animal's communication system, there might be aspects of animal communication that humans lack. For instance, there might be aspects in bee dancing and the exchange of pheromones in ants which are not present in human communication. Humans communicate mostly with vocalizations while non-human primates use gestures to communicate. Humans and primates have the same ancestor, and it is plausible that they already had an aptitude for language use. As humans evolved, our hearing improved and our use of language with it, while in primate evolution, gestures may have become more important, as their vision improved. It is therefore important when investigating an animal's communication system to look at how the animals communicate effectively instead of projecting the human way of communicating onto them.

## 4 Non-human primate communication

In the previous part, the specific human way of communication, namely language, has been introduced. Now, I will move to non-human primate communication to investigate whether this communication system could also be called a language. First, I will explain the notion of anthropomorphism, which is the fallacy of projecting human characteristics onto animals. In this section, research is discussed that was too focused on human capabilities. Then, I will describe several researches where they taught sign language to non-human primates. This is where non-human primate communication is compared to young human children using language and the primates' understanding of signs is debated. Next, I will discuss whether non-human primates use semantics and syntax when communicating. Here, I will go into depth about the gestures and vocalizations the primates use when communicating. Vocal plasticity and learning will also be discussed here. And finally, it will be discussed whether it suffices to call non-human primate communication a language.

Most of the early research on animal's communication and cognition has been focused on non-human primates. Primates are an obvious choice for this research as they are the closest relatives of humans. Even though primates may be genetically akin to humans, there are also some big differences in how their bodies evolved and their communication with it. For instance, human vocal cords are developed a lot further than non-human primate vocal cords, which results in primates relying more on gestures than vocalizations when communicating (Gardner & Gardner, 1975). Because primates are so closely related to humans, the research is also susceptible to anthropomorphism. Anthropomorphism happens where you project human characteristics onto other animals and test whether they also possess it. This can interfere with the research as the human way is not always the best and only explanation for the existence of a phenomenon. When investigating an animal, one should always try to place oneself in the animal's shoes as much as possible.

An example of when anthropomorphism clouded animal research was with the self-recognition test. For a long time, the consensus in animal research was that if a certain species was able to recognize their own reflection in mirrors, it would be able to distinguish between himself and other entities and therefore be conscious, which indicates high levels of cognition in the animal (Gallup et al. 2002). After a while, we discovered that unlike humans, a lot of animals do not have vision as their primary sense. Instead, they rely more on other senses such as smell and hearing. Dogs, for instance, have an extremely strong sense of smell, but very bad eyesight. Because they failed the mirror test, it was concluded that dogs are not conscious and are therefore less cognitively developed than other animals who do recognize themselves in mirrors. However, new research now shows that dogs do recognize themselves on the basis of smell instead of vision (Horowitz, 2017). The mirror test alone, is therefore not conclusive in order to prove whether an animal has consciousness. Anthropomorphism, on the other hand, can also give us insight into how the animal perceives the world. Because we can never fully understand the reality of animals, sometimes, human characteristics can prove to be useful in order to gain a better understanding of it. Even though it can be useful to project human characteristics onto animals to compare and unravel similarities and differences between humans and animals, we should be wary to regard animals as less developed too quickly when they do not match human characteristics, as evolution might have come up with a different solution to the same problem.

Early primate research has shown that even though non-human primates do use vocalizations in their communication, their most useful interaction is grounded in gestures. Research that tried to teach primates spoken words of human language failed, mainly because the larynx of primates has evolved differently from ours. Thus, non-human primates are not well equipped for a lot of nuance in their vocal communication. However, they are well equipped for making nuances in their gestural communication. Gardner & Gardner (1975) were one of the first researchers who tried to teach sign language to non-human primates. The chimpanzee Washoe was the first animal who was taught American Sign Language (Ameslan). Over the period of 51 training sessions, Washoe learned to produce 132 distinct gestures and could recognize an even larger number of gestures.

Gardner & Gardner compared Washoe's sign language acquisition to that of young children learning language. Similar to how human children learn, a lot of Washoe's signs were learned spontaneously through interaction. She learned how to use the signs in different situations instead of the sign only having one distinct definition. An example of this is the sign OPEN. This sign was taught to Washoe in order to open specific doors. After a while, Washoe learned that the sign OPEN was also applicable to other doors, jars and even used the sign to ask the researchers to turn on water faucets. Another reason Washoe was able to learn the signs fairly quickly was because she categorized the words she learned. If all distinct signs had to be taught separately, it would probably have taken significantly longer to teach her. Evidence has shown that even when Washoe answers a question wrong, her answer could have been the right one. For instance when asked, *who is that*, Washoe always replied with a person's name, instead of an object or an activity. This means that Washoe recognizes certain classes in her language and categorizes them accordingly.

Savage-Rumbaugh et al. (1978) objected to the Gardners' research that Washoe's acquisition of Ameslan reflected imitation of the teacher more than understanding of the signs. In a way, Washoe had been conditioned to map certain signs with their referents, in order to get a reward for the right answer, similar to how dogs are conditioned to learn tricks. However, this does not entail that the chimpanzee or the dog actually comprehends what the signs refer to. In order to tackle this problem, Savage-Rumbaugh et al. set up their own research with the chimps Sherman and Austin who they had been teaching Ameslan over the last few years. In this research, the chimps' understanding of symbolic reference was tested in order to see whether the non-human primates did actually understand the symbols instead of merely repeating what the teacher showed them. In the Gardners' research, Washoe was taught the names of certain foods, through requesting the food and receiving it from the teacher. This means that the food itself could have been the reward for giving the right answer to *What's this* questions. In Savage-Rumbaugh's research, Austin and Sherman were also taught names of food, although the food could not be requested for consumption by the chimps in this research. Instead, the chimps only got social praise for the right answer. By removing the immediate food rewards, the researchers prevented the non-human primates from learning through conditioning.

Now, it is investigated whether non-human primates understand and use semantics when communicating. When discussing semantics in animal research, it is usually described as reference. In order to test the chimps' understanding of symbolic reference, Savage-Rumbaugh et al. (1978) also investigated the chimps' ability to decode information about food which was not directly observable. By removing the observable food, the researchers ensured that a symbol

became the reference for food instead of signals. The results of the research showed that the chimps had no trouble in reporting food items which they could not see at the time, but had encountered before. By removing the immediate food reward through request and testing the symbolic understanding of the chimps, Savage-Rumbaugh et al. have shown that teaching Ameslan to chimpanzees indicates a deeper understanding of the language instead of mere conditioning. Even though chimpanzees do not use symbols in their own communication, their understanding of it can be demonstrated. This entails that the non-human primates comprehend semantics, while they might not need semantics in their own communication.

All of the previously described research focuses on primate gestures. Gestures might be more developed in non-human primates than their vocalizations, but because communication is multimodal, vocalizations still play an important role in their interaction. While the demonstration of the understanding of semantics by non-human primates comes from their gestural communication, the argument for syntax can be found in primate vocalizations. Crockford & Boesch (2005) claim that a pivotal aspect of human language is the ability to combine sounds into one that carries a new meaning. Instead of the singular sounds that have to be taught individually, combined sounds can vastly increase the number of different words that can be produced in a language. Syntax allows humans to combine sounds in their language as it governs the possible combinations.

Crockford and Boesch state that human language consists of two types of syntax, a phonological and lexical one. Phonological syntax refers to the combinations of a fixed set of symbols, into a theoretically infinite amount of words and sentences. This type of syntax is about the physical sound of symbols and words. An example of phonological syntax in the communication system of non-human primates are the long distance calls. These calls are used for regulatory spacing between groups. Long distance calls have a fixed structure and the context in which the combination is used differs from the context of the individual component calls. Lexical syntax, on the other hand, refers to the meaning of words being combined to form a new meaning. Lexical syntax can be unpacked into two aspects of syntax, either as a contextual modifier for other calls or where the grammatical rules generate sentences. Contextual modifiers can be found in the communication system of non-human primates, however, there is no evidence which suggests that there is also a syntax which allows for the forming of sentences in primate communication. An example of a contextual modifier is when the chirps which are used in alarm situations are combined with squeaks which are used in alert situations. The resulting combinations were produced in intermediary contexts requiring vigilance but with reduced fear or alarm. Crockford & Boesch claim that it is unlikely that call combinations used by any animal approach the complexity of syntax used in human language. For instance, it has not been demonstrated that changing the order of components in a non-human primate call changes the content of the message, like it does in human language. However, comparative research is necessary in order to distinguish between what is uniquely human and what can also be found in other animals.

It is plausible to compare non-human primate communication to human language in order to unravel differences and similarities between them. In order to investigate the evolution of human speech from a comparative perspective it is necessary to focus on the vocal aspect of non-human primate communication and relate them to human vocalizations. Even though gestural communication might be more developed in non-human primates, vocalizations are still pivotal

in their communication. Vocalizations are used for communicating with conspecifics who are not visible at the time. There are also reports of vocalizations being used as a social act, comparable to the bonding aspect of grooming (Kulahci, 2015). Savage-Rumbaugh already showed that understanding of semantics can be found in gestural communication of primates. Fedurek & Slocombe (2011) claim that semantics can also be found in primate vocalizations. Alarm calls, for instance, do have reference because the calls are distinct from one another and produced consistently in a response to a specific external stimulus. In addition, the receiver of the message reacts to the call in the same way as he would react to the stimulus itself, which is also a criterion of reference. Similar to Crockford & Boesch, Fedurek & Slocombe also state that non-human primate vocalizations have a syntax. Many vocalizations are structured in a particular way and are a combination of several individual components. Even though there is a syntax in non-human primate vocalizations, it is not as developed as the syntax in human language. This entails that there could already have been a pre-syntactic capacity in our ancestors which paved the way for the syntax in both non-human primate and human communication.

Humans have a high vocal plasticity which allows them to imitate a wide range of sounds. There are reports of non-human primates in captivity who spontaneously learn new sounds, such as chimpanzees who use a novel raspberry sound to get attention or orang-outans who learn to whistle (Fedurek & Slocombe, 2011). The difference with humans, however, lies in the non-human primates not using their larynx while producing these sounds, which is vital for speech production. Evidence shows that the vocal repertoire of non-human primates is fixed and genetically determined, unlike the vocal repertoire of humans. This means that learning has little to do with the acquisition of the signs in non-human primate communication, while it does play a big role in acquiring human language. Vocal learning consists of production, comprehension and usage learning. The non-human primates are able to produce many sounds and have comprehension of it, thus satisfying the first two premises of vocal learning. However, because the language of non-human primates is fixed and innately determined, they do not have usage learning. Fedurek & Slocombe state that the evidence for reference and complex comprehension in primates may represent precursors to linguistic abilities in our ancestors. However, the low vocal plasticity of non-human primates, combined with the inability to produce novel calls, indicates that the specific development required for speech production likely evolved once humans split from the primate lineage.

To sum up, primate research has been susceptible to anthropomorphism, which happens when you project human characteristics onto animals. When the teaching of human vocalizations to primates failed, the research turned to teaching sign language instead. The primates' understanding of symbols can be demonstrated by removing the immediate referent. This entails that primates do understand reference and there is also evidence that they have basic forms of syntax. However, their syntactical compositionality is very low when compared to humans. When looking at primate vocalizations in the wild, the animals lack vocal plasticity and vocal learning. Thus, the non-human primates do not possess a full language because they lack these important elements of language.

## 5 Dolphin communication

In the previous section, several primate researches on communication have been debated. Now, we will move to dolphin communication to investigate whether these animals possess language. In this section, I will first elaborate on the different types of vocalizations that dolphins use when communicating. Here, I will explain which vocalization is used in which context. Then, I will move to research which taught dolphins artificial languages. In this section, the dolphins' understanding of human language will be demonstrated. Next, the dolphins' use and understanding of syntax and semantics will be debated. Here, I will compare dolphin communication to human language. And finally I will discuss whether dolphins possess language.

Extensive research on dolphins over the past years has given us better insight in how the animals interact and communicate with each other. Despite the recent research on dolphins, we still do not know as much about their communication system as we do about the communication of non-human primates. Janik (2009) lists different reasons for why our data about dolphin communication is limited. Firstly, dolphins are much harder to do research on, when compared to non-human primates, simply because dolphins are usually submerged and spend most of their time underwater. Some studies have focused on the observable behavior from the animals at the surface, but this does not explain all of the behaviour dolphins exhibit underwater. Secondly, dolphins have evolved to the point where they are able to produce sounds underwater, without opening their mouths or visibly showing that they produced a sound. An acoustic lens in their forehead allows them to hear the signals others produced. These complications make it very difficult to determine which dolphin produced which sound, when you research them. To battle this unclarity when researching dolphins, scientists have attached acoustic recording tags directly to the animals, or other acoustic localization methods to identify which dolphin sends which signal (Janik, 2009). However, this method is relatively young and more research like this is needed if we want to fully capture the delphinid communication system.

From the research on dolphins, three types of vocalizations have been distinguished which the dolphins use to communicate. The types are whistles, clicks and burst-pulsed sounds (Janik, 2009). Whistles are tonal signals having a bandwidth between 800 Hz and 28,5 kHz and a duration between 100 milliseconds and approximately 4 seconds. Whistles are primarily used for social interactions and identification. Besides the shared whistles types that are common in a community, every individual dolphin also has their own uniquely distinct signature whistle. These signature whistles serve as an identification. Comparable to human names, the dolphins understand that a signature whistle refers to a specific individual. Conspecifics will learn each other's signature whistles and can recognize each other through these vocalizations rather than visual cues (Janik, 2009). Clicks are short ultrasonic signals with a maximum frequency of 200 k Hz, which are used for echolocation as well as communication. These sounds are often produced near the surface. Burst-pulsed sounds refer to all of the sounds the dolphins make which cannot be classified as whistles or clicks. The majority of studies on dolphin communication have focused on the use of whistles as they make up for most of the delphinid communication.

One of the most extensive researches on the language processing abilities of delphinids was carried out by Herman et al. (1984). For this study, the researchers taught two distinct artificial languages to two captive bottlenose dolphins. An acoustic language was taught to the dolphin

Phoenix while a gestural language was taught to the dolphin Akeakamai. In this research, the ability of the animals to deal with lexically and syntactically novel items was tested, as well as the dolphin's ability to recognize faulty sentences which contained an impossible task. Instead of focusing on the animals capability to produce a sentence, there was an emphasis on the level of comprehension of the animals. If a dolphin was able to carry out a certain task correctly, it showed not only that the animal understood what was requested from him but also that the dolphin utilizes both semantic and syntactic information (Herman et al. 1984). The technique used to evaluate the dolphin's responses was the so-called blind observer technique where someone who did not know what sentence was given to the dolphin, would have to review the dolphin's behavior and state which task the dolphin performed.

Herman et al. (1984) tried to eliminate chance as much as possible and prevent the dolphins from learning by mere repetition by making the training sessions unpredictable for the dolphins. They implemented the following strategies while conducting the research. First of all, the sentences were presented in a quasi-random order. This strategy ensured that the dolphins could not be conditioned to predict the next sentence while simultaneously guarding against biases. When a certain item, such as a ball was being tested, many different examples of balls would be present in the tank, which allowed for a generalization of a certain word from a specific exemplar to an object class. Usually there would be a variety of different items present in the tank, drifting around freely or where the dolphin last left them. This meant that the dolphin had to pick the right object every time in order to carry out the task correctly (Herman et al. 1984). In addition, the location of the trainer-transportable items was changed frequently. This helped to prevent the dolphins from encoding objects in relation to their spatial position, instead of their semantic relation. And finally, by using many different people as tank side trainers, they ensured that the dolphins would not get accustomed to one specific person which would promote generalization.

Herman et al. (1984) first investigated the dolphin's ability to understand lexically novel sentences. A lexically novel sentence refers to the implementation of new words into one of the familiar sentence forms. In a single session, of the 30 to 40 sentences that were given to the dolphins, a maximum of 2 sentences were lexically new. The researchers made sure that not a single word in the novel sentence appeared in the preceding five sentences (Herman et al. 1984). After the dolphin performed the task in the novel sentence correctly, the sentence was added to the bulk of familiar sentences. Of all the 200 lexically novel sentences that were tested, Phoenix responded correctly to approximately 63% of them and Akeakamai correctly performed tasks in approximately 68% of the new sentences. Besides lexically novel items, the researchers also tested the dolphin's ability to understand structural or syntactic novel sentence forms. Familiar sentence forms were altered to see if the dolphins still carried out the right task. For instance, the dolphins had been trained in sentence forms such as BOTTOM FRISBEE FETCH HOOP, in which the dolphins had to transport the frisbee from the bottom of the tank to the floating hoop on the surface. The new syntactic form of the sentence was FRISBEE FETCH BOTTOM HOOP. Results show that Phoenix answered correctly to 63% and Akeakamai to 76% of the novel structural forms, indicating that the dolphins were not merely conditioned to react to the meaning of words, but are also able to understand syntactic variations.

Next, Herman et al. (1984) tested the dolphin's ability to carry out semantically reversible sentences. In these sentences, the transportable and stationary items were swapped to see



whether the dolphins still performed the right task. For instance, instead of BALL FETCH HOOP which meant that the dolphin had to transport the ball to the hoop, the sentence became HOOP FETCH BALL and the dolphin needed to transport the hoop to the ball. Phoenix's responses to these sentences were 65% correct and Akeakamai responded correctly to 54% of these sentences. These levels are close to the overall performance level on FETCH sentences, meaning that reversing the sentence did not cause any problems for the interpretation of the dolphins. And finally, Herman et al. (1984) investigated the dolphins ability to recognize anomalous sentences which contained an impossible task. Examples of anomalous sentences are FETCH sentences where the object cannot be transported, or when the sentence does not specify where the item should be transported to. The results of the responses to these sentences were mixed as the dolphins sometimes outright ignored them and sometimes tried to repair the sentence by adding or removing items in the sentence. An example of an attempt to repair is when the sentence WATER TOSS was given to the dolphins, which the researchers had deemed semantically anomalous because it contained an impossible task. Both dolphins replied to this sentence by tossing a stream of water, and thus finding a solution to the anomalous sentence.

Human language consists of syntactic rules and semantic referencing. Syntax has several elements that govern how sentences are formed. It is unlikely that dolphin communication also consists of all of these syntactical elements, but some elements of syntax might exist in their communication. Kako (1999) investigated the animals' ability to acquire elements of syntax when communicating. The experimental data that Kako uses for his investigation is the research that Herman (1984) conducted on the dolphins Phoenix and Akeakamai. There are different ways to define syntax. In its first, most generic form, syntax is defined as a set of rules for assembling units of any type into larger units. Kako (1999) claims that this form of syntax is too broad as too many things would then classify as being syntactical. For instance, human music and even buildings would then classify as syntactical. The second definition of syntax refers to all the properties manifest in human language. Kako (1999) concludes that this definition of syntax is too narrow, as no animals would then have syntax in their communication system because no animal communication system has all of the syntactical features that human language has. However, some animals might be able to acquire a subset of these features. This leads us to the third definition of syntax, which is a set of structural properties that define the core of syntax.

According to Kako (1999), there are four fundamental properties which make up the core of syntax. The first one, discrete combinatorics, relates to the combined meaning of words in a language. The meaning of words in a sentence complement each other rather than mix together like when you mix paint. Discrete combinatorics allows for different compositions of the same words, resulting in sentences with distinct meaning. The second property of syntax is category-based rules which states that the users of the language understand the order of classes of words in a sentence. This property allows for recognition of grammatically right and wrong sentences. For instance, the sentence *April is the fourth month in the year* is acceptable because it is grammatically correct, but the sentence *Fourth the year is month April in the* is not. Rules determine the position of word classes and if the positions get altered it might result in a sentence which does not carry any meaning (Kako, 1999). The third syntactical property is argument structure and refers to the relational character of verbs. The linguistic animal is able to understand how many participants are involved in the event and which syntactic position they have in the sentence. The verb give, for instance, combines a *giver*, a *given item* and a *receiver*.

If one of those arguments is missing, it results in an incomplete sentence. Without argument structure, it would become very hard to deduce from a sentence what happened to whom. The final property of syntax are closed-class items. Human language consists of open-class as well as closed-class items. Open-class items are verbs, nouns and adjectives. Examples of open-class items are *work*, *person* and *green*. Closed-class items, on the other hand, are prepositions, determiners and quantifiers. *In*, *this* and *many* are examples of closed-class items. New items get added to the open-class group all the time. This implies that there are a lot more open-class than closed-class words in a language. Open-class words are able to express the smallest details while closed-class items are insensitive to even the biggest changes. The meaning of open-class words is discrete and self-explanatory, while the meaning of closed-class words is more abstract and derivable from the sentence (Kako, 1999).

Kako (1999) claims that some elements of syntax can be found in the artificial languages that were taught to the dolphins Phoenix and Akeakamai. Firstly, Kako (1999) claims that the dolphins understand discrete combinatorics. Most of the dolphin's tasks would be impossible to execute if they did not understand that words have distinct meanings and do not blend together. Secondly, Kako (1999) states that the dolphins exhibit understanding of category-based rules. Results of the research done by Herman et al. (1984) show that the dolphins had a high success rate when dealing with lexically or syntactically novel items. According to Kako (1999), this significant result can only be due to the dolphins understanding the categories of words, instead of the relation to words such as FETCH and HOOP. This also explains why the dolphins are able to execute a command successfully while they have no prior experience with specific words. Thirdly, Kako states that it is uncertain whether the dolphins understand argument structure because their responses are inconsistent. Sometimes the dolphins would ignore the command and other times try to repair it. The results do not clarify whether the sentences struck the dolphins as ungrammatical or whether they found them impossible to enact. And finally, Kako (1999) states that the dolphins do not show understanding of closed-class items. Relational sentences with OVER/UNDER/THROUGH are actually disguised conjoined sentences. They were taught as action terms and the word GO preceding them, as in GO UNDER. The enactment of the dolphins of these sentences indicates that these words continue to function like open-class words in human language. This means there is no evidence that the dolphins are able to learn closed-class items that specify these relations.

All of the previously discussed empirical data are a result of trying to teach dolphins a natural language or an artificial one. Even though the animals are able to understand most of the characteristics of a language, they also seem to be lacking certain elements of syntax. Similar to how human language possesses features that are lacking in dolphin communication, their communication system might also have certain components that we do not have in our language. For example, body posture plays a big role in dolphin communication, and therefore we might be misinterpreting certain dolphin signals. Signature whistles have come to be called whistles because that is how humans perceive the signals. Furthermore, humans are unable to hear most of the dolphin signals due to very high frequencies, meaning that we are missing out on perhaps the most important signals in their communication system. In order to better understand the dolphin's own language use, Ryabov (2016) investigated the dolphin's use of noncoherent pulses (NP), which are a bundle of burst-pulsed sounds, which the dolphins use to communicate. Ryabov compared these NP's to human words to provide a better comprehension of what role

the NP's play in dolphin communication. Ryabov (2016) hypothesized that an exchange of NP's between dolphins is similar to a human conversation, although there are some crucial differences. Similar to human language, the dolphin's role of sender or receiver are interchangeable in a conversation. Unlike humans, dolphins pronounce all the phonemes of a word simultaneously. The dolphins will also wait to produce a new pulse until the reflections of the previous one have attenuated.

To estimate the extent to which the communication system of dolphins can actually be called a language, Ryabov (2016) compared his findings on dolphin communication to human language. He distinguishes five fundamental features in human language. Another communication system only suffices as a language if it satisfies these features as well. The five criteria are: *duality*, *productivity*, *arbitrariness*, *displacement* and *cultural transition*<sup>1</sup>. The first criterion, *duality*, relates to the stringing together of subunits to create a larger signal. This criterion gets satisfied because the dolphins are able to combine sounds into new meanings. The communication system of dolphins consists of a fixed number of phonemes. While the phonemes are limited, they can be combined to create a limitless amount of vocalizations such as whistles and pulse-burst sounds. The system also consists of *productivity* because it allows for the implementation of novel sounds. The signature whistles demonstrate this, because in the development of one's own whistle, familiar sounds such as the mother's whistle, are combined with new non-familiar sounds. The third criterion, *arbitrariness* gets satisfied because the dolphins are able to learn conceptually, which has been demonstrated by research done by Herman (1984). In this research, there was no direct link between the number of spectral extrema of a word and its physical reference, indicating that the dolphins learned the arbitrary relation between items and words. The fourth criterion, *displacement* also gets satisfied as the dolphins are able to understand when items are absent. In particular, the ability of the dolphins to understand the reference of an absent item indicates that the dolphins have displacement in their communication system and can refer to something which is not directly observable. The final feature, *cultural transition* gets satisfied as well. Results from dolphin research indicate that the animals transmit social and cultural knowledge to their kin. For instance, the non-genetic transmission of social behavior is an example of cultural transition. These findings indicate that the language and culture of a specific dolphin group are also taught from one generation to the next.

Ryabov (2016) concludes that when you compare the communication system of dolphins to the language of humans on the basis of his five features of language, the dolphin's communication system does satisfy all of the features. One could object to this by wondering if the satisfaction of the five criteria is actually enough for the communication system to be called a complete language such as the human one. For instance, Ryabov does not discuss the syntactic component of dolphin communication. Syntax, however, is one of the prime features of language that governs internal structure and grammar. If dolphins do not have syntax, their communication is not as comparable with human language as Ryabov suggests.

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<sup>1</sup> Ryabov actually describes seven design features of human language and credits these to Hockett (1960). However, two of these features (*interchangeability & semanticity*) do not match Hockett's own features.

Janik (2013) also claims that of all the animal communication systems, the dolphin one is the most closely related to human language. Even though dolphins might be evolutionarily more distinct from us than primates, the most important aspects that human language has also can be found in dolphin communication, while non-human primates lack some of these crucial features. Despite excessive research on primate communication, researchers were unable to find a referential use of gestures such as pointing beyond captive animals. Janik (2013) argues that a language should consist of aspects of vocal learning, reference and syntax and the communication system of dolphins has all of these features. Vocal learning consists of production, comprehension and usage learning. In the communication system of dolphins, usage learning seems to play a pivotal role in the acquisition of signature whistles. Here, the dolphins learn to develop a novel frequency modulation that is not shared by any other dolphin. The resulting pattern is an arbitrary signal which carries the identity information of that specific dolphin and is recognizable by others. Thus, the dolphins produce their own specific whistle, comprehend that it refers to an individual, and learn how and when to use it. These findings indicate that there is vocal learning in their communication system.

The use of signature whistles also indicates that dolphins understand reference. Janik (2013) compares signature whistles to human names. In human language, the names refer to specific persons, in dolphin communication, signature whistles carry the same function. In the research from Herman (1984), the dolphins had to pair novel sounds to specific objects. In these tests, the dolphins were able to carry out the tasks correctly, and the only explanation for this is that they learned to pair the sounds with their referents. Whether the dolphins also understand syntax has been investigated in research as well. In these tests, the dolphins had to distinguish left from right and sometimes the sentence would be reversed. The findings from these studies show that the dolphins do comprehend certain modifiers and understand that when a sentence gets reversed, the meaning of the sentence also changes. However, the understanding of syntax in wild dolphins has not been demonstrated. Janik claims that, given the discrete structure of clicks, there is a large potential for syntactical information in click sequences. It would be surprising if wild dolphins make no use of syntax at all in their communication while all captive dolphins demonstrate understanding of it. Thus, Janik states that the communication system of delphinids is closest to humans and suffices to be called a language.

Human language is a specialized communication system that uses syntax and semantics. Even if some features of language are shared with dolphin communication, it is imaginable that dolphin communication is specialized in its own way, suiting the environment of dolphins. Just like human language has elements that are lacking in dolphin communication, it is plausible that there are elements of dolphin communication which are not present in human language. It can be discussed whether a communication system that does not have all features of language could be called a language as well. However, there is not enough reason to already exclude dolphins from language use beforehand, just because they have evolved differently from us. Evidently, the comparison between human language and animal's communication systems can give us insight in communication in general and reveal differences and similarities between them.

## 6 Discussion

The question whether animals possess language has been debated throughout the history of philosophy. Some believe that language use is unique to humans, while others believe that animals could also possess it. If certain animals also possess language, it would entail that language use is not unique to humans alone. Non-human primate communication has been investigated thoroughly, as they are the species most closely related to humans. Early primate research has been susceptible to anthropomorphism, which made the research too focused on human capabilities. After learning that non-human primate vocal cords are developed differently, the research shifted to the investigation of gestural communication. This research indicated that while the primates' understanding of reference can be demonstrated, they do lack important elements of syntax. In addition, non-human primates have a low syntactical compositionality compared to humans and low vocal plasticity. These findings indicate that non-human primates lack too many features of language to call their communication system a language as well.

Investigation of the dolphin communication system has shown that it has the most important elements of human language. The dolphins' reaction to semantically reversible sentences has demonstrated that the dolphins understand reference and basic syntax. However, when you teach dolphins an artificial language, they do not have all the elements of syntax. But, when you analyze their own communication system, it does satisfy all important features of human language. The use of signature whistles demonstrates that dolphins have semantics and vocal learning in their communication. Their communication also has a high syntactical composition, and allows for many different combinations of distinct sounds. Most of the sounds in dolphin communication are not measurable and just like dolphins might not have every aspect of human language in their communication, it is plausible that certain aspects of dolphin communication are not shared with human language.

Even though dolphins are genetically more distinct from humans than non-human primates, their communication system resembles human interaction more than primate communication does. This shows that evolution sometimes finds a different solution to tackle the same problem. It can be discussed whether dolphins possess language and what the most important features of language are. In effect, human language is nothing more than a specialized communication system that has meaning, uses reference and is structured in a certain way. Dolphin communication is specialized in its own way and happens to share several features with human language. It is plausible and imaginable that an alien species, who might be evolutionarily even more distinct from us than dolphins, also could have these features of language. Just because a species is genetically distinct from us does not mean that it could never have a language. Even if dolphins do not have a full language, the comparison with human language can shed light on how humans and dolphins communicate.

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