As I shall try to demonstrate, human language is possibly the single most remarkable characteristic that we have, the one that most truly sets our species apart. Our faculty of language exhibits a number of properties which are remarkable, even astonishing. Without language, we could hardly have created the human world that we know. Our development of everything, from music to warfare could never have taken place in the absence of language. More than any other single characteristic, then, language is what makes us human. And human language is unique.

At first glance, this unique character may appear not so obvious. After all, practically every creature on the planet seems to have some kind of signalling system, some way of communicating with other members of the same species. Crickets chirp, birds sing, monkeys cry, fireflies flash, and even ants leave smelly trails for their co-workers to follow.

The fact is however that human language is completely different from all these other signalling systems, and we are obliged to treat it as a thing apart: a truly unique phenomenon.

I begin this chapter discussing some of the fundamental properties of human language. One of these properties is absolutely crucial to the very existence of language.

**Duality of patterning**

For most people, most of the time, the ordinary medium of language is speech. How do we speak? Easy: we allow air from the lungs to pass out through our mouths, and at the same time we move our mouths in various ways to produce speech sounds - consonants and vowels. What we say consists of a sequence of speech sounds, one after the other.

But here is an interesting question: how many different speech sounds can you produce?

Well, there is no exact answer to this question: it depends on just how much difference you want to insist on. But the number is certainly not large. Unless you've had specialist training in phonetics (the study of speech sounds), you will probably find it very difficult to produce even a hundred different individual sounds. (Remember, we're talking about individual sounds here, not sequences of sounds.) In fact, every human language operates with a much smaller set of speech sounds than this. Let's take a look at English.

Consider the word *cat*. How many speech sounds does it contain? They are three: the k-sound, the flat a, and the t-sound. For convenience, let us introduce special
symbols for these speech sounds: /k/, /æ/ and /t/, respectively. We use the slashes to indicate that we are talking about the distinctive speech sounds of a particular language - in this case, English. These distinctive speech sounds are called the **phonemes** of the language. Thus, in terms of the phonemes of English, the word *cat* can be represented as /kæt/.

Now, if someone asks you what the English word /kæt/ means, you will have no trouble in answering. But suppose someone asks you instead what the English phoneme /k/ means? This time it is impossible to answer, for the phoneme /k/ in fact has no meaning in English. Nor does any other phoneme: /æ/ and /t/ are just as meaningless as /k/.

But now notice something else: these same meaningless phonemes can be rearranged to produce different words with different meanings. Thus, the order /tæk/ produces the word *tack*, while /ækt/ gives *act*, /æt/ gives *at*, and /tækt/ gives *tact* or *tacked*.

Let's add one more phoneme to our set: the p-sound, or /p/. Now we can form the word /pæt/ *pat*, as well as /tæp/ *tap*, /pæk/ *pack*, /kæp/ *cap*, /pækt/ *pact* or *packed*, /tæpt/ *tapped*, /æpt/ *apt*, /kæpt/ *capped*, and quite a few others. You can see what's going on: by combining a very small set of meaningless speech sounds in various ways, we can produce a very large number of different meaningful items: words. All human languages are constructed in this way, and this type of structure is called **duality of patterning**, or **duality** for short. Duality is the use of a small number of meaningless elements in combination to produce a large number of meaningful elements.

Why is this type of structure so significant? Well, just imagine what the alternative would be. Suppose we had no meaningless sound units to work with — suppose instead that every individual sound we could produce had its own meaning. What would be the consequence of such an arrangement? It's obvious: **the number of different meanings we could express would be no greater than the number of different sounds we could produce.** And, since we have already seen that we can't produce more than about a hundred different speech sounds, the result would be that a language could only contain about a hundred 'words'. And this would be catastrophic: imagine a language consisting of no more than a hundred words. It is not remotely possible that, with such a drastically limited vocabulary, we could do most of the things we do with English or Spanish: we couldn't explain to the mechanic what's wrong with our car, we couldn't organise elections or negotiate treaties, and we couldn't charm our way into another person's heart with seductive conversation.

'So what?' you may be asking at this very moment. Isn't it the obvious way to go about things? Maybe so, but here's the crux: **no other species on earth has a signalling system based in duality.** Duality is unique to human language.

What do other creatures do, then? They do what we have just declared unthinkable for human language: their signalling systems are based on the principle of 'one sound, one meaning'. That is, a typical non-human animal will have one sound meaning, perhaps, 'This is my territory', and another meaning 'Look out: danger in
the air’, and perhaps a few more. But that’s it — the total number of different things such a creature can ‘say’ is no larger than the number of different sounds available. In practice, the number of different signals, or calls used by any given species is usually between three and six. And this, it should be obvious by now, is a stupendous difference. Some of the other important characteristics of language that we will be discussing are only made possible by this fundamental property of duality.

Displacement and open-endedness

Displacement is the use of language to talk about things other than the here and now. We have not the slightest difficulty in talking about last night’s football game, or our own childhood, or the behaviour of dinosaurs which lived over 100 million years ago, or the ultimate fate of the universe; with equal ease, we can discuss political events in Peru or the surface of the planet Neptune.

Open-endedness is our ability to use language to say anything at all, including lots of things that we have never said or heard before. Here are a few English sentences:

1. I find that polythene banjo strings give a most unsatisfactory twang.
2. Luxembourg has invaded New Zealand.
3. A large pink spider wearing sunglasses and wielding a feather duster boogied across the floor.
4. Shakespeare wrote his plays in Swahili, and they were translated into English by his African bodyguards.

It is most unlikely that you have ever encountered any of these sentences before, and yet you have not the slightest difficulty in understanding them — even if you don’t believe all of them. Nor do you have any more difficulty in producing totally new English sentences whenever you need them. In fact, most of the things you say and hear every day are completely new to you, and may never before have been uttered by anyone.

Both of these phenomena, our ability to talk about places and things far away in space and time, and our ability to produce and understand new utterances virtually without limit, are so familiar to us that we never give them a moment’s thought. And yet they are truly remarkable. Remarkable, and absolutely vital. Can you imagine being able to talk about nothing but the present moment and about nothing but what you can see as you speak? Equally, can you imagine speaking a language that consisted only of a fixed list of possible utterances, so that, every time you opened your mouth, you could do no more than choose one utterance from that list? Such a ‘language’ would be inconceivably far away from what we understand languages to be.

And yet this unthinkable state of affairs is exactly the way animal signalling systems appear to be. With one striking and famous exception, discussed below,
non-human animals do not exhibit displacement. Virtually all signs by non-human animals appear to relate directly, and exclusively, to the time and place of uttering. Furthermore, these creatures exhibit nothing that we could call open-endedness. Instead, it appears to be genuinely the case that each species' signalling system contains only a small number of possible utterances, and that nothing can be expressed beyond the limited range of possibilities available. A monkey may be able to say 'Look out: eagle' if that message is available in the system, but that same monkey cannot introduce any novelties: he cannot, for example, come up with an unprecedented 'Look out: two hunters with rifles', or, still less, on spotting the first Land Rover that he meets, 'Hey, everybody: what do you suppose that is?'

Of course, given the absence of duality, it could hardly be otherwise: we have already seen that duality is essential in a system that can express more than a small number of different meanings. Lacking duality, non-human creatures appear to be locked into a world of expression which we can barely conceive of: a system of communication lacking both a past and a future, bounded by the horizon, and devoid of novelties, consisting only of the endless repetition of a few familiar messages about what's going on at the moment.

**Stimulus-freedom**

Related to some of the preceding design features, but none the less partially distinct, is the property of **stimulus-freedom**, which is the ability to say anything you like in any context. Suppose someone says to you 'What do you think of my skirt?' You are free to make any response you like, including none at all. You might reply 'It's too short', or 'It doesn't go with your pink blouse', or 'Sorry, I have no taste in clothes'. You can even decline to answer, and change the subject.

Of course, this doesn't mean that human conversation is absolutely random. There are all sorts of social pressures that make some responses more likely than others. If you value the friendship of the woman in the skirt, you are most unlikely to reply 'God, Julia, my dog's blanket would look better; you have the worst taste in clothes'. Even if you're thinking that, you probably wouldn't say it. But you could say it if you wanted to: there's nothing about the language that prevents you, but merely social conventions and the desire to maintain good relationships.

By now you are probably expecting to hear that stimulus-freedom too is unique to human language, and I shall not disappoint you. Non-human signals are not stimulus-free, but rather **stimulus-bound**. That is, a non-human creature produces a particular signal always and only when the appropriate stimulus is present. If Fred the monkey is up a tree, and he sees a dangerous eagle approaching, he automatically produces the cry that means 'Look out: eagle!', and he never does this at any other time. He doesn't, on spotting the eagle, think to himself 'Maybe if I keep quiet the eagle will grab Old Charlie down there, and I'll be safe'. Nor does a bored Fred suddenly come out with an eagle warning and then laugh 'Haw, haw, Charlie - gotcha that time!'

Very occasionally however, an animal has been observed to do something unusual. For example, an Arctic fox was once spotted making a danger call in the
absence of any danger, apparently just to distract her cubs from a meal she was trying to eat. But such incidents are, so far at least, very rare and strictly anecdotal: they do not represent normal behaviour, which is overwhelmingly stimulus-bound.

Lacking duality, lacking displacement, lacking open-endedness, lacking stimulus-freedom, animal signalling systems are very different from human languages. The communicative world in which other creatures live is as different from ours as anything we could imagine. As I said at the beginning of this chapter, human language is unique on earth, and without it we could not count ourselves human at all.

**Arbitrariness**

In addition to the design features which set human language well apart from animal signalling systems, there are others which are not unique at all, but none the less worthy of attention. Chief among these is **arbitrariness**, which is the absence of any necessary connection between a linguistic form and its meaning.

Note that word *necessary*. I am certainly not suggesting that there is no connection at all between the English word *pig* and the animal to which we commonly apply it. Of course there's a connection, but it's an arbitrary connection. There is no a priori reason why English speakers should apply the particular sound sequence *pig* to that particular animal: the connection is purely a matter of agreement, and the word can be successfully used only so long as English speakers agree to use it in this particular way. Speakers of other languages, of course, have reached different agreements, but no word is intrinsically better suited to naming this particular animal than any other, though each is perfectly adequate as long as speakers agree about it.

Such agreement need not be for all time. The animal was formerly called a *swine* in English, but this older word is now little used except as a light-hearted insult, and *pig* has replaced it as the name of the animal. The decision as to which words shall have which meanings is entirely a matter of convention. Different languages have different conventions (that's part of the reason they are different languages), and conventions can and do change.

Arbitrariness can be demonstrated the other way round. The English word *mean* has several different meanings. The French word *mine* sounds almost exactly like English *mean*, but the French word means 'mine'. Likewise, Welsh *min* means 'edge', Basque *min* means 'pain', and Arabic *min* means 'from'. There is nothing about this sequence of sounds that makes any one meaning more natural than another.

The overwhelming presence of arbitrariness in language is the chief reason it takes so long to learn the vocabulary of a foreign language: it's generally impossible to guess the meaning of an unfamiliar word, and each new word just has to be learned individually. Even if I give you the big clue that all of the following Basque words are the names of living creatures, I very much doubt that you'll be able to guess any of them: *zaldi, igel, txori, oilo, behi, sagu*. In fact, they mean 'horse', 'frog', 'bird', 'hen', 'cow' and 'mouse', respectively.
This arbitrariness is the reason that the 'universal translator' beloved of science-fiction B movies is simply impossible. You know the scene: our intrepid space adventurers arrive on a new planet and find an alien race speaking a totally unfamiliar language, so they whip out their machine and twiddle a couple of dials, and hey presto!: the alien speech is at once rendered into perfect American English. Because of arbitrariness, even the most powerful computer can have no way of knowing whether the alien utterance *Kwarfnigli* means 'Welcome to our planet', or 'Prepare to be sacrificed to the Great God Kwarf, or 'You've parked your space ship in a tow-away zone', or perhaps even 'Hey, guys, come and look at these weirdos'. On a more realistic scale, even if you learn a couple of thousand Basque words, if someone says to you 'Watch out, you might run into a *lupu* out there', where *lupu* is a word you don't know, you have no way of knowing whether a *lupu* might be a bear trap, a poisonous snake, an armed robber or a starving wolf. In fact, it's a scorpion. So much for the universal translator.

Arbitrariness is in no way unique to human language: it is typical of animal signalling systems and of virtually every conceivable system of communication. But, occasionally, in language and elsewhere, we find elements which are not entirely arbitrary, but rather somewhat iconic. **Iconicity** is a direct correlation between form and meaning. We saw some iconic elements in the bee dance, in which a time represents a time and an angle represents an angle. But English, too, has some iconic elements.

The most familiar examples of iconicity in English are provided by instances of **onomatopoeia** - the representation of sounds by words of similar sound. Such words as *splash*, *clink*, *buzz*, *meow*, *moan*, *whoosh*, *thud*, *moo*, *ping*, *quack* and *boom* all represent attempts to reproduce real-world sounds with English phonemes. But even these onomatopoeic items still exhibit a great deal of arbitrariness in their forms. The easiest way to see this is to compare onomatopoeic items from several languages. The sound of a gunshot is represented in English as *bang*, in Spanish as *pum*, in French as *pan*, and in German as *peng*.

In fact, onomatopoeic words are so strongly arbitrary that they have to be learned individually, just like ordinary words. Can you guess the meaning of Japanese *chirin-chirin*? It means 'tinkle'. How about Turkish *sh*p? It means 'plop'. Turkish *shak'? It's 'clap' or 'crack'. Hebrew *yimyum*? It's 'meow' (I) Basque *kukurruku*? Easy, this one: it's 'cock-a-doodle-do'..

There is another, much more subtle, type of iconicity in language. Suppose I tell you that the Basque word *tximeleta* is also the name of a creature. What sort of creature do you suppose a *tximeleta* might be? Large or small? Fast or slow? Pretty or ugly? Any thoughts? Now suppose I tell you further that *tximeleta* means one of the following: 'fox', 'bull', 'butterfly', 'snail', 'tortoise'. Which do you suppose it is?

Well, I was hoping you'd guessed it by now. Most people find that the word *tximeleta* seems to suggest, not something large or ponderous or slow, but rather
something small and light and fluttery, and so they correctly pick out the only small, light, fluttery creature in the list.

This is not onomatopoeia, because the form of the word *tximeleta* is not in any way related to the sound of anything - butterflies don't even make any sound. Rather, the sound of the word seems somehow to correlate with the appearance of the insect: the word sounds light and fluttery, and the butterfly looks light and fluttery. This type of iconicity is sometimes called **phonaesthesia**, and both phonaesthesia and onomatopoeia are varieties of what is more generally called **sound symbolism**. All types of sound symbolism are partial exceptions to the more usual arbitrariness of language, but sound symbolism is a special case, and arbitrariness is the norm.

**Signing chimps**

Even though, as I have stressed in this chapter, language is clearly unique to humans, we might still ask the following question: could a non-human animal learn a human language if it had the chance?

This question has inspired a great number of experiments, some of which have occasionally attracted headlines in the news. What many (not all) of the investigators have attempted is to bring a baby animal into a human household, to bring it up as far as possible like a human baby, to surround it with language, and to encourage it to use language itself. But this obvious approach presents some formidable difficulties. For one thing, not all baby animals can be fitted into a human household. Dolphins and whales are known to be highly intelligent, but it is scarcely possible to bring up a baby whale in your living room. For this reason, most experimenters have worked with baby apes, usually chimpanzees, occasionally gorillas. With their humanoid form, baby apes can be accommodated in human surroundings. Just as importantly, apes (especially chimps) are our closest living relatives, and hence we might expect that, if any other creatures could learn human language, it would be apes.

But apes, as we have seen, lack a human vocal tract, and hence there is no possibility of teaching them to speak. This blunt fact defeated the first experiments. However, speech is not the only possible medium for language, and it's not even the only one that human beings use. Deaf people have difficulty in producing and understanding speech, and in the nineteenth century several systems were invented to assist them. These were systems of sign language, in which the user, or **signer**, communicates with gestures made mostly with the hands. For example, in American Sign Language, or ASL, the version used in the USA, putting the tip of the thumb to the lips means 'drink', while pulling the thumb and two fingers away from the upper lip means 'cat'. Like other versions of sign language, ASL is widely used by deaf people, who often become extremely fluent in using it. There are even children of deaf parents whose first language is sign language and who are therefore 'native signers'. Now sign language is not just a crude approximation to language, as was formerly thought, nor is it merely a coded version of English. In recent years linguists have discovered that the sign language used by native
signers appears to possess all of the crucial characteristics of human language, including rich grammatical systems with things like subordinate clauses and verbal inflections - and apes have hands closely resembling our own.

In the 1960s the psychologists Allen and Beatrice Gardner introduced a young chimpanzee called Washoe into a group of adult human signers; these signers made every effort to encourage Washoe to understand and use signs. The results seemed so encouraging that further chimps were added to the experiment, and other groups began similar experiments with chimpanzees or occasionally gorillas. Still other groups tried something similar, not with sign language, but with invented languages whose 'words' were coloured plastic magnets of varying shapes stuck on a board or geometric shapes displayed on a computer screen.

By the late 1960s and early 1970s most of these research groups were reporting impressive achievements by their animals. The animals were said to be capable of understanding hundreds of signs or symbols, of understanding and responding appropriately to new sentences made up of novel combinations of signs or symbols, of producing spontaneous utterances of their own, of understanding high-level abstractions, of coining new 'words' by original combinations of existing signs or symbols, and even of teaching sign language to their own offspring. These reports attracted much publicity and also a great deal of criticism.

The sceptics found no shortage of weaknesses in the evidence supporting the claims of the chimpanzee experimenters. First, much of that evidence proved to be purely anecdotal: that is, it consisted of reports that some particular animal on some particular occasion had been observed to do something-or-other pretty damned impressive. But anecdotal evidence is almost devoid of value in science: any single event can have any of a large number of explanations, most of them not very interesting, and only well-documented reports of consistent behaviour by an animal can be counted as substantial evidence. Second, many of the experimenters were found to have applied very generous standards in testing their animals. For example, if a signing chimp was shown an apple and asked (in ASL) 'What is this?', the experimenters frequently counted as a correct response any sequence of signs including the sign for 'apple', including something like 'yellow banana hungry me apple banana apple', which is far from being the sort of response usually heard from a human child learning a first language. Third, we have in many cases nothing more than the experimenters' own word for it that the apes were making any signs at all. In one case in which a native human signer was called in to check the animals' behaviour, he protested that he couldn't see any recognizable signs, but only meaningless gestures which were none the less being enthusiastically recorded as signs by the other humans present. Finally, and most damningly, the critics discovered that the experimental procedures typically used to test the animals were so sloppy that an animal under test could often see its human handler unconsciously forming the required response with her or his own hands, so that it could see what to do: a well-known phenomenon in working with animals, and known in the 'Clever Hans effect', after a nineteenth-century performing horse which could apparently answer questions in arithmetic but which was actually just watching its owner for clues as to what to do. When the
experimental technique was tightened up, the performance of the animals became very much worse, and was often no better than chance.

As a result of these criticisms, some experimenters became disillusioned with the whole project of teaching language to animals, while others decided simply to shift their attention to studying the ordinary cognitive abilities of their animals, without trying to teach them novel types of behaviour. Work in this field still continues today, and experimenters still report that their animals can learn to understand two or three hundred signs, though the performance of the animals seems to tail off rapidly after about this much, just at the point at which a human child's progress begins to accelerate almost explosively. Because of this, many people have concluded that the most important result we have obtained from all these projects is a vivid demonstration of the vast gulf that separates the linguistic behaviour of human children from that of all other creatures. Language, it seems, is still unique to human beings.