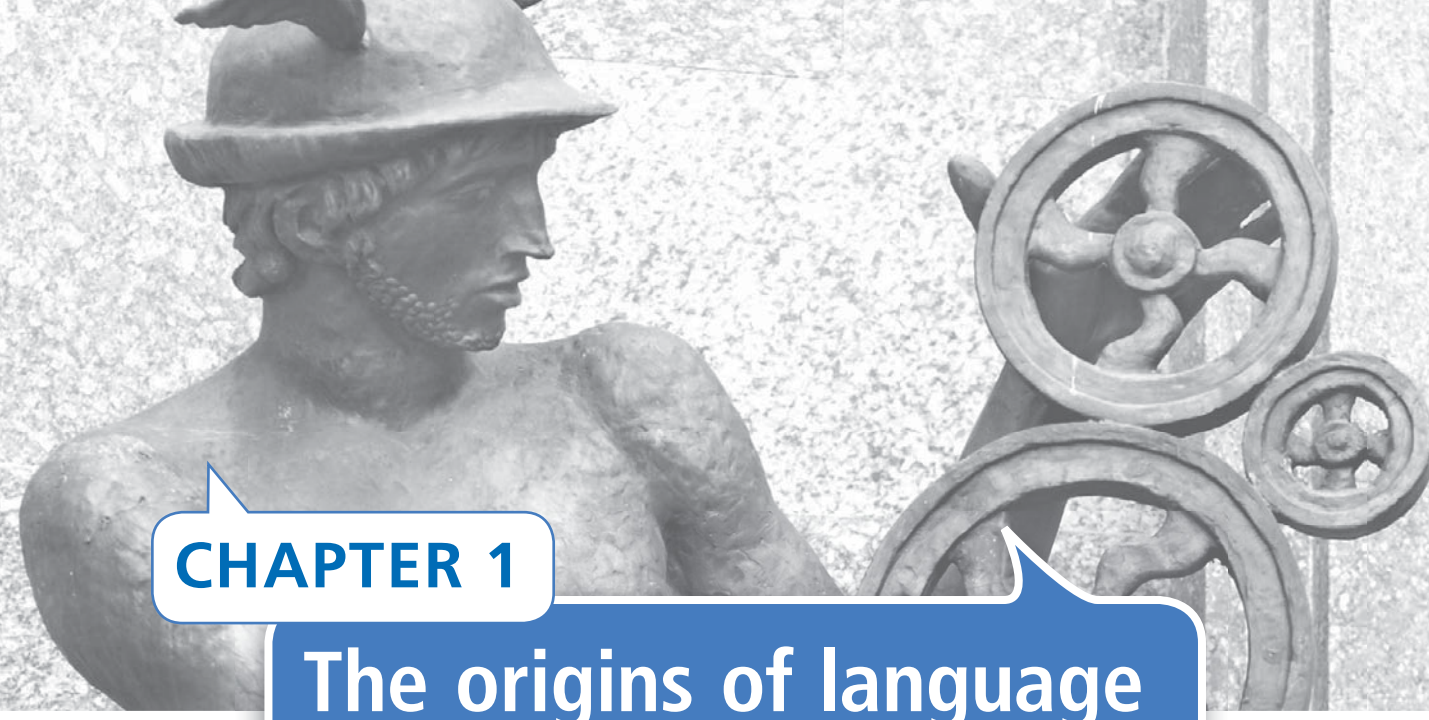

CHAPTER 1
The origins of language

The suspicion does not appear improbable that the progenitors of man, either the males or females, or both sexes, before they had acquired the power of expressing their mutual love in articulate language, endeavoured to charm each other with musical notes and rhythm.

Darwin (1871)

In Charles Darwin's vision of the origins of language, early humans had already developed musical ability prior to language and were using it "to charm each other." This may not match the typical image that most of us have of our early ancestors as rather rough characters wearing animal skins and not very charming, but it is an interesting speculation about how language may have originated. It remains, however, a speculation.

We simply don't know how language originated. We do know that the ability to produce sound and simple vocal patterning (a hum versus a grunt, for example) appears to be in an ancient part of the brain that we share with all vertebrates, including fish, frogs, birds and other mammals. But that isn't human language. We suspect that some type of spoken language must have developed between 100,000 and 50,000 years ago, well before written language (about 5,000 years ago). Yet, among the traces of earlier periods of life on earth, we never find any direct evidence or artifacts relating to the speech of our distant ancestors that might tell us how language was back in the early stages. Perhaps because of this absence of direct physical evidence, there has been no shortage of speculation about the origins of human speech.

The divine source

In the biblical tradition, as described in the book of Genesis, God created Adam and "whatsoever Adam called every living creature, that was the name thereof." Alternatively, following a Hindu tradition, language came from Sarasvati, wife of Brahma, creator of the universe. In most religions, there appears to be a divine source who provides humans with language. In an attempt to rediscover this original divine language, a few experiments have been carried out, with rather conflicting results. The basic hypothesis seems to have been that, if human infants were allowed to grow up without hearing any language around them, then they would spontaneously begin using the original God-given language.

The Greek writer Herodotus reported the story of an Egyptian pharaoh named Psammetichus (or Psamtik) who tried the experiment with two newborn babies more than 2,500 years ago. After two years of isolation except for the company of goats and a mute shepherd, the children were reported to have spontaneously uttered, not an Egyptian word, but something that was identified as the Phrygian word *bekos*, meaning "bread." The pharaoh concluded that Phrygian, an older language spoken in part of what is modern Turkey, must be the original language. That seems very unlikely. The children may not have picked up this "word" from any human source, but as several commentators have pointed out, they must have heard what the goats were saying. (First remove the *-kos* ending, which was added in the Greek version of the story, then pronounce *be-* as you would the English word *bed* without *-d* at the end. Can you hear a goat?)

King James the Fourth of Scotland carried out a similar experiment around the year 1500 and the children were reported to have spontaneously started speaking Hebrew, confirming the king's belief that Hebrew had indeed been the language of the Garden of Eden. It is unfortunate that all other cases of children who have been discovered living in isolation, without coming into contact with human speech, tend not to confirm the results of these types of divine-source experiments. Very young children living without access to human language in their early years grow up with no language at all. This was true of Victor, the wild boy of Aveyron in France, discovered near the end of the eighteenth century, and also of Genie, an American child whose special life circumstances came to light in the 1970s (see Chapter 12). From this type of evidence, there is no "spontaneous" language. If human language did emanate from a divine source, we have no way of reconstructing that original language, especially given the events in a place called Babel, "because the Lord did there confound the language of all the earth," as described in Genesis (11: 9).

The natural sound source

A quite different view of the beginnings of language is based on the concept of natural sounds. The human auditory system is already functioning before birth (at around

seven months). That early processing capacity develops into an ability to identify sounds in the environment, allowing humans to make a connection between a sound and the thing producing that sound. This leads to the idea that primitive words derive from imitations of the natural sounds that early men and women heard around them. Among several nicknames that he invented to talk about the origins of speech, Jespersen (1922) called this idea the "bow-wow" theory.

The "bow-wow" theory

In this scenario, when different objects flew by, making a Caw-Caw or Coo-Coo sound, the early human tried to imitate the sounds and then used them to refer to those objects even when they weren't present. The fact that all modern languages have some words with pronunciations that seem to echo naturally occurring sounds could be used to support this theory. In English, in addition to *cuckoo*, we have *splash*, *bang*, *boom*, *rattle*, *buzz*, *hiss*, *screech*, and of course *bow-wow*.

Words that sound similar to the noises they describe are examples of **onomatopeia**. While it is true that a number of words in any language are onomatopoeic, it is hard to see how most of the soundless things (e.g. "low branch") as well as abstract concepts (e.g. "truth") could have been referred to in a language that simply echoed natural sounds. We might also be rather skeptical about a view that seems to assume that a language is only a set of words used as "names" for things.

The "pooh-pooh" theory

Another of Jespersen's nicknames was the "pooh-pooh" theory, which proposed that speech developed from the instinctive sounds people make in emotional circumstances. That is, the original sounds of language may have come from natural cries of emotion such as pain, anger and joy. By this route, presumably, *Ouch!* came to have its painful connotations. But *Ouch!* and other interjections such as *Ah!*, *Ooh!*, *Phew!*, *Wow!* or *Yuck!* are usually produced with sudden intakes of breath, which is the opposite of ordinary talk. We normally produce spoken language as we breath out, so we speak while we exhale, not inhale. In other words, the expressive noises people make in emotional reactions contain sounds that are not otherwise used in speech production and consequently would seem to be rather unlikely candidates as source sounds for language.

The social interaction source

Another proposal involving natural sounds was nicknamed the "yo-he-ho" theory. The idea is that the sounds of a person involved in physical effort could be the source of our language, especially when that physical effort involved several people and the

interaction had to be coordinated. So, a group of early humans might develop a set of hums, grunts, groans and curses that were used when they were lifting and carrying large bits of trees or lifeless hairy mammoths.

The appeal of this proposal is that it places the development of human language in a social context. Early people must have lived in groups, if only because larger groups offered better protection from attack. Groups are necessarily social organizations and, to maintain those organizations, some form of communication is required, even if it is just grunts and curses. So, human sounds, however they were produced, must have had some principled use within the life and social interaction of early human groups. This is an important idea that may relate to the uses of humanly produced sounds. It does not, however, answer our question regarding the origins of the sounds produced. Apes and other primates live in social groups and use grunts and social calls, but they do not seem to have developed the capacity for speech.

The physical adaptation source

Instead of looking at types of sounds as the source of human speech, we can look at the types of physical features humans possess, especially those that are distinct from other creatures, which may have been able to support speech production. We can start with the observation that, at some early stage, our ancestors made a very significant transition to an upright posture, with bi-pedal (on two feet) locomotion, and a revised role for the front limbs.

Some effects of this type of change can be seen in physical differences between the skull of a gorilla and that of a Neanderthal man from around 60,000 years ago. The reconstructed vocal tract of a Neanderthal suggests that some consonant-like sound distinctions would have been possible. We have to wait until about 35,000 years ago for features in reconstructions of fossilized skeletal structures that begin to resemble those of modern humans. In the study of evolutionary development, there are certain physical features, best thought of as partial adaptations, which appear to be relevant for speech. They are streamlined versions of features found in other primates. By themselves, such features wouldn't guarantee speech, but they are good clues that a creature with such features probably has the capacity for speech.

Teeth and lips

Human **teeth** are upright, not slanting outwards like those of apes, and they are roughly even in height. Such characteristics are not very useful for ripping or tearing food and seem better adapted for grinding and chewing. They are also very helpful in making sounds such as *f* or *v*. Human **lips** have much more intricate muscle interlacing than is found in other primates and their resulting flexibility certainly helps in making sounds like *p*, *b* and *m*. In fact, the *b* and *m* sounds are the most widely

attested in the vocalizations made by human infants during their first year, no matter which language their parents are using.

Mouth and tongue

The human **mouth** is relatively small compared to other primates and can be opened and closed rapidly. It is also part of an extended vocal tract that has much more of an L-shape than the fairly straight path from front to back in other mammals. In contrast to the fairly thin flat tongue of other large primates, humans have a shorter, thicker and more muscular **tongue** that can be used to shape a wide variety of sounds inside the oral cavity. In addition, unlike other primates, humans can close off the airway through the nose to create more air pressure in the mouth. The overall effect of these small differences taken together is a face with more intricate muscle interlacing in the lips and mouth, capable of a wider range of shapes and a more rapid and powerful delivery of sounds produced through these different shapes.

Larynx and pharynx

The human **larynx** or "voice box" (containing the vocal folds or vocal cords) differs significantly in position from the larynx of other primates such as monkeys. In the course of human physical development, the assumption of an upright posture moved the head more directly above the spinal column and the larynx dropped to a lower position. This created a longer cavity called the **pharynx**, above the vocal folds, which acts as a resonator for increased range and clarity of the sounds produced via the larynx and the vocal tract. Other primates have almost no pharynx. One unfortunate consequence of this development is that the lower position of the human larynx makes it much more possible for the human to choke on pieces of food. Monkeys may not be able to use their larynx to produce speech sounds, but they do not suffer from the problem of getting food stuck in their windpipe. In evolutionary terms, there must have been a big advantage in getting this extra vocal power (i.e. a larger range of sounds) to outweigh the potential disadvantage from an increased risk of choking to death.

The tool-making source

In the physical adaptation view, one function (producing speech sounds) must have been superimposed on existing anatomical features (teeth, lips) previously used for other purposes (chewing, sucking). A similar development is believed to have taken place with human hands and some believe that manual gestures may have been a precursor of language. By about two million years ago, there is evidence that humans had developed preferential right-handedness and had become capable of making

stone tools. Wood tools and composite tools eventually followed. Tool-making, or the outcome of manipulating objects and changing them using both hands, is evidence of a brain at work.

The human brain

The human **brain** is not only large relative to human body size, it is also **lateralized**, that is, it has specialized functions in each of the two hemispheres. (More details are presented in Chapter 12.) Those functions that control the motor movements involved in complex vocalization (speaking) and object manipulation (making or using tools) are very close to each other in the left hemisphere of the brain. That is, the area of the motor cortex that controls the muscles of the arms and hands is next to the articulatory muscles of the face, jaw and tongue. It may be that there was an evolutionary connection between the language-using and tool-using abilities of humans and that both were involved in the development of the speaking brain. Most of the other speculative proposals concerning the origins of speech seem to be based on a picture of humans producing single noises to indicate objects in their environment. This activity may indeed have been a crucial stage in the development of language, but what it lacks is any structural organization. All languages, including sign language, require the organizing and combining of sounds or signs in specific arrangements. We seem to have developed a part of our brain that specializes in making these arrangements.

If we think in terms of the most basic process involved in primitive tool-making, it is not enough to be able to grasp one rock (make one sound); the human must also be able to bring another rock (other sounds) into proper contact with the first in order to develop a tool. In terms of language structure, the human may have first developed a naming ability by producing a specific and consistent noise (e.g. *beer*) for a specific object. The crucial additional step was to bring another specific noise (e.g. *good*) into combination with the first to build a complex message (*beer good*). Several thousand years of development later, humans have honed this message-building capacity to a point where, on Saturdays, watching a football game, they can drink a sustaining beverage and proclaim *This beer is good*. As far as we know, other primates are not doing this.

The genetic source

We can think of the human baby in its first few years as a living example of some of these physical changes taking place. At birth, the baby's brain is only a quarter of its eventual weight and the larynx is much higher in the throat, allowing babies, like chimpanzees, to breathe and drink at the same time. In a relatively short period of time, the larynx descends, the brain develops, the child assumes an upright posture and starts walking and talking.

This almost automatic set of developments and the complexity of the young child's language have led some scholars to look for something more powerful than small physical adaptations of the species over time as the source of language. Even children who are born deaf (and do not develop speech) become fluent sign language users, given appropriate circumstances, very early in life. This seems to indicate that human offspring are born with a special capacity for language. It is innate, no other creature seems to have it, and it isn't tied to a specific variety of language. Is it possible that this language capacity is genetically hard-wired in the newborn human?

As a solution to the puzzle of the origins of language, this **innateness hypothesis** would seem to point to something in human genetics, possibly a crucial mutation, as the source. This would not have been a gradual change, but something that happened rather quickly. We are not sure when this proposed genetic change might have taken place or how it might relate to the physical adaptations described earlier. However, as we consider this hypothesis, we find our speculations about the origins of language moving away from fossil evidence or the physical source of basic human sounds toward analogies with how computers work (e.g. being pre-programmed or hard-wired) and concepts taken from the study of genetics. The investigation of the origins of language then turns into a search for the special "language gene" that only humans possess.

If we are indeed the only creatures with this special capacity for language, then will it be completely impossible for any other creature to produce or understand language? We'll try to answer that question in Chapter 2.

STUDY QUESTIONS

1 Why are interjections such as *Ooh!* or *Yuck!* considered to be unlikely sources of human speech sounds?

2 What is the basic idea behind the "bow-wow" theory of language origin?

3 Why is it difficult to agree with Psammetichus that Phrygian must have been the original human language?

4 Where is the pharynx and how did it become an important part of human sound production?

5 Why do you think that young deaf children who become fluent in sign language would be cited in support of the innateness hypothesis?

6 With which of the six "sources" would you associate this quotation?

> Chewing, licking and sucking are extremely widespread mammalian activities, which, in terms of casual observation, have obvious similarities with speech. (MacNeilage, 1998)

TASKS

A What is the connection between the Heimlich maneuver and the development of human speech?

B What exactly happened at Babel and why is it used in explanations of language origins?

C What are the arguments for and against a teleological explanation of the origins of human language?

D The idea that "ontogeny recapitulates phylogeny" was first proposed by Ernst Haeckel in 1866 and is still frequently used in discussions of language origins. Can you find a simpler or less technical way to express this idea?

E The Danish linguist Otto Jespersen, who gave us the terms "bow-wow" and "pooh-pooh" for theories about language origins, dismissed both of these ideas in favor of another theory. What explanation did Jespersen (1922, chapter 21) favor as the likely origin of early speech?

F In his analysis of the beginnings of human language, William Foley comes to the conclusion that "language as we understand it was born about 200,000 years ago" (1997: 73). This is substantially earlier than the dates (between 100,000 and 50,000 years ago) that other scholars have proposed. What kinds of evidence and arguments are typically presented in order to choose a particular date "when language was born"?

G What is the connection between the innateness hypothesis, as described in this chapter, and the idea of a Universal Grammar?

H When it was first identified, the FOXP2 gene was hailed as the "language gene." What was the basis of this claim and how has it been modified?

DISCUSSION TOPICS/PROJECTS

I In this chapter we didn't address the issue of whether language has developed as part of our general cognitive abilities or whether it has evolved as a separate component that can exist independently (and is unrelated to intelligence, for example). What kind of evidence do you think would be needed to resolve this question?

(For background reading, see chapter 4 of Aitchison, 2000.)

II A connection has been proposed between language, tool-using and right-handedness in the majority of humans. Is it possible that freedom to use the hands, after assuming an upright bipedal posture, resulted in certain skills that led to the development of language? Why did we assume an upright posture? What kind of changes must have taken place in our hands?

(For background reading, see Beaken, 2011.)

FURTHER READING

Basic treatments

Aitchison, J. (2000) *The Seeds of Speech* (Canto edition) Cambridge University Press

Kenneally, C. (2007) *The First Word* Viking Press

More detailed treatments

Beaken, M. (2011) *The Making of Language* (2nd edition) Dunedin Academic Press

McMahon, A. and R. McMahon (2013) *Evolutionary Linguistics* Cambridge University Press

Music before language

Mithen, S. (2006) *The Singing Neanderthals* Harvard University Press

A hum versus a grunt

Bass, A., E. Gilland and R. Baker (2008) "Evolutionary origins for social vocalization in a vertebrate hindbrain-spinal compartment" *Science* 321 (July 18): 417–421

Victor and Genie

Lane, H. (1976) *The Wild Boy of Aveyron* Harvard University Press

Rymer, R. (1993) *Genie* HarperCollins

"Bow-wow" theory, etc.

Jespersen, O. (1922) *Language: Its Nature, Development and Origin* George Allen & Unwin

The early sounds made by infants

Locke, J. (1983) *Phonological Acquisition and Change* Academic Press

Social interaction

Burling, R. (2005) *The Talking Ape* Oxford University Press

Physical development

Lieberman, P. (1998) *Eve Spoke: Human Language and Human Evolution* W. W. Norton

Gesture

Corballis, M. (2002) *From Hand to Mouth* Princeton University Press

McNeill, D. (2012) *How Language Began: Gesture and Speech in Human Evolution* Cambridge University Press

Brain development

Loritz, D. (1999) *How the Brain Evolved Language* Oxford University Press

Tool-making

Gibson, K. and T. Ingold (eds.) (1993) *Tools, Language and Cognition in Human Evolution* Cambridge University Press

Innateness

Pinker, S. (1994) *The Language Instinct* William Morrow

Against innateness

Sampson, G. (2005) *The "Language Instinct" Debate* (revised edition) Continuum

Other references

Foley, W. (1997) *Anthropological Linguistics* Blackwell

MacNeilage, P. (1998) "The frame/content theory of evolution of speech production" *Behavioral and Brain Sciences* 21: 499–546

CHAPTER 2

Animals and human language

One evening in the mid-1980s my wife and I were returning from an evening cruise around Boston Harbor and decided to take a waterfront stroll. We were passing in front of the Boston Aquarium when a gravelly voice yelled out, "Hey! Hey! Get outa there!" Thinking we had mistakenly wandered somewhere we were not allowed, we stopped and looked around for a security guard or some other official, but saw no one, and no warning signs. Again the voice boomed, "Hey! Hey you!" As we tracked the voice we found ourselves approaching a large, glass-fenced pool in front of the aquarium where four harbor seals were lounging on display. Incredulous, I traced the source of the command to a large seal reclining vertically in the water, with his head extended back and up, his mouth slightly open, rotating slowly. A seal was talking, not to me, but to the air, and incidentally to anyone within earshot who cared to listen.

Deacon (1997)

There are a lot of stories about creatures that can talk. We usually assume that they are fantasy or fiction or that they involve birds or animals simply imitating something they have heard humans say (as Terrence Deacon discovered was the case with the loud seal in Boston Aquarium). Yet we think that creatures are capable of communicating, certainly with other members of their own species. Is it possible that a creature could learn to communicate with humans using language? Or does human language have properties that make it so unique that it is quite unlike any other communication system and hence unlearnable by any other creature? To answer these questions, we first look at some special properties of human language, then review a number of experiments in communication involving humans and animals.

Communication

We should first distinguish between specifically **communicative signals** and those which may be unintentionally **informative signals**. Someone listening to you may become informed about you through a number of signals that you have not intentionally sent. She may note that you have a cold (you sneezed), that you aren't at ease (you shifted around in your seat), that you are disorganized (non-matching socks) and that you are from somewhere else (you have a strange accent). However, when you use language to tell this person, *I'm one of the applicants for the vacant position of senior brain surgeon at the hospital*, you are normally considered to be intentionally communicating something.

Humans are capable of producing sounds and syllables in a stream of speech that appears to have no communicative purpose, as in **glossolalia**, or "speaking in tongues," which is associated with the religious practices of Pentecostal churches. These outpourings sound like language, but with no speaker control, it isn't intentional communication. We might say the same thing about some of the chirping and singing produced by birds. We also don't assume that the blackbird is communicating anything by having black feathers, sitting on a branch and looking down at the ground. However, the bird is considered to be sending a communicative signal with the loud squawking that is produced when a cat appears on the scene. So, when we talk about distinctions between human language and animal communication, we are considering both in terms of their potential as a means of intentional communication.

Properties of human language

While we tend to think of communication as the primary function of human language, it is not a distinguishing feature. All creatures communicate in some way, even if it's not through vocalization. However, we suspect that other creatures are not reflecting on the way they create their communicative messages or reviewing how they work (or not). That is, one barking dog is probably not offering advice to another barking dog along the lines of "Hey, you should lower your bark to make it sound more menacing." They're not barking about barking. Humans are clearly able to reflect on language and its uses (e.g. "I wish he wouldn't use so many technical terms"). This is **reflexivity**. The property of reflexivity (or "reflexiveness") accounts for the fact that we can use language to think and talk about language itself, making it one of the distinguishing features of human language. Indeed, without this general ability, we wouldn't be able to reflect on or identify any of the other distinct properties of human language. We'll look in detail at another five of them: displacement, arbitrariness, productivity, cultural transmission and duality.

Displacement

When your pet cat comes home and stands at your feet calling *meow*, you are likely to understand this message as relating to that immediate time and place. If you ask your cat what it's been up to, you'll probably get the same *meow* response. Animal communication seems to be designed exclusively for this moment, here and now. It isn't used to relate events that are far removed in time and place. When your dog says *GRRR*, it means *GRRR, right now,* because dogs aren't capable of communicating *GRRR, last night, over in the park*. In contrast, human language users are normally capable of producing messages equivalent to *GRRR, last night, over in the park*, and then going on to say *In fact, I'll be going back tomorrow for some more.* Humans can refer to past and future time. This property of human language is called **displacement**. It allows language users to talk about things and events not present in the immediate environment. Indeed, displacement allows us to talk about things and places (e.g. angels, fairies, Santa Claus, Superman, heaven, hell) whose existence we cannot even be sure of.

We could look at bee communication as a small exception because it seems to have some version of displacement. When a honeybee finds a source of nectar and returns to the beehive, it can perform a dance routine to communicate to the other bees the location of this nectar. Depending on the type of dance (round dance for nearby and tail-wagging dance, with variable tempo, for further away and how far), the other bees can work out where this newly discovered feast can be found. Doesn't this ability of the bee to indicate a location some distance away mean that bee communication has at least some degree of displacement as a feature? Yes, but it is displacement of a very limited type. It just doesn't have the range of possibilities found in human language. Certainly, the bee can direct other bees to a food source. However, it must be the most recent food source. It cannot be *that delicious rose bush on the other side of town that we visited last weekend*, nor can it be, as far as we know, possible future nectar in bee heaven.

Arbitrariness

It is generally the case that there is no "natural" connection between a linguistic form and its meaning. The connection is quite arbitrary. We can't just look at the Arabic word بلک and, from its shape, for example, determine that it has a natural and obvious meaning any more than we can with its English translation form *dog*. The linguistic form has no natural or "iconic" relationship with that hairy four-legged barking object out in the world. This aspect of the relationship between words and objects is described as **arbitrariness**. It is possible, as in a child's game, to make words appear to "fit" the idea or activity they indicate, as shown in Figure 2.1.

Figure 2.1

However, this type of game only emphasizes the arbitrariness of the connection that normally exists between a word and its meaning.

There are some words in language with sounds that seem to "echo" the sounds of objects or activities and hence seem to have a less arbitrary connection. English examples are *cuckoo*, *crash*, *slurp*, *squelch* or *whirr*. However, these onomatopoeic words are relatively rare in human language.

For the majority of animal signals, there does appear to be a clear connection between the conveyed message and the signal used to convey it. This impression may be closely connected to the fact that, for any animal, the set of signals used in communication is finite. Each variety of animal communication consists of a limited set of vocal or gestural forms. Many of these forms are only used in specific situations (to establish territory) or at particular times (to find a mate).

Productivity

Humans are continually creating new expressions by manipulating their linguistic resources to describe new objects and situations. This property is described as **productivity** (or "creativity" or "open-endedness") and essentially means that the potential number of utterances in any human language is infinite.

The communication systems of other creatures are not like that. Cicadas have four signals to choose from and vervet monkeys have thirty-six vocal calls. Nor does it seem possible for creatures to produce new signals to communicate novel experiences or events. The honeybee, normally able to communicate the location of a nectar source to other bees, will fail to do so if the location is really "new." In one experiment, a hive of bees was placed at the foot of a radio tower and a food source placed at the top. Ten bees were taken to the top, given a taste of the delicious food, and sent off to tell the rest of the hive about their find. The message was conveyed via a bee dance and the whole gang buzzed off to get the free food. They flew around in all directions, but couldn't locate the food. (It's probably one way to make bees really mad.) The problem seems to be that bee communication has a fixed set of signals for communicating location and they all relate to horizontal distance. The bee cannot manipulate its communication system to create a "new" message indicating vertical distance. According to Karl von Frisch, who conducted the experiment, "the bees have no word for *up* in their language" and they can't invent one.

This lack of productivity in animal communication can be described in terms of **fixed reference**. Each signal in the communication system of other creatures seems to be fixed in terms of relating to a particular occasion or purpose. This is particularly true of scent-based signaling, as in the pheromones (a chemical substance) released by insects such as female moths as they try to contact a mate. It's a case of one scent, one meaning.

Among our closer relatives, there are lemurs (similar to small monkeys) in Madagascar that have only three basic calls, each tied to one type of dangerous or threatening situation. In the vervet monkey's repertoire, there is one danger signal *CHUTTER*, which is used when a snake is around, and another *RRAUP*, used when an eagle is spotted nearby. These signals are fixed in terms of their reference and cannot be manipulated. What might be presented as evidence of productivity in the monkey's communication system would be an utterance of something like *CHUTT-RRAUP* when a flying creature that looked like a snake came by. Despite a lot of research involving snakes suddenly appearing in the air above them (among other unusual and terrifying experiences), the vervet monkeys didn't produce a new danger signal. The human, given similar circumstances, is quite capable of creating a "new" signal, after initial surprise perhaps, by saying something never said before, as in *Hey! Watch out for that flying snake!*

Cultural transmission

While we may inherit physical features such as brown eyes and dark hair from our parents, we do not inherit their language. We acquire a language in a culture with other speakers and not from parental genes. An infant born to Korean parents in Korea, but adopted and brought up from birth by English speakers in the United States, will have physical characteristics inherited from his or her natural parents, but will inevitably speak English. A kitten, given comparable early experiences, will produce *meow* regardless.

This process whereby a language is passed on from one generation to the next is described as **cultural transmission**. It is clear that humans are born with some kind of predisposition to acquire language in a general sense. However, we are not born with the ability to produce utterances in a specific language such as English. We acquire our first language as children in a culture.

The general pattern in animal communication is that creatures are born with a set of specific signals that are produced instinctively. There is some evidence from studies of birds as they develop their songs that instinct has to combine with learning (or exposure) in order for the right song to be produced. If those birds spend their first seven weeks without hearing other birds, they will instinctively produce songs or calls, but those songs will be abnormal in some way. Human infants, growing up in isolation, produce no "instinctive" language.

Duality

Human language is organized at two levels or layers simultaneously. This property is called **duality** (or "double articulation"). When we speak, we have a physical level at which we produce individual sounds, like *n*, *b* and *i*. As individual sounds, none of these discrete forms has any intrinsic meaning. In a particular combination such as *bin*, we have another level producing a meaning that is different from the meaning of the combination in *nib*. So, at one level, we have distinct sounds, and, at another level, we have distinct meanings. This duality of levels is one of the most economical features of human language because, with a limited set of discrete sounds, we are capable of producing a very large number of sound combinations (e.g. words) that are distinct in meaning.

Among other creatures, each communicative signal appears to be a single fixed form that cannot be broken down into separate parts. Although your dog may be able to produce *woof* ("I'm happy to see you"), it does not seem to do so on the basis of a distinct level of production combining the separate elements of *w* + *oo* + *f*. If the dog was operating with the double level (i.e. duality), then we might expect to hear different combinations with different meanings, such as *oowf* ("I'm hungry") and *foow* ("I'm really bored").

Talking to animals

If these properties make human language such a unique communication system, then it would seem extremely unlikely that other creatures would be able to understand it. Some humans, however, do not behave as if this is the case. There is a lot of spoken language directed by humans to animals, apparently under the impression that the animal follows what is being said. Riders can say *Whoa* to horses and they stop, we can say *Heel* to dogs and they will follow at heel (well, sometimes), and a variety of circus animals go *Up*, *Down* and *Roll over* in response to spoken commands. Should we treat these examples as evidence that non-humans can understand human language? Probably not. The standard explanation is that the animal produces a particular behavior in response to a particular sound stimulus, but does not actually "understand" what the words in the noise mean.

If it seems difficult to conceive of animals understanding human language, then it appears to be even less likely that an animal would be capable of producing human language. After all, we do not generally observe animals of one species learning to produce the signals of another species. You could keep your horse in a field of cows for years, but it still won't say *Moo*. And, in some homes, a new baby and a puppy may arrive at the same time. Baby and puppy grow up in the same environment, hearing the same things, but two years later, the baby is

making lots of human speech sounds and the puppy is not. Perhaps a puppy is a poor example. Wouldn't it be better to work with a closer relative such as a chimpanzee?

Chimpanzees and language

The idea of raising a chimp and a child together may seem like a nightmare, but this is basically what was done in an early attempt to teach a chimpanzee to use human language. In the 1930s, two scientists (Luella and Winthrop Kellogg) reported on their experience of raising an infant chimpanzee together with their baby son. The chimpanzee, called Gua, was reported to be able to understand about a hundred words, but did not "say" any of them. In the 1940s, a chimpanzee named Viki was reared by another scientist couple (Catherine and Keith Hayes) in their own home, exactly as if she was a human child. These foster parents spent five years attempting to get Viki to "say" English words by trying to shape her mouth as she produced sounds. Viki eventually managed to produce some words, rather poorly articulated versions of *mama*, *papa* and *cup*. In retrospect, this was a remarkable achievement since it has become clear that non-human primates do not actually have a physically structured vocal tract which is suitable for articulating the sounds used in speech. Apes and gorillas can, like chimpanzees, communicate with a wide range of vocal calls, but they just can't make human speech sounds.

Washoe

Recognizing that a chimpanzee was not likely to learn spoken language, another scientist couple (Beatrix and Allen Gardner) set out to teach a female chimpanzee called Washoe to use a version of American Sign Language. As described later in Chapter 15, this sign language has all the essential properties of human language and is learned by many congenitally deaf children as their natural first language.

From the beginning, the Gardners and their research assistants raised Washoe like a human child in a comfortable domestic environment. Sign language was always used when Washoe was around and she was encouraged to use signs, even her own incomplete "baby-versions" of the signs used by adults. In a period of three and a half years, Washoe came to use signs for more than a hundred words, ranging from *airplane*, *baby* and *banana* through to *window*, *woman* and *you*. Even more impressive was Washoe's ability to take these forms and combine them to produce "sentences" of the type *gimme tickle*, *more fruit* and *open food drink* (to get someone to open the refrigerator). Some of the forms appear to have been inventions by Washoe, as in her novel sign for *bib* and in the combination *water bird* (referring to a swan),

which would seem to indicate that her communication system had the potential for productivity. Washoe also demonstrated understanding of a much larger number of signs than she produced and was capable of holding rudimentary conversations, mainly in the form of question–answer sequences. A similar ability with sign language was reported by Francine Patterson working with a gorilla named Koko not long after.

Sarah

At the same time as Washoe was learning sign language, another chimpanzee was being taught (by Ann and David Premack) to use a set of plastic shapes for the purpose of communicating with humans. These plastic shapes represented "words" that could be arranged in sequence to build "sentences" (Sarah preferred a vertical order, as shown in Figure 2.2). The basic approach was quite different from that of the Gardners. Sarah was systematically trained to associate these shapes with objects or actions. She remained an animal in a cage, being trained with food rewards to manipulate a set of symbols. Once she had learned to use a large number of these plastic shapes, Sarah was capable of getting an apple by selecting the correct plastic shape (a blue triangle) from a large array. Notice that this symbol is arbitrary since it would be hard to argue for any natural connection between an apple and a blue plastic triangle. Sarah was also capable of producing "sentences" such as *Mary give chocolate Sarah* and had the impressive capacity to understand complex structures such as *If Sarah put red on green, Mary give Sarah chocolate*. Sarah got the chocolate.

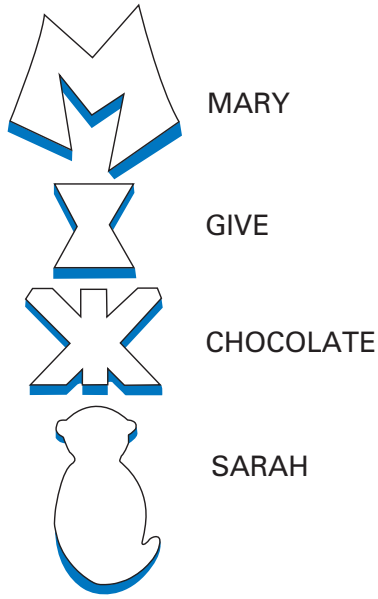

Figure 2.2

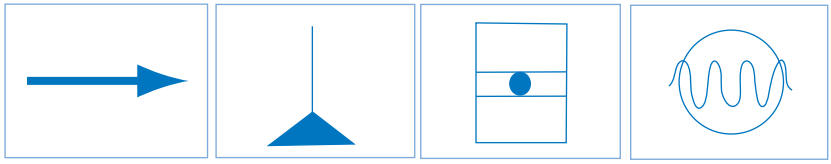

Figure 2.3

Lana

A similar training technique with another artificial language was used (by Duane Rumbaugh) to train a chimpanzee called Lana. The language she learned was called Yerkish and consisted of a set of symbols on a large keyboard linked to a computer. When Lana wanted some water, she had to find and press four symbols to produce the message *please machine give water*, as illustrated in Figure 2.3.

Both Sarah and Lana demonstrated an ability to use what look like word symbols and basic structures in ways that superficially resemble the use of language. There is, however, a lot of skepticism regarding these apparent linguistic skills. It has been pointed out that when Lana used the symbol for "please," she did not have to understand the meaning of the English word *please*. The symbol for "please" on the computer keyboard might simply be the equivalent of a button on a vending machine and, so the argument goes, we could learn to operate vending machines without necessarily knowing language. This is only one of the many arguments that have been presented against the idea that the use of signs and symbols by these chimpanzees is similar to the use of language.

The controversy

On the basis of his work with another chimpanzee called Nim, the psychologist Herbert Terrace argued that chimpanzees simply produce signs in response to the demands of people and tend to repeat signs those people use, yet they are treated (by naive researchers) as if they are taking part in a "conversation." As in many critical studies of animal learning, the chimpanzees' behavior is viewed as a type of conditioned response to cues provided (often unwittingly) by human trainers. Herbert's conclusion was that chimpanzees are clever creatures who learn to produce a certain type of behavior (signing or symbol selection) in order to get rewards and are essentially performing sophisticated "tricks."

In response, the Gardners argued that they were not animal trainers, nor were they inculcating and then eliciting conditioned responses from Washoe. In complex experiments, designed to eliminate any possible provision of cues by humans, they showed that in the absence of any human, Washoe could produce correct signs to identify objects in pictures. They also emphasize a major difference between the experiences of Washoe and Nim. While Nim was a research animal in a complex