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THE DEVELOPMENT OF CHILDREN'S THINKING

ITS SOCIAL AND COMMUNICATIVE FOUNDATIONS

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7 ANIMAL COMMUNICATION AND HUMAN LANGUAGE

LEARNING OUTCOMES

By the end of this chapter you should:

- Understand how the study of animal communication informs us about the nature and sophistication of human communication.
- Be able to discuss the details of the communication patterns of vervet monkeys and honeybees.
- Know that attempts to teach apes to speak have been conducted for a hundred years and why those based on behavioural training were inconclusive.
- Be able to define what a LAD and a LASS are (and know their theoretical differences).
- Be able to discuss the differences between human and animal communication and therefore the complexity of the latter.
- Be aware of how more recent training programmes based on social interaction have changed our understanding of how apes may learn to communicate with humans as well as how they have informed our understanding of children's early language development.

Do animals use languages? Can dogs learn words? Rico, a 9-year-old border collie, was able to learn 200 words (Kaminski, Call, & Fischer, 2004). But are these really words in the same sense that humans use them? What Rico had learned was to *fetch* 200 different

objects (Bloom, 2004). This is an incredibly impressive feat, but what does it tell us about human languages? When a child learns a word, more is expected than the ability to fetch the object that it identifies. Rico became an expert in the fetching game, but this is only one of the many 'games' children learn to engage in with language. Did Rico learn in the same way as children do? Is what he achieved very different from learning to obey commands such as to *sit* and *come*? These are the sorts of questions we address in attempting to learn more about human languages by studying animal communication systems. By studying one we also learn a lot about the other.

We have discussed the development of infant communication before language in the previous chapters. What do we learn by comparisons with other animals? We can ask if there is anything like human language among the complex systems of animal communication. As we suggest in Chapter 5, animals communicate at several levels. Its form, however, varies radically across species. We cited the brilliant colouring of poison dart frogs, which is highly visible. It 'communicates' or signals its deadly nature to potential predators, but this colouring has evolved; it is not intentional as in the case of an electric transformer painted yellow and black and labelled 'Danger'. Humans communicate in very different ways compared to social insects like ants and bees. However, we can also see some involuntary communication in humans such as when someone turns red with embarrassment. This communicates something to others even though it is not intentional. It is the intentional forms of communication, however, that are important in human languages.

Recent research shows that chimpanzees can look where others are looking and even follow pointing gestures, but they do not understand a human trying to show them the location of food (Call, Hare, & Tomasello, 1998; Call & Tomasello, 2008). However, 2-year-old human children have no difficulty understanding this task and, surprisingly, dogs do much better than chimps (Kaminski et al., 2004). We can learn much about the basics of human communication through these comparisons. In this chapter we describe two 'rounds' of research conducted over the past hundred years, in which researchers have attempted to teach higher-order primates to communicate. In reality there have been scores of skirmishes, as successive generations have used new strategies in trying to solve Dr Doolittle's problem of talking to the animals – and getting them to talk back. We divide these into two general rounds because recent attempts have been based on very different principles and their results have been very informative about the origins and nature of human communication – a topic we develop in the next two chapters.

7.1 THE EVOLUTION OF MEANING AND LANGUAGE

If the ability to convey meaning and learn languages is an evolved capacity we could explore its nature by considering what, if anything, humans share with closely related species.

In order to do this we first consider whether animal communications systems exist that are similar to human language. We then turn to the question of whether other species can be taught to use languages similar to human languages.

Is animal communication different from human language?

A first step in taking a comparative approach to animal communication is to see if any other species has a communication system that is similar to human language. Researching this question is not just to indulge in idle curiosity. Whether or not animals use language is related to important questions about the nature of this sophisticated human skill, and whether or not it is inborn or learned. The linguist Noam Chomsky (1965) has claimed that language is innate, that humans and only humans are able to acquire language. We will discuss further in the next two chapters Chomsky's claim that humans are born with an evolved Language Acquisition Device (LAD) that makes learning human languages possible. This is required because according to his description of language there is no way for children to be able to learn a language, given the limited input they receive. He has argued that known learning mechanisms could not account for how children learn language because he holds that children are not corrected when they make a mistake so they could not learn the rules of syntax (that is, they lack what is known as *negative evidence*, which is discussed in the next chapter). If the rules of syntax are not available to children in the language they are exposed to, but children do learn languages, then it follows that the rules must be 'pre-wired' or built into an innate language module within the child. This view has a long tradition in Western thinking dating back at least three hundred years before Plato and Aristotle, as seen, for example, in Parmenides' poem *On Nature*. That is, if children cannot learn language based on the information available, but obviously typically developing children do acquire a language, then they must already know it – in some sense. This last qualification is essential. Of course, we know that babies are not born speaking German, Mandarin, or English. A LAD is a universal grammar (UG) with parameters that can be set by exposure to a particular human language. That is, it is claimed that humans must be born with some universal ground plan, or a 'one-size-fits-all' set of rules that will form the foundation for all human languages, all five to six thousand of them – in fact, any possible human language. Therefore, acquiring a language, Chomsky assumes, is much more like maturation, more like growing an arm or a leg, than learning a skill such as arithmetic. He argues that it must be this way because he couldn't imagine how children could learn language given the input they are exposed to. This claim has been called the argument from 'lack of imagination'. Of course, this verdict is somewhat ironic, given Chomsky's brilliance. However, it does illustrate the fact that given certain starting points, particular conclusions necessarily follow.

Chomsky believes that the ability to learn and use language is unique to humans. It is an inherited, species-specific ability. The idea that some animals might be able to learn a language if they are taught to do so does not, according to Chomsky, make any

biological sense. This would be like saying we might find an animal that has some very advantageous ability such as the ability to fly and has wings, but has not thought to use them for flying until researchers came along and taught it how to do so.

An important first step in determining if animals have communication systems similar to that of humans or can be taught to communicate is to *define* language. Without a clear definition of language, we have no criteria at hand to determine whether animals do have a language. And attempting to define it helps to refine our understanding of just what *human* language is. Like Rico, apes can also learn certain communication skills, but the question remains: is this what is essential about language? Other reasons for studying animal communication include the fact that it is interesting to observe how other species cooperate, coordinate efforts and convey information. This research contributes to understanding the evolution of language. One way to study the evolution of a capacity is to examine the fossil record, but language itself leaves no trace (although some physical structures, such as specialised brain structures and skeletal evidence indicating the size of the vocal chords, may leave a fossil record). Since it is not possible to study the evolution of spoken communication fully in this manner, another way is to look at the distribution of varying capacities for language in currently living species. That is, to see if closely related species communicate in a way that is similar to human language.

Before discussing the research, it is important to know something about studies of animal communication. It is a fairly unusual area of research because of the amount of controversy it has generated. It is also unusual because of the amount of public interest in this work. One of the important researchers in this area, David Premack, acknowledged that he should have anticipated the amount of interest and controversy this research would generate, but that it was hard to prepare for this because there are few areas in psychology that are similar. Most psychologists just tend to work away by themselves with little attention from the outside world, but the chimpanzee language work was different. At the time, there was a great deal of attention from major media outlets such as magazines like *Life* and *People*, and such was the publicity of this work that Premack and his wife Ann presented their most discussed analysis of chimp language in the journal *Scientific American* (Premack & Premack, 1972), which usually publishes short, popular accounts of already published work.

Research on animal communication generates a great deal of interest because the whole enterprise challenges beliefs about essential differences between other animals and humans. This research requires a large investment of time, effort and money, sometimes even personal money. Animal language research involves long-term projects that take many years, which means the pay-off in terms of data is delayed. The work is controversial because most projects just involve a few individual animals, so warm personal relationships tend to develop, which may make objectivity difficult. Furthermore, the research design tends to be different from typical studies in psychology because usually there are only one or at most a few participants in each study. This sort of research may

be difficult to accept for other psychologists who are accustomed to studies with large numbers of participants and tight controls over variables. Let's examine the products of this intensive investigation.

Do animals have languages?

The first question to address is do animals talk naturally? That is, are their communication systems similar to human languages? To answer this question we need to return to the issue of defining, but this task is not as easy as might appear. One approach is to consider what is essential to human language. Hockett (1966) proposed several features to capture this. His list changed over time, and the longest one contained 16 characteristics. Here we consider three features that seem most important. The first is *semanticity or reference* (taken from the Greek word *significant* to refer to meaning). Humans use language to refer to things, but it is not clear whether other animals do this. When a hen squawks because there is a fox outside the henhouse, is the hen saying 'Watch out, danger!' or does she just automatically make this sound when she is frightened, in the way a human might involuntarily scream when he or she sees a snake? In both cases the fact that something potentially dangerous is going on would be communicated, but in these cases this communication is not intentional.

Vervet monkeys have a system of several different calls that distinguish different sorts of danger. There is one call for a snake (puff adder or cobra), another call for an eagle, a third call used for lions and leopards, and a fourth to signal the presence of a spotted hyena or Masai tribesman. Many other species of monkeys also have call systems (Fitch, 2005). Perhaps these different calls are like words as the monkeys do respond to them differently. When other monkeys hear the call warning of a snake they stand on their hind legs and look around for a snake. When they hear the call for an eagle they dive into the vegetation as if they are hiding from an airborne attack. And at the lion call they quickly climb a tree (Fitch, 2010). Many species of birds and mammals learn to eavesdrop on other species' use of alarm calls to learn about dangers (Magrath, Haff, Fallow, & Radford, 2015; Seyfarth & Cheney, 2012).

These calls may serve a *function* because they elicit particular responses from conspecifics. However, it may be that they are not intentionally used referentially – they could simply be the reaction of the utterer to a threat. For example, vervets will continue making the call even if all of their group has seen the danger and escaped. At the same time, alarm calls do not seem to be just automatic reactions because it is more likely that birds and mammals will give such calls when they are close to others of their species compared to when they are alone. Some species, such as chickens, produce alarm calls only when they are with other chickens. A question arising here is are alarm calls given depending on whether the others have not seen the predator? This has been addressed with chimpanzees who emit two kinds of calls. First, when they encounter immediate danger such as a

leopard, python, or a neighbouring group of chimpanzees they give loud 'SOS' screams or barks. When the threat is less serious, however, such as poisonous vipers or evidence of leopards or other chimpanzees, they make quiet 'alert hoos'. An extensive field study was conducted by following individual chimpanzees through the forest and placing a model of a poisonous snake in its path, then waiting to see if it would give alarm calls to other approaching chimpanzees. It was found that they called more if the other chimpanzees had not seen the model snake, and alarm calls were also more likely if there was a close bond with the other chimpanzees. Also, the number of alarm calls given depended on the risk to the caller as well as to the receiver of the signals (Crockford, Wittig, Mundry, & Zuberbühler, 2012).

Humans have a sort of call system in parallel to language, such as yelps of pain, shrieks of fear, and different types of crying in babies which express different needs (that can be identified by caregivers). However, alarm calls seem to lack the productivity of human languages (i.e. the creative use of language to say new things; see below, Fitch, 2005). Thus, even though animals clearly do have communication systems that work very well for their purposes, we have to be careful before accepting the claim that animal communication is a simple form of language. We may be trying to compare systems as different as a human language like English or Japanese with a set of traffic signals, which also functions to coordinate action but in a different way.

A second important characteristic of human languages provided in Hockett's list is *displacement*. This is the ability to refer to things that are far removed in time or space. Alarm calls do not show displacement because they are only used in the presence of danger. They are not used to discuss dangers that are not present. For example, a dog may bark when a burglar is in the house, but it will not do so to tell us that there was a burglar in the house yesterday. There is, however, an example of an animal communication system that does seem to have at least a form of displacement. This is the complex communication system used by honeybees. Beekeepers had long noticed that when one worker from a hive finds a new source of nectar other bees from the same hive also start to arrive at the new source. Soon there would be a large number of bees from the same hive gathered at the new source of nectar, but bees from other hives did not tend to find the new source as quickly. And bees from hives that are quite close together often fly to different sources of nectar. So, it seems that bees are somehow communicating about the location of nectar.

Much of the important research on this issue was conducted by the ethologist Karl von Frisch (1967). He found that when a foraging bee discovers a rich source of food it is able to communicate the source of the food to the other bees in its hive. It communicates this message through a pattern of movements; that is, by doing a sort of dance on the inside walls of the hive. There are two major types of dance, depending on how far the food source is from the hive: the round dance and the tail-wagging or waggle dance. If the nectar is within 10 metres of the hive the returning bee does what is called the round dance on the wall of the hive. This involves going in a circle in one direction and then turning in

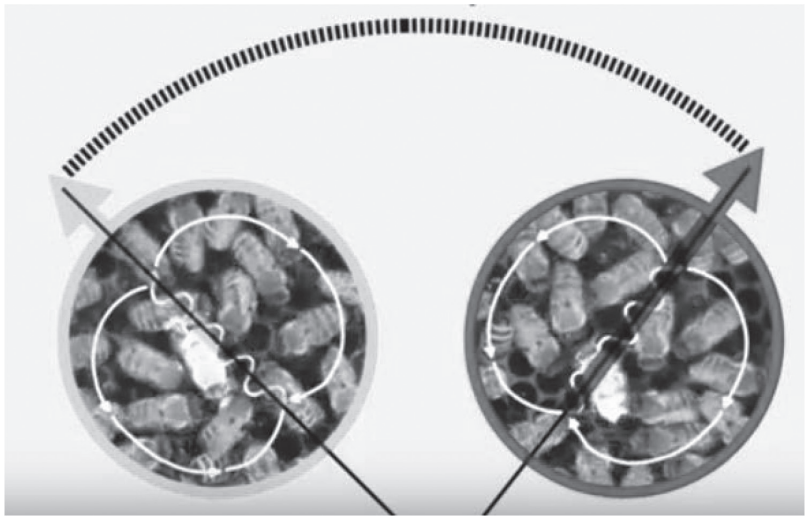

Figure 7.1 Demonstration by Georgia Tech University of Computing (www.youtube.com/watch?v=bFDGPgXtK-U)

The location of two sites is marked with a drop of green or red paint dropped onto the back of the bee who returns to dance. The two bees are dancing at different locations on the hive wall. The direction of each bee's waggle accurately identifies the location of each food source – the video is excellent and well worth a viewing.

the opposite direction. The intensity of the dance signals the richness of the food source, and the scent of the dancing bee indicates what type of food source to look for. The other bees then fly randomly around the hive until they pick up the scent they had detected on the dancing bee, and at that point they can fly directly to the rich food source.

The tail-wagging or waggle dance, however, is an even more impressive way to communicate information. Honeybees use this pattern of movements when the source of nectar is far from the hive, over 100 metres. For distances in between 10 and 100 metres bees may perform either of the two types of dance, but for the longer distances they are more likely to do the tail-wagging dance. Studies have shown that bees can accurately indicate food sources up to 11 kilometres away (almost 7 miles). With these sorts of distances it would not be efficient for bees to search randomly and try to follow scents. Thus, the tail-wagging dance contains much more information about the direction and distance the bees should fly. The structure of this dance consists of two roughly semicircular paths with a straight-line portion in between, and this is when the bee waggles. The orientation of the straight-line portion of the dance tells the other bees which direction they should fly with respect to the position of the sun. Vertical means to fly directly towards the sun, 80 degrees to the left means to fly 80 degrees to the left of the sun, and downward indicates

away from the sun. The length of time spent during the tail-wagging portion of the dance tells the other bees the distance that must be flown. The bees also make a special buzzing sound during this part of the dance, and the general level of excitement during the dance communicates the richness of the source. There are some differences in dancing among different types of honeybees and individuals within a type (Frisch, 1966, 1967).

The waggle dance of honeybees is a very complex and efficient communication system, especially for an animal with a brain the size of a grass seed. And this system involves some displacement, just like a human language, because bees can communicate about food sources that are not present. But the degree of displacement is much less than that of human languages. Bees cannot communicate about the food sources they visited the day before, nor food sources that are farther away; they can't communicate about nectar in the next valley. And they also can't communicate anything about vertical distance. If the nectar source is placed at the top of a tower they can't tell the other bees because 'bees have no word for "up" in their language. There are no flowers in the clouds' (von Frisch, 1927/1966, p. 139). The other bees will just come to the base of the tower, and buzz around there before giving up and going home.

So, the communication system used by bees is fairly rigid, and this leads to the most important characteristic of human language that seems to set it apart from animal communication systems, and that is creativity which is identified by openness or productivity. This is the feature that Chomsky emphasised – it is the ability to talk about anything. Animals may be able to communicate a lot of information, but as Bertrand Russell put it no matter how eloquently a dog barks he will never be able to tell you that his parents were poor but honest. Animals have a fixed number of signals that they can employ to convey messages. Bees cannot communicate about vertical distance because they haven't needed to communicate such information: there are no food sources in the air, so there would be no selective pressure for this to evolve. In contrast, with human languages we can discuss just about anything, and if we don't have a word for something we invent one. We are constantly adding new words to our languages, and our communication is constantly changing. For example, hundreds of computer-related words have crept into everyday language over the past thirty years and dictionaries are regularly updated. Bees cannot 'dance about dancing' (i.e. use their form of communication to reflect upon the process of communicating), whereas humans can discuss communication, as we are currently doing. That is, animal communication systems, although complex and efficient, do not have the *openness or creativity* of human languages through which new messages can be created, the third of Hockett's (1966) criteria that we draw upon.

The next question, after finding that animals do not naturally use forms of communication that are comparable to human language (although this debate is not completely settled), is to ask if animals can be taught to use a human language. The most convincing evidence would be a demonstration of adult human language in animals, but this is unrealistic and instead researchers have adopted the strategy of trying to show that animals are *on the path to language*, although they may not have full human capability.

7.2 CAN ANIMALS BE TAUGHT LANGUAGES?

If animals don't naturally use communication systems similar to human languages, can they be taught a language? Much of this research has focused on Great Apes and chimpanzees in particular. There have been several waves of research addressing this question.

The first rounds in the chimp language wars

For a number of years researchers have tried to teach language to apes. One of the early studies began in 1909 when William Furness (1916) attempted to teach two young orangutans and two chimpanzees to speak. After considerable training one of the orangutans learned to produce 'papa' and 'cup'. The apes did, however, learn to understand a great deal of what was said to them. Another early attempt began in 1931 when Winthrop and Luella Kellogg (Kellogg & Kellogg, 1933) took a 7-month-old chimpanzee, Gua, into their home and brought it up alongside their own son, Donald. These researchers decided not to attempt systematically to teach words to the chimp, but rather to let Gua pick up language in the same way a child learns. The chimpanzee was well in advance of the child with things like releasing a door latch by 10 months, learning to unlock the front door by 13 months, and eating with a spoon before the child did. At around 12 to 14 months Gua and Donald were about equal in the number of different requests that they seemed to understand and respond to. These were sentences like 'supper's ready' or 'close the drawer'. Each of them understood about 20 different requests. Although the child was slower to begin with, at 19 months, when the study was ended, Donald started to learn new words quickly. Of course their son learned to speak but the chimpanzee never did, although Gua did learn to understand the meaning of over 70 single words.

A second attempt began in 1947 when Keith and Catherine Hayes (Brown, 1958; Hayes & Hayes, 1951) gave a young chimpanzee, Viki, intensive coaching in English. They made a great effort to develop vocal speech, but the chimp only learned four words – 'papa, mama, cup, and up' – and even these were not clearly articulated. Furthermore, it was not clear that she was using these words properly. This was after three years of hard training. Although it was very difficult to train her to speak, Viki did seem to grasp a large number of phrases. But the Hayes team recognised that it was very difficult to measure comprehension because failure to follow a command is not necessarily a measure of understanding since a chimp, just like a child, may not feel like obeying.

It seems, however, that chimpanzees are not able to learn to make the sounds used in human languages. This inability may be located at the neural level rather than at the level of anatomical structures. Fitch (2005, p. 200) suggests that 'the basic vocal tract anatomy of a chimp or monkey, or even a dog or goat, would clearly support many of the phonetic contrasts found in human languages, if a human brain were in control'. Thus, there was a change in research strategy in the 1960s and 1970s. Researchers shifted from teaching chimpanzees to use a vocal medium to teaching them to use a visual medium of communication.

In 1966 Allen and Beatrix Gardner acquired a female chimpanzee named Washoe. She was thought to be about one year old when they started: her age is important because it may be that language learning is easiest or only possible for young animals. The Gardners taught Washoe to use modified American Sign Language, and they tried to approach language learning in a fairly 'natural' way. That is, they kept her surrounded by humans who used signs to communicate with each other and with her. She was raised by student caretakers in a house trailer in the Gardners' backyard, and no one was allowed to use spoken language around her, only signs were allowed. There were no rigorous training schedules, and the Gardners hoped that she would pick up language in a fairly natural way. Washoe did not usually learn new signs just by observing her caretakers, as normal children would. Instead, the Gardners would teach her signs by shaping her hands in the proper way. Of course, there were some problems in trying to teach an ape a language. The following quotation gives a flavour of these problems: 'Washoe can become completely diverted from her original object, she may ask for something entirely different, run away, go into a tantrum, or even bite her tutor' (Gardner & Gardner, 1969, p. 666). But in spite of these problems she did learn a number of signs. After the first 21 months she had learned 34 signs, and a sign was only counted as learned if she used it spontaneously and appropriately on consecutive days.

Washoe sometimes combined words in new ways. For example she used 'water-bird' for swan. This seems like evidence of productivity; that is, combining words in new ways. This interpretation was controversial, however, because Washoe did see both water and a bird and might have been referring to them individually, and consecutively, so it is inconclusive whether she had devised a novel concept. She did use this combination of signs again in other contexts, but these were also inconclusive because she was heavily reinforced for the first utterance. Usually, however, when Washoe combined words she just added words like 'hurry', 'more', 'food', 'please', and 'gimme' to nouns.

A problem with assessing novel word combinations and what they mean is that the Gardners only reported a few interesting novel word combinations. They did not report how often Washoe made uninteresting combinations that were just nonsense. This is important because the apocryphal room full of monkeys typing randomly may, every so often, just by chance produce an interesting looking string of words, even if it is unlikely that they will come up with *Hamlet*.

Some of the Gardners' students employed the same approach with gorillas and orangutans. Francine Patterson (1978) worked with a gorilla named Koko. Koko was taught sign language, and she also seemed to be creative in her use of signs. She appeared to combine signs in new ways. For example, Koko used the sequence EYE HAT for 'mask', WHITE TIGER for 'zebra', and COOKIE ROCK for a sweet, stale roll. She also signed ME CRY THERE when she saw a picture of a gorilla in a bath, apparently because she didn't like having a bath (Aitchison, 1989, p. 43). These early claims were picked up by the media in programmes like *Sixty Minutes*, *20/20*, and *The Tonight Show*, and magazines like *People* and *Life*. This research in the 1960s and 1970s focused on the question of

whether or not apes could learn the basic features of a grammar. This was a major interest in psycholinguistics at the time, particularly because of the claim that grammar is innate. It is why people got so excited about the possibility that these apes could produce strings of symbols. By the late 1970s many people were claiming that there was evidence that apes could create sentences. It seemed that apes were combining words to produce new meanings and it was argued that they were using simple grammatical rules. This seemed to be evidence that language was not a uniquely human capacity, and it also suggested that apes and humans shared some common ancestor with a linguistic capacity.

This claim, however, was demolished in 1979 by Herbert Terrace. In the 1970s Terrace started a research project with a chimpanzee he named Nim Chimpsky. Terrace worked with this chimpanzee for a few years and taught him to sign with American Sign Language. But it was after the project ran out of money, and the chimpanzee had to be returned to a chimpanzee colony in Oklahoma, that Terrace started carefully to analyse the videotapes he and his research team had made of Nim's signing. He analysed about 20,000 combinations of two or more signs made by Nim using this communication system. Many of these seemed to have been generated by simple grammatical rules (e.g. more + x). So this seemed to be strong support for the claim that apes can learn to use language and that they can use grammatical rules.

This, however, was not what Terrace claimed. Instead, he argued that a careful frame-by-frame analysis of the videotapes showed that Nim's signing occurred in response to his teacher who encouraged him to gesture, and thus much of Nim's repertoire was a full or partial imitation of what his teacher was signing. Nim's signing therefore seemed to be *non-spontaneous* and *imitative*. Terrace pointed out some major flaws in the research on apes' language, and he argued that even when apes had been trained to use language they did not use it spontaneously. Apes only used gestures to *get* something – to request something from their trainers, usually food. This is different from the way humans use language, because a child often just spontaneously uses words to refer to things, or to point objects out to another person with no desire to obtain them – just for the joy of sharing attention (see Chapters 5 and 6). An important function of a child's initial communication is to inform a parent that he has noticed something. Children enjoy naming things, and this is something that, at least at the time that Terrace was writing, had not been observed in apes.

Terrace (1979) also argued that Nim's signs were highly repetitive of the trainer's immediately preceding signs and also highly redundant. For example:

'Apple eat eat apple eat apple hurry apple hurry hurry.'

The Gardners never did straightforwardly deal with Terrace's critique that the combinations of signs produced by apes like Washoe were mostly imitations. This may have been because they would not have the evidence to respond to his criticism unless they had kept a record of the signs directed to Washoe, and all of her combinations of signs. So it was

hard to know if Washoe was imitating the experimenter or not. And even when they replicated their work with other chimpanzees they did not address Terrace's criticism directly. Terrace's conclusion ended the first round of the chimp language wars.

The second round in the chimp language wars

After this devastating attack by Terrace, funding dried up in this area of research, and many researchers lost interest in the topic. That is how things were in the mid-1980s, but some researchers continued in this area and changed methods and objectives and used new participants. Just before these controversies emerged, Sue Savage-Rumbaugh and her colleagues had started some interesting research in which they dealt with many of the flaws that Terrace had pointed out in earlier research. They used two young male chimpanzees named Sherman and Austin, and when they weren't being trained or tested these chimps lived with other chimpanzees.

Savage-Rumbaugh's earlier work with a chimp called Lana had been criticised by Terrace who claimed that Lana's sentences were really just 'stock phrases'; that is, since she was trained to use strings of symbols she treated them as a unit and did not create them herself. Thus, in the Sherman and Austin project, the chimps were trained with single words. Second, all of the communication between the experimenters and the apes was done through lexigrams, symbols representing a word, on a keyboard which made it possible for the researchers to keep a record of all the experimenters' and chimps' utterances. This meant that they could check how many of the apes' combinations of signs were imitations. Savage-Rumbaugh and colleagues also redirected the focus of their research from analyses of syntax to questions about intentional communication, reference, and semantics. Finally, an interesting difference to previous research was that her project involved two apes communicating with each other, so the researchers investigated the apes' *comprehension* of each others' utterances. This was something that had been taken for granted, or neglected, in previous research (Savage-Rumbaugh, Rumbaugh, & Boysen, 1978). Most previous researchers had assumed that their apes like Washoe and Nim understood more than they produced but they couldn't give any empirical support for this claim (Savage-Rumbaugh, 1986).

The next major advance involved work with 'pygmy chimpanzees' (*pan paniscus*) or 'Bonobos' instead of the common chimpanzee (*pan troglodytes*). Bonobos seem to be more intelligent than common chimpanzees, and have social characteristics that appear closer to those of humans. They are smaller, less aggressive, more social, more intelligent, and more communicative than common chimpanzees. However, bonobos are also very rare. They are native to Zaire but they are not protected and are an endangered species.

The first attempt in this new line of research was made with an adult female bonobo caught in the wild. She was named Matata, and intensive efforts to teach her to use symbols were made for four years, but with no success. When she was sent to be involved in a breeding programme and her adopted son, Kanzi, was left behind, it became clear that

Figure 7.2 Kanzi, language-reared male bonobo, converses with Sue Savage-Rumbaugh in 2006 using a portable 'keyboard' of arbitrary symbols that Kanzi associates with words

he had acquired symbols just by observing the efforts to train his mother, even though he was not rewarded and no efforts were made to teach him. When he was 2 years old it also became evident that he had an understanding of spoken language. At this point the researchers decided that they would not try directly to teach Kanzi language. Instead, they would just see how much he could pick up by himself in the same natural way that children learn languages. By 5 years of age Kanzi spontaneously produced combinations of symbols that revealed a sensitivity to English word order, and he seemed to be able to invent grammatical rules.

Kanzi's training was quite different from that of other apes and it was motivated by Savage-Rumbaugh's learning approach to language. In most previous studies of ape communication animals were taught to form associations between symbols and objects. Many species can learn to do this; for example, a dolphin can be trained to retrieve a frisbee in response to symbols that the trainer uses to refer to a specific object, but does the dolphin understand such communication in the way humans do? Is reference just an association between a word and something in the world? No, words don't just refer by themselves, speakers refer with words. Rather, symbolic communication is constituted by a triadic relation among speaker, listener, and reference to the world. According to this view, reference is a social function, and words are the vehicle of the process of referring.

It is possible to train an ape to use a symbol for an apple in order to get an apple. This is done by laboriously rewarding the animal with a slice of apple if it selects the token that corresponds to it, but this simple association between a symbol and an object has very limited use. The ape may not be able to use the symbol in all the ways that humans use the word (e.g. 'You are the apple of my eye'). It is much more difficult to teach an ape to be able to use a token to describe a food that it is not allowed to eat, or a food that it sees someone else eating, or a kind of food that it does not like, and so on.

So what is it that makes an environment appropriate for learning a human language? What was it about Kanzi's experience that was different from that of other apes and animals that allowed him to learn so much more effectively? What are the critical differences between the linguistic experience of normal children and the language training given to animals? Sue Savage-Rumbaugh (1986) describes several differences that she thinks are critical. For a start, communication of new information to predict important events is crucial. This involves knowledge of what is going to happen next, which makes the world more predictable. For example, in the utterance 'Oh here comes Mummy', the information provided is important for the child, particularly in the attachment phase of development (see Chapter 5). Error correction is also important when a young child is learning language. If the child doesn't understand, her parents do not withhold rewards and keep on repeating the sentence. And adults don't throw the child a fish if she carries out a request correctly. Instead, if the child doesn't understand, the parent attempts to do something to reach a mutual understanding. For example, if a child is told to 'help carry your toys' or 'throw the ball' and she doesn't understand, then the parent would usually show how to do it. The child is involved in the flow of interaction and the linguistic cues are used to help coordinate this activity.

The child's communicative experience contrasts with the language training given to animals such as dolphins. For dolphins, linguistic experience involves associating a symbol with a behaviour in order to be rewarded with a fish. They learn that when they are given certain symbols, either visual or auditory, they should do something, like fetch a frisbee, and if they do the right thing they will get food. Under these conditions there is no need to be concerned with the intent of the speaker. What the experimenter asks is not of intrinsic interest to the dolphin; its purpose is only to help the experimenter evaluate the animal's ability to respond correctly. In contrast, the child is involved in interaction that is interesting and motivating. Her behaviour is being influenced through linguistic means and she is motivated to use language to influence her parents. For example, a toddler who hears 'Let's drink some juice' may later want to start this action herself by saying the same thing or pointing towards the jug. But the dolphin is not likely to be motivated to want to ask another dolphin to 'take the frisbee to the surfboard'.

Savage-Rumbaugh (1986) has examined the social structure that children are embedded in when they learn language and she emphasises the importance of this social support for learning. In contrast to Chomsky's LAD, this is closer to Bruner's (1985) theory of language development, which emphasises that language is learned in the context of social

activity and with the support of others. To highlight the importance of the social context in his theory, Bruner came up with the acronym LASS (Language Acquisition Support System) in opposition to Chomsky's LAD. In Savage-Rumbaugh's view of language acquisition, comprehension is very important. She argues that a great deal of language learning goes on in the course of children trying to understand their parents' utterances. Most of the research on the linguistic capacity of apes, however, has focused on their ability to produce words, and there has been little concern with their comprehension, perhaps also because studying comprehension is much more difficult than studying production. It has been recognised, however, that comprehension precedes production in the language development of children (e.g. Snyder, Bates, & Bretherton, 1981). Parents know that their children understand many more words than they can produce. And when people are learning a second language they understand more than what they can produce. Typically, when children are between 1 and 2 years of age they may use about 10 words, but they can usually understand more than 50 (e.g. Snyder et al., 1981, see Chapters 8 and 9). Similarly, a 2-year-old bonobo raised in a naturalistic language environment was able to understand 70 words, but could only produce 4 words (Savage-Rumbaugh, Murphy, Brakke, Williams, & Rumbaugh, 1993).

In their research, Savage-Rumbaugh and colleagues (1993) focused on comprehension of language rather than production, and the language comprehension skills of a 2-year-old child (Ali) were compared to those of an 8-year-old bonobo (Kanzi). The bonobo was raised in a language environment that was similar to that experienced by children, but modified in ways to make it more appropriate for apes. For example, researchers went for walks in the forest with Kanzi and they found food in various places, just as they would in the wild. They also talked about anything that occurred and would be of interest to the ape. Ali's mother, Jeannine Murphy, was also a caretaker for Kanzi. Murphy worked full time as a caretaker for Kanzi, and after her daughter was born she worked half days. Thus, the research participants shared similar language environments. Although the child did not play with the apes, she did see them through a window.

The caretakers spoke to Kanzi in English, and they also used symbols on a large board, referred to as *lexigrams* (see Figure 7.2). The caretakers pointed to the symbols when they spoke. Both the child and the bonobo were tested on the same sentences and the procedure was treated like a game. Their understanding of the same 660 novel sentences was assessed. Ali and Kanzi were presented with two types of trials: non-blind and blind. The first 240 trials were non-blind – the experimenter was in the room with Ali or Kanzi. That is, Ali's mother was with Ali, and Sue Savage-Rumbaugh was with Kanzi. This was done in order to get Ali and Kanzi used to the testing procedure. Note, however, that the two experimenters were blind to the responses of the other research participant. In the blind trials, the experimenter was behind a one-way mirror and there was another person in the room with the participant, but this person had headphones on with loud music so that she could not hear the test sentence given to Ali or Kanzi. This was done so that the experimenter could not unconsciously help Ali and Kanzi.

THE CLEVER HANS EFFECT

Experimenters in this area have to be very careful because of what is called the Clever Hans phenomenon. Clever Hans was a horse a century ago who appeared to be able to count. The horse gave the answer to arithmetic problems by tapping his hoof and stopping at the correct number. The horse's performance was very convincing, and it appeared to be able to do all sorts of calculations. Clever Hans became quite an attraction and hundreds flocked to his nightly stage performance. However, it was eventually discovered that the horse was responding to unintentional cues from his owner and, indeed, some members of the public. The horse just struck the ground with his foot until the trainer, unconsciously, signalled him to stop by showing tension just before the right answer and relaxing when he reached it. All the horse had to do was to start striking the ground and stop when he sensed some cue from the trainer. Cues such as relaxing the shoulders when the correct count had been reached were enough to tell the horse it was time to stop. Thus, in research with animals it is important to include careful controls such as experimenters who are kept unaware of the animal's responses.

The following were some of the test sentences used in this study with Kanzi and Ali:

'Can you make the snake bite the doggie?'

'Take the lettuce out of the microwave.'

'Wash the hotdogs.'

'Go to the refrigerator and get a banana.'

'Take the potatoes outdoors and get the apple.'

It is important to be clear that neither Kanzi nor Ali could have heard these sorts of requests because people don't usually cook lettuce or store it in a microwave and so on. Overall, in response to these test sentences Kanzi was correct on 72% across all the trials, and Ali was correct on 66% of the trials. This rate includes counting 'partially correct' as incorrect, even though Kanzi and Ali generally responded correctly to at least a portion of the sentence. So, overall, both Ali and Kanzi showed high levels of comprehension for these types of sentences. Some of their errors, in fact, actually showed some level of understanding. For example, Kanzi was asked to 'Put some water on the carrot' on a day when it happened to be raining heavily at the time. Kanzi responded by tossing the carrot out into the rain,

which worked quite well to achieve the goal, but might have been coincidental. That was the only time during the test that he threw something outside, and no one had ever shown him this way of getting carrots wet, so this could have been a novel solution. Ali also came up with interesting solutions. Even though Kanzi's and Ali's errors showed some understanding, Savage-Rumbaugh counted them as incorrect because they are ambiguous and she wanted to be very conservative.

There were also many different examples of sentences in which the word order was very important. Take, for example, the following sentences:

'Put the hat on your ball.'

'Put the ball on the hat.'

Across all the types of sentences in which key words were presented in both orders, Kanzi was correct on 88% of the sentences and Ali was correct on 66%, and their errors were not usually getting the order backwards (Kanzi made two of these errors and Ali made five in the 660 trials). Instead, when they made a mistake, it tended to be a semantic one or due to inattention. For example, when Kanzi heard 'Put the melon in the tomatoes', he put the melon in the water. Ali made similar types of mistakes: when she heard 'Pour the lemonade in the Coke' she tried to pour the lemonade (from the can) into the bowl of lemonade.

So, it seems that both Kanzi and Ali were sensitive to word order. Kanzi was slightly better than Ali at the time of the test, although neither was perfect, and of course Ali developed very rapidly after this study. Both Ali and Kanzi seemed to process the requests at the level of the sentence, because the meaning they assigned to the instruction was based on its role in the whole utterance rather than a simple dictionary definition of individual words. For example, both responded correctly to:

'Give the knife to [person]'

and to

'Can you knife the sweet potatoes' (p. 99).

Even though the word 'knife' is used in different ways in the two sentences (as an object in the first and as action in the second) both Ali and Kanzi responded correctly. These were very unusual requests and they would never have heard these sorts of sentences before. For example, Kanzi had a ball with a face on it and when he was asked to 'Feed your ball some tomato' he put the tomato to its mouth.

Kanzi's understanding of language cannot be attributed to imitation because such actions had not been demonstrated. The sentences were new and the experimenter had not responded to them, so there was nothing for Kanzi to copy. Also, in order to understand

the requests, he had to be able to process the sentences at a syntactical level. He had to parse the phonemes (the components of words) and words as well as the structure of the sentence. Furthermore, his ability to understand English appeared spontaneously when he was raised in a linguistic environment that was similar to that experienced by children. Although his language skills were rudimentary, his performance is still impressive and these results present a challenge to the accepted view that language is an innate capacity of only humans.

Savage-Rumbaugh's work has also been criticised for being the product of stimulus response learning rather than the acquisition of language in all its complexity (Seidenberg & Petitto, 1987). Steven Pinker (1994, p. 341) claims that 'Kanzi's language abilities, if one is being charitable, are just above those of his common cousins by a just-noticeable difference, but not more'. Michael Tomasello (2008, pp. 252–256) points out that other non-primate species such as dolphins and parrots have shown a similar ability to understand patterns of signs. That is, they have shown comprehension but not production of communicative acts, and thus even apes like Kanzi do not appear to use syntax in their communication with humans. Tomasello suggests that the reason for this is that their communication centres around requests, which contrasts with the way human children use language for many other purposes.

These criticisms are fair but does this mean that human language is qualitatively different from that of bonobos and other higher-order species? Reviewing this divisive and passionate literature (hence the reason why we and others use the term 'chimp wars'), Caroline Rowland (2014) draws upon five of Charles Hockett's sixteen 'design features' of language to consider whether animal communication is equivalent to that of humans. She points out that even the bee dance shows '*displacement*' (the object being referred to is not physically present), that the learning of new dialects in some birds (species of finches) shows '*discreteness*' (similar sounds being linked together but are perceived as being different), and that the alarm calls of vervet monkeys illustrate '*arbitrariness*' (there is no reason for the particular sound to have this meaning, as in onomatopoeia). She continues:

> However, unlike human languages, no animal communication system demonstrates all of Hockett's design features. For example, vervet monkeys do not invent new calls for new predators or string calls together to convey different meanings (*productivity*) or use their calls to reflect on and talk about the calls themselves (*reflexiveness*). (2014, p.12)

Given that several of the examples from Savage-Rumbaugh's studies involve the use of different and novel combinations of lexigrams, the debate about whether or not great apes can learn language encourages us to think more carefully about the importance of the environment in which children develop these skills. Furthermore, research on animal communication is interesting because it encourages us to think about the very nature of language.

7.3 IMPLICATIONS OF RESEARCH ON ANIMAL COMMUNICATION: THE ROLE OF MEANING

We turn in this section to consider the implications of the chimp language wars for our understanding of the development of (human) thinking. The first attempts to train non-human primates to use something like human communication failed because the view of language that informed the research was based on the idea that words communicate by being associated with things. This is a view of meaning according to which language is conceptualised as a naming game. Therefore, the goal was just to train an animal to form associations between new signs and objects, and see if animals would combine signs and show evidence of syntax. The more successful second attempt to teach apes language, however, was based on quite a different view of language and meaning. The take-home message then is that language does not work simply through associations between words and objects or events. What is especially interesting about this second round of chimp research is the nature of the interactive and linguistic environment that made language learning possible. Words are not seen as being attached to meanings; rather that people use them to convey meaning and they are learned within shared routines or well-known patterns of activity. This approach to language learning resulted in bonobos and chimpanzees acquiring at least its rudiments.

The question of whether other species can learn human languages depends on how it is conceptualised. From the perspective of Chomsky (e.g. 2007) and Pinker (1994), language is based on knowledge of the set of rules of syntax, and since chimpanzees do not seem to be able to learn this whole system they are not considered to have a language. This approach has been referred to as Cartesian (see Chapter 1) because it is based on a search for a firm dividing line between species and contrasted with a Darwinian approach based on an expectation of continuity between species (Canfield, 1995, 2007). The Darwinian approach also fits with Wittgenstein's (1953) view of language, according to which rather than one coherent whole, language is made up of a large collection of different social activities or language games. Adults are immersed in 'playing' such games in an effortless way so it may be difficult to reflect on the nature of language. However, it can be seen developing as children learn to communicate. In the previous chapter we examined how they become engaged in everyday activities such as eating, going for a walk, playing, greeting, and so on. They gradually rely on shared knowledge of these routines to communicate. For example, a 13-month-old holding his foot over his shoe or a 16-month-old bringing her shoes to her mother is also developing the ability to request going for a walk. They do so based on shared experience with this activity. Such communication becomes even more effective when the child adds a word like 'outside'.

From this perspective, Savage Rumbaugh's research described in the previous section suggests that some other species, particularly the great apes, can learn some of the rudiments of language. However, whether they can learn the fluidity of language games

is debatable. For example, the sign language-trained chimpanzee, Washoe, was alleged to have insulted her keeper. She displayed anger about being placed in a small holding cage and she made the sign for dirty as in dirty diaper and then the sign for her keeper's name. This bears the hallmarks of a human insult, but there is no record of Washoe combining signs to make similar comments. To be convincing that she had mastered the language game of insulting, we would need evidence of an expectation that her signs would hurt his feelings through belittling and humiliating him, and that she could experience being insulted herself (Canfield, 1995).

This example encourages us to think again about the differences between animal and human forms of communication. Consider the difference between a dog scratching at a door to be let in, and a person knocking at the door. What is the difference between these two examples? It appears that they have the same goal – to get in. But what differences in understanding are involved and how do these develop? We could explain the dog's behaviour as being socially shaped. Perhaps it was initially just trying to open the door with its paw with no awareness that this would result in it gaining access. The scratching has meaning for the owner but the dog was not intentionally trying to communicate (just to get in). As the scratching is responded to by the owner, gradually the dog comes to acquire expectations about what happens when he scratches at the door – that is, it often opens. But this explanation will not do for the human, at least for humans older than about 12 months. Some form of awareness or anticipation of how others typically respond must surely be involved. The dog's activity can be explained as originating in practical activity. Human communication is similarly based originally in such concrete action, but our activity does not stop there when we consider the development of conventions like door knocking (and waiting for a sufficient or 'polite' time before knocking again). At some point children develop an awareness of the effect of a signal on others. How does this happen? Our approach is that instead of simply focusing on the individual and a psychological concept like 'attention', we start from the infant's observable interaction with others. Attentiveness is an observable aspect of interpersonal engagement with others. Infants develop expectations about another person's attitudes in particular situations.

The issue of meaning has been an underlying theme in the first part of this chapter as well as the previous two chapters, on the origins of infant communication. Meaning first emerged in this book in explaining how infants develop the ability to use gestures, discussed in Chapter 5. It then cropped up later when we considered whether animal communication is similar to human language. It will be the focus of our attention in our analysis of the nature of language itself in Chapter 8 and in how children learn language in Chapter 9, where we will examine the everyday miracle of how it is that words come to have meaning.

Although the nature of meaning has been a central problem in philosophy for much of the last century, psychologists rarely concern themselves with this question. Theories in psychology, however, are built on assumptions about meaning, and it is essential to examine these because they are too often simply taken for granted. This lack of concern regarding meaning may be because it is felt that an answer is already well accepted and

straightforward. However, this view of meaning on which theories in psychology and language development are based is deeply flawed, according to criticism from Ludwig Wittgenstein and others (see Chapter 9). In attempting to unpack this process the work of G. H. Mead (1934, especially pages 75–79) is helpful, although there are parts of the story that still need to be filled in because he was not interested primarily in development. Rather, he focused on how meaning exists in interactions between animals, and his approach is highly relevant to the issues that emerge from the ape studies discussed in this chapter. Mead introduced an important distinction between conversations of gestures and significant gestures. A *non-significant gesture* is an action taken by one dog that is responded to by a second animal, but there is no evidence that the first intended to evoke that response. In a dog fight, for example, one dog may take an aggressive posture and the other will assume a defensive stance or run. In contrast, *significant gestures*, which are a hallmark of higher order communication, involve the shared understanding of a gesture or utterance shown in being able to anticipate how the other will respond. That is, they demarcate the transition from a communication that is unintentional to one that is intentional:

> A … gesture … means this idea behind it and it arouses that idea in the other individual … in the present case we have a symbol which answers to a meaning in the experience of the first individual and which also calls out that meaning in the second individual. Where the gesture reaches that situation it has become what we call 'language'. It is now a significant symbol and it signifies a certain meaning. (Mead, 1934, pp. 45–46)

Savage Rumbaugh's research suggests that Kanzi's and others' use of signs contains the elements of this capability. However, there are still many questions about how non-significant gestures develop into significant gestures, how it is that humans are adapted to make this transition. Meaning is an underlying issue in dealing with the question of human thinking.

SUMMARY AND CONCLUSIONS

We have examined animal communication systems, primarily in order to learn more about human language. This topic is also relevant for reflecting on how human forms of language and cognition evolved. The first question we addressed concerned whether there are any animal communication systems that are similar to human languages. Although many species from honeybees to great apes have complex and effective systems of communication, it is less clear how aware they are of communicating, and whether there is a fixed set of events that can be communicated about, or if there is potential for generativity in the sense of communicating about new experiences. It is the generative, or productive, use of language that seems quintessentially human.

The next question was whether animals can be taught to use human languages. Based on the first round of the chimp language wars, the general evaluation of the capacity of primates to learn language is that apes imitate their caregivers, and only make requests with redundant series of signs, and hence it was widely accepted that apes cannot learn language. However, this conclusion was called into question by research conducted by Savage-Rumbaugh and her colleagues suggesting that bonobos and chimpanzees can learn to understand human languages and acquire at least rudimentary communication skills when they grow up in a linguistic environment, similar to the way in which human children learn languages. This approach to research was based on a different view of meaning. From this perspective, instead of being attached to words or sentences, meaning depends on the context within an ongoing sequence of interaction. This view of meaning is consistent with the approach introduced by G. H. Mead. From this perspective meaning is necessarily social, and therefore thinking, which is based on a system of meaning, must emerge within the child's everyday social interactions.

FURTHER READING

Savage-Rumbaugh, E. S. (1996). *Kanzi: The Ape at the Brink of the Human Mind*. New York: Wiley.

Savage-Rumbaugh, S. E., Murphy, J., Sevcik, R. A., Brakke, K. E., Williams, S. L., & Rumbaugh, D. M. (1993). Language comprehension in ape and child. *Monographs of the Society for Research in Child Development*, *58* (Serial No. 233).

VIDEO LINKS

Vervet monkeys' alarm calls: www.youtube.com/watch?v=q8ZG8Dpc8mM

Honeybee dancing to communicate: www.youtube.com/watch?v=-7ijI-g4jHg

Honeybee playing soccer: www.theregister.co.uk/2017/02/27/scientists_teach_bees_to_play_football/

Kanzi the bonobo: www.youtube.com/watch?v=2Dhc2zePJFE; www.greatapetrust.org/library/video-gallery/#bonobosTab