Chapter 1

Language

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I HAVE A FRIEND who says that studying the psychology of language is a waste of time. He expounds this idea very eloquently and at great length. He says it in nice, beautifully enunciated – if rather loud – sentences to anyone who will listen (and often to people who won't). I think this irony is wasted on him.

One of his reasons for thinking that investigating language is pointless is that, according to him, there's nothing special about language. We learn language as we learn any other skill: we learn to speak like we might learn to ride a bike. It makes use of the same psychological resources and processes as everything else we do. For him there's no difference between speaking a sentence and navigating our way home.

I think he wants things both ways, because when I put the alternative to him – that there is something special about language, that maybe we don't learn it like we learn other things, and maybe it doesn't use the same psychological processes as everything else – he says that in that case it's just a special case, and therefore not very interesting either.

Using language is one of the most impressive things we do. I find only vision comes close. We routinely produce utterances of amazing complexity and originality. Think

back to the last few things you've said; have you ever said exactly those things before? Probably not, or if you have, you won't have to wait long before you say something no one else in the world has ever said in just that way ever before. Our use of language is creative. We combine words and sentence structures in novel ways all the time. And we do this combination incredibly quickly and with amazing accuracy. We can do this combination in speech or writing. We can also decode what other people say – we listen and read, and extract the meaning and intended message, again apparently effortlessly.

Language is also important. We spend a lot of time using it or even just thinking in it. Most of us have a running voice in the head telling us what to do and what we're thinking, and it's easy to think of that voice as being the core of us. The complexity of modern life is unthinkable without it: how could we have designed and built cars, computers, and atom smashers without it? Indeed, it's difficult to imagine being human without language.

Perhaps unwittingly, my conversations with my friend touch upon three of the most interesting issues in the modern study of language. First, how do we actually *do* language? What are the processes involved in speaking, writing, listening, and reading? Second, how do children acquire language? They're not born talking, but they soon are chattering away, if not at first quite like adults. Third, to what extent does acquiring and using language depend on knowledge and mechanisms specific to language?

This book is about the psychology of language. I find the "psychology of language" to be a bit of a mouthful, and what on earth do you call people who do it? Psychologists of language? In the sixties and seventies there was a perfectly good word, "psycholinguistics", with the people who did psycholinguistics called psycholinguists. For reasons I've never understood these words became unfashionable about the same time as flares stopped being widely available. I don't think these events were linked, but perhaps if "psycholinguistics" can be brought back into fashion, even flares stand a chance again.

"Psycholinguistics" and "psycholinguists": I'm going to use these words. Perhaps they will be deservedly revived.

What is language?

Type "language definition" in to your favourite search engine. Here's one I've adapted from www.thefreedictionary.com, according to which language is:

1 communication of thoughts and feelings through a system of arbitrary signs such as voice sounds or gestures
2 such a system including its rules for combining its components such as words
3 such a system as used by a nation or people.

This definition covers the most important aspects of what language is, but it's worth considering these points in more detail.

First, language is primarily a system for communication: its main purpose is to transfer information from one person to another. I think I'd add to this point that the communication is intended. Animals communicate to each other – for example, a blackbird singing communicates that a male is resident in a territory and available to females – but it's far from obvious that there is always a deliberate intention to convey information. In contrast, when we talk, we intend to convey specific information. This is not to say that everything we communicate is intentional: I might say something foolish and thereby communicate my ignorance, but this is a side-effect of what I say rather than its main effect, and certainly language didn't arise to convey side-effects. It is also not to say that the only function of language is strictly intentional communication: we often use language for social bonding, as a means of emotional expression ("darnation!", and sometimes perhaps a little stronger), and even for play (telling puns and jokes). And language seems to play a central role in guiding and perhaps even determining our thoughts.

Second, language is a system of words and rules for combining them. Words mean something; they are signs that stand for something. "Cat", "chase", "rat, "truth", "kick", and "big" all refer to objects in the world, events, ideas, actions, or properties of things. We know thousands of words: we know their meanings, and what they look and sound like. All this knowledge is stored in a huge mental dictionary we call the *lexicon*. But language is clearly much more than a list of words; we combine words together to form sentences, and sentences convey complex meanings about the relation between things: essentially, who did what to whom. But we don't just combine words in any old fashion; like computer languages, we can only combine words in particular ways. We can say "the cat chases the rat" or "the rat chases the cat", but not "the cat rat the chases" or "the the chases cat rat". That is, we know some rules that enable us to combine words together in particular ways. We call these rules the *syntactic rules* (sometimes just the *syntax*) of the language. What is more, word order is vitally important (in languages such as English at least): "the cat chases the rat" means something different from "the rat chases the cat". It is our ability to use rules to combine words that gives language its immense power, and that enables us to convey a huge (infinite, in fact) number of ideas.

The distinction between the lexicon and syntax is an important one in psycholinguistics. If syntax makes you think of grammar, you're right: we use the word *grammar* in a more general way to describe the complete set of rules that describe a language, primarily the syntax, how words can be made up, and even what sorts of sounds are permitted and how they are combined in a particular language. Be warned, though, that "grammar" is unfortunately one of those words that can mean what we want it to mean; sometimes it's used almost synonymously with "syntax", sometimes as the more general term to refer to the complete set of rules for a language. No wonder psycholinguistics is hard.

Third, the relation between the meaning and appearance or sound of words is arbitrary: you can't tell what a word means just by hearing it; you have to know it. Of course there are a few words that sound rather like what they depict (such words are called onomatopoeic) – but there are just a few, and even then the meaning isn't completely predictable. "Whisper" sounds a bit like the sound of whispering, but perhaps "sisper" would have done just as well. Knowing how "hermeneutical" is pronounced tells you nothing about what it means.

Fourth, although we have defined language in the abstract, there are many specific languages in the world. We say that English, French, Russian, and Igbo (a Nigerian language) are all different languages, but they are nevertheless all *types* of language: they all use words and syntactic rules to form messages.

How do languages differ?

A motif of this book is how bad I am at language and languages. I'm not proud of this fact; it's just the way it is. Indeed, I think I should have your sympathy for reasons that will become apparent later. It's perhaps odd that someone so bad at language should carry out research into language, but perhaps there's something in the adage about psychologists really just being interested in their own particular problems. Being hopeless at foreign (to me) languages, I had to ask members of my linguistically diverse psychology department how they would say the following in their own languages (I could manage the first):

The cat on the mat chased the giant rat. (English)
Le chat qui était sur le tapis a couru après le rat géant. (French)
Die Katze auf der Matte jagte die gigantische Ratte. (German)
Il gatto sullo stoino inseguiva il topo gigante. (Italian)
De kat op de mat joeg op de gigantische rat. (Dutch)
Pisica de pe pres a sarit la sobolanul gigantic. (Romanian)
Kot który był na macie, gonił ogromnego szczura. (Polish)
A macska a szőnyegen kergette az óriás patkányt. (Hungarian)
Matto-no ue-no neko-ga ookina nezumi-o oikaketa. (Japanese)

I think I know what's going on in the French, Dutch, and German translations. It is fairly obvious that there are similarities between them and English, and I remember enough school French to be able to work out the rest. Italian looks a bit more different to me but is still recognisable. Polish, Hungarian, and Japanese are very different and unrecognisable to me; for all I know, my colleagues could be pulling my leg and causing me to write unwitting obscenities. I apologise if they have.

There are differences other than just the vocabulary ("cat", "chat", and "Katze" all mean the same thing). In German what is called the *case* of the noun

and the form of the verb are much more important than in English; the form of nouns and verbs changes by a process called *inflection* to reflect their grammatical role – for example, whether something is the subject or the object of the sentence – the thing doing the action or the thing having the action done to it. (There are other cases: I still remember nominative, accusative, vocative, genitive, and dative from my Latin lessons.) We do this a bit in English, when, for example, we use "she" as the subject of the sentence and "her" as the object, but nowhere near as much as in heavily inflected languages, of which German is one. If you know any Latin, you will realise that Latin is extremely heavily inflected, so much so that word order is relatively unimportant. To satisfy my nostalgia for being 12 again, here are the inflected cases of a Latin word, *stella* ("star"):

stella – the star	stellae – the stars (nominative case)
stella – o star	stellae – o stars (vocative)
stellam – the star	stellas – the stars (accusative, for direct objects)
stellae – of the star	stellarum – of the stars (genitive)
stellae – to the star	stellis – to the stars (dative)
stella – from the star	stellis – from the stars (ablative)

Japanese constructs its sentences very differently: I'm told the best translation is "mat on cat big rat chased"; notice how in Japanese also the verb comes at the end of the sentence. Turkish, like Finnish, Japanese, and Swahili, runs words modifying each other together, making it what is called an *agglutinative* language. Here is an example:

Ögretemediklerimizdenmisiniz? – Are you the one who we failed to teach?

(Where Ö*gret* – to teach, *emedik* – failed, *lerimiz* – we, *den* – are you, *misiniz* – the one who). In agglutinative languages each unit in a word expresses a particular grammatical meaning in a very clear way.

The sounds different languages use can differ, too. To an English speaker, the properly pronounced "ch" sound in the Scottish "loch" and German "Bach" sounds slightly odd; that's because it's not a sound used in "normal" English. Technically, it's called a *voiceless velar frictative* because of the way it's made and the vocal tract being constricted as air is pushed out through it, and English doesn't use voiceless velar fricatives (see Figure 1.1 for a diagram of the articulatory apparatus). Arabic sounds different to English speakers because it makes use of *pharyngeal* sounds, where the root of the tongue is raised to the pharynx at the back of the mouth – and, of course, English sounds different to Arabic speakers because English doesn't make use of pharyngeal sounds. Some African languages, such as Bantu and Khoisan, make use of loud click sounds as consonants. Japanese doesn't make a distinction between the "l" and "r" sounds, which is

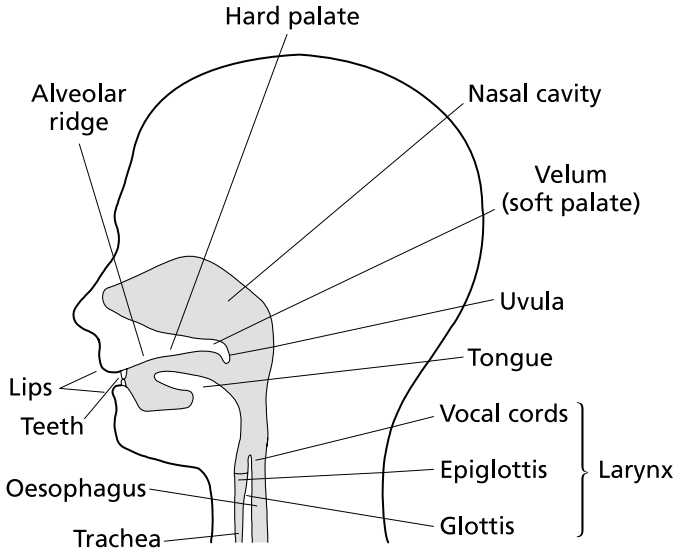

FIGURE 1.1 The structure of the human vocal tract

why Japanese people learning English have difficulty in producing these sounds correctly. "L" and "r" are called *liquid* sounds; Irish Gaelic has 10 liquids, and of course native English speakers would have difficulty learning all these distinctions. The list of differences in sounds between languages is clearly going to be enormous, and has obvious consequences for adult speakers trying to learn a new language.

I also asked a colleague in Iran for a translation; here are the results in Farsi and Arabic, along with Greek, Japanese, and Chinese (below). These don't even use the same *script*, or method of writing. Farsi, Arabic, and Hebrew are written from right to left.

Greek

Η γάτα στο χαλί κυνήγησε τον γιγάντιο αρουραίο.

Japanese

マットの上の猫が大きなネズミを追いかけた。

Chinese

那只大老鼠　在毯子上　被　猫　追赶。
(The giant rat) (On the mat) (Passive expression) (The cat) (Chased)

Translation to Farsi

chased the giant rat mat on cat
گربه روی فرش موش صحرا یی بزرگ را تعقیب کرد.
V O Prep. S

orbe(cat) rouye(on) farsh(mat) moush-e sahraie-ye(rat) bozorg(the giant) ra taghib kard(chased) Farsi

Translation to Arabic

the giant rat chased mat on cat
القطه علي حصيرطاردت الجرن العملاق
O V S

Al-ghetta(cat) ala(on) hasir(mat) taradat(chased) Al-jerza al-amlagh(the giant rat) Arabic

Translation to Hebrew

החותול אל השטיח רדף אחרי החולדה האנקות
H′ chatul al h′ shatiach radaf acharey h′ chulda h′ anakit

So languages clearly differ in many ways: the words they use (the vocabulary), the preferred order of words, the syntactic rules they use, the extent to and way in which they inflect words to mark grammatical role, the way grammatical units are combined, the sounds they use, and the ways in which they write words down.

Although there are differences, there are also many similarities. Some languages (English, French, German, Dutch, and Italian) are obviously related to each other, but all languages use separate words for separate concepts (they all have different words for rat, mat, cat, giant, and chased), and they all have a means of telling us what did what to whom – that is, of marking the *grammatical role*. We know that it's the cat chasing the rat, not the other way round. All languages use words, and all languages use rules to combine these words, and it turns out these combination rules are often similar to each other in very systematic ways.

How many languages are there?

My wife is a Geordie (she comes from Newcastle). Fortunately, when I choose to, most of the time I can understand what she says, but I have a great deal of difficulty with some of her relatives. Geordie is a *dialect* (it has identifiable vocabulary and grammatical features) with a strong *accent* (it sounds distinctive). Although Geordie differs from RP English (received pronunciation, as spoken by the Queen and BBC announcers in the good old days), and I have difficulty

understanding it, most people would still label it as a type of English. But when does a dialect become a different language? There are no hard and fast rules, and for this reason it is difficult to be precise about how many languages there currently are in the world.

Linguists estimate that there are 5000–6000 languages in the world, but some languages with small numbers of speakers are dying out, perhaps even as you read this. Some languages are as endangered as the black robin (apparently only five of which were left off the coast of New Zealand in the early 1980s). Over the past few centuries countless languages have been extinguished, sometimes deliberately, sometimes because the number of speakers has become too small for the language to be viable, sometimes because another language takes over.

Occasionally languages close to extinction make a resurgence. Welsh is an interesting case study of this (Price, 1984). It is the oldest language still spoken in mainland Britain. At the end of the sixth century or so the Brythonic language (an old Celtic language itself closely related to the Gaelic languages of Scotland and Ireland) became differentiated into Welsh, Cornish, Cumbric, and Breton. It had a long and rich literary tradition and was spoken extensively. English encroachment in the thirteenth century began to reduce the geographical area of Welsh. The Act of Union of England and Wales in 1536 did not actually proscribe Welsh, but stipulated that public officials had to use English. A rapid decline in the late eighteenth and early nineteenth centuries followed, and in the middle part of the nineteenth century English became the primary target language in state schools. The large number of English immigrants, particularly attracted by industrialisation in the south, further reduced the relative number of speakers and its perceived importance. You might have heard about the "Welsh knot", which was a piece of wood hung around the necks of school children who spoke Welsh at school in the nineteenth century. In one tradition the knot would be passed on if the wearer heard another child speaking Welsh, and at the end of the day the final wearer would be given a good thrashing. It is hardly surprising that such means discouraged the use of Welsh.

A resurgence in the Welsh language started in the 1930s, with the first state system Welsh medium school opened in Llanelli in 1947. The Welsh Language Act of 1967 allowed any legal proceeding to be in Welsh. Nevertheless the number of bilingual speakers declined from 929,824 (50% of the population) in 1901 to 508,207 (19%) in 1981; the decline in monolingual speakers is even more dramatic, correspondingly 280,905 to just 21,583. Broadcasting was mostly in English until the launch of S4C in 1982. The Welsh Language Act of 1993 and Government of Wales Act of 1998 now mean that Welsh and English should be treated equally. Signs and official papers, for example, must now all be produced bilingually. As a result the use of Welsh has now seen an upsurge, with currently 611,000 speakers (21.7% of the population in 2004). As ever, it is difficult to determine the causes of historical events, but it's reasonable to say that the determination of a few

individuals has played a significant role in the resurgence of Welsh. For example, Clive Betts, in his 1976 book *Culture in Crisis*, argued for the establishment of a "Welsh heartland" where at least 70% of speakers would be Welsh and where Welsh would be the official language, and English would be a second-class language, to be used only when necessary, and to be taught only in Anglicised Heartland towns, such as Bangor, Aberystwyth, and Carmarthen (Price, 1984). Desperate situations need desperate plans.

So although Welsh was in decline, the situation is now not as bleak as it might have been. Contrast the history of Welsh with the history of Cornish, where the number of speakers was much smaller and speakers occupied a relatively small part of England. As English spread, Cornish became marginalised further and further to the west, particularly after 1500. The decline was rapid after that, with the last known monoglot speaker (someone speaking just one language) dying in 1676 and – although it's often debated – the last native speaker, Dolly Pontreath, dying in

I love Welsh scenery, and I love Welsh road signs nearly as much. This "Landscape with (very small) Welsh road sign (on the left)" is one of my classic photographs; it displays just about every mistake known to real photographers. How many can you spot? Translation between languages can sometimes go very wrong, such as in the road sign reported in the BBC News in October 2008 which read in English at the top: "No entry for heavy goods vehicles. Residential site only". The translation in Welsh beneath said: "I am not in the office at the moment. Send any work to be translated"

Mousehole, a fishing port near Penzance, in 1777. There are now some attempts to revive Cornish in everyday use, although it remains to be seen how successful these will be.

How has English changed?

Type "Shakespeare insult generator" into your favourite search engine. There are a number of sites that will generate an insult for you based on words found in Shakespeare; it didn't take me long to come up with "Methink you stinks thou beslubbering onion-eyed hugger-mugger". I quite like that, but it's unlikely to cut many people to the quick when they steal that parking space you've been nursing for two minutes.

It's obvious that language has changed considerably over time: we don't say "forsooth", "pribbling", or "coxcomb" too much these days. At least, though, Shakespeare is readily comprehensible (most of the time) to English speakers; go back a bit further and Chaucer is much more problematic for the unskilled reader.

> And somme seyen that we loven best
> To be free, and do right as us lest,
> And that no man repreve us of oure vice,
> But seye that we be wise, and no thyng nyce.
> For trewely ther is noon of us alle,
> If any wight wol clawe us on the galle,
> That we nel kike, for he seith us sooth.
>
> Chaucer, *The Wife of Bath's tale*, 935–941, written around 1390

It makes more sense if you speak it aloud, but it's still hard going, and the last two lines have me flummoxed.

The history of English is the history of England. English is a ragbag of languages, and England has often been described as a "mongrel nation". It doesn't sound very kind, but it conveys the idea. The history of England before the Norman Conquest was one of waves of invasions: Celts, Romans, Angles, Saxons, Jutes, and Danes, all leaving their linguistic mark. By the early eleventh century things had settled down, and the dominant language was Anglo-Saxon, a Germanic language, with Celtic languages (Cornish, Cumbrian, Manx, and Gaelic) spoken at the fringes. The Norman Conquest of 1066 was the last major invasion, and had a profound influence, producing for a while a two-tier system, with French the language of the ruling aristocracy, court, and law, and English the language of the vanquished majority. After a while the Germanic language reasserted itself, partly because more people spoke it, and partly because the Norman aristocracy became isolated from France, so that the language lost the source of its renewal, and marriages between

Normans and Anglo-Saxons became more common. Nevertheless, it was not until Henry IV was crowned king in 1399 that the country was ruled by a native speaker of English, although Edward III had made English the official language of Parliament in 1362. By then of course the English language had absorbed a huge number of French words and phrases. The class distinction of the French-speaking rulers and Anglo-Saxon-speaking peasants even became reflected in the names of trades: the more prestigious, skilled trades used names based on French, such as tailor, painter, and mason, while the less prestigious ones carried on with Anglo-Saxon names, such as miller, baker, shoemaker (Bryson, 1990). English still has several thousand words derived from French, mostly to do with court, law, and fashion.

Of course it isn't just vocabulary that changed; the rules of grammar changed as well. Mostly in its time in exile English became simplified. Grammatical inflections were lost, gender (whether a noun is male, female, or neuter, as they still are in languages such as French and German) vanished, and the number of word endings reduced. It's worth noting that early English was highly variable, much more so than today, not just from one region to another, or within regions, but even within speakers. Chaucer sometimes talks of "doughtren" and sometimes of "doughtres" (for the plural daughters). The invention of the printing press and the availability of printed material had a standardising effect.

Latin has also influenced the development of English. As the official language of the Church, its effect on religious matters, law, and education has been profound. Many important seventeenth-century scholastic works were first published in Latin (including Newton's *Principia* and Harvey's treatise on the circulation of blood, *Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus*). A large number of Latin words survive, although their derivation is often obscured by Norman being a Romance language, like Latin. Latin was held in such high prestige that the early scholars of English grammar thought that the formal rules of English should be based on Latin.

Language has never stood still. Victorian language sounds distinctive to modern readers. All sorts of influences work on languages over time: they become simplified, they incorporate parts of other languages, they adapt or coin new words when needed, dialects spread while others become modified (look at the recent success of "Estuarine English"), and new phrases become fashionable. "Transistor", "television", "aeroplane", and "computer" are all relatively recent additions. A few years ago I liked to think of myself as one of the earliest ipodologists. And, of course, language is still changing. Not many people now tell me that it's heavy, man, or that I'm a groovy cat; and who knows how long it will be before people stare at you oddly when you say "chav"?

English has been exported too, particularly to America. Geographical spread also leads to linguistic isolation and change. I still can't get used to saying elevator, hood, sidewalk, and gotten when in the USA.

Some change offends some people. There are people out there (sometimes I'm

one) who get upset about split infinitives ("to boldly go where no man has gone before", or, as the joke goes, "to boldly split infinitives no one has split before"), but even I can't raise much enthusiasm about dangling prepositions ("he was the man she gave the present to" rather than the so-called correct "he was the man to whom she gave the present"). Incidentally, this rule arose because Latin infinitives can't be split, so, said the early authorities, neither can English ones. The distinctions between "who" and "whom" and different uses of "shall" and "will" are now close to having become extinct. Some people get agitated about pronunciation: make sure you pronounce both those rs in "library", and don't say "libary" instead! And by the way, it's mispronunciation, not mispronounciation. I think what's important is that language losing its distinctions and language using its power are bad things; so every time we don't say "whom" instead of "who", it makes it a little bit harder for whoever has to understand the sentence. But it's difficult to believe that language will be degraded into a powerless mishmash of incomprehensible ambiguity. New distinctions and ways of making old ones will evolve. Things change. Get over it (but please get "its" and "it's" right).

How has language changed?

We've noted that some languages seem similar to each other. *Linguists* (people who

A house in Stratford-upon-Avon; my memory is that it's Shakespeare's

study language) have grouped together languages that appear to be related into language *families*. It's obvious that French, Italian, and Spanish are related, and these are grouped together into the *Romance* family; English, Dutch, and German also have much in common, and these are grouped to form the *Germanic* family of languages. Why should they be similar? The most obvious explanation is that members of the same family are historically derived from the same language root. If we went far enough back in time, we would find one language – for example, let's call it proto-Germanic – that over time, as speakers of the language became geographically dispersed and relatively isolated, split into the languages we speak today.

But the Romance and Germanic languages aren't really that different from each other, which means that if we go back a bit further in time, Romance and Germanic languages are derived from just one language. They also have features in common with other languages: the word "mother" is "mere" in French, "Mutter" in German, "moeder" in Dutch, "moder" in Swedish, "madre" in Italian and Spanish, "matka" in Polish, "maht" in Russian, "máthair" in Irish, and "mata" in Sanskrit. The number of similarities between other words (numbers provide a striking example) suggests that these similarities cannot be due to coincidence. So at one time all these languages must once have been related. Indeed, most of the languages of Europe and West Asia are all thought to have been derived from a language called proto-Indo-European, and members of the family are called *Indo-European* languages. In this way we can construct a family tree for related languages, as shown in Figure 1.2. But it's important to note that not all languages spoken in these areas are Indo-European. Basque, spoken by the Basque people

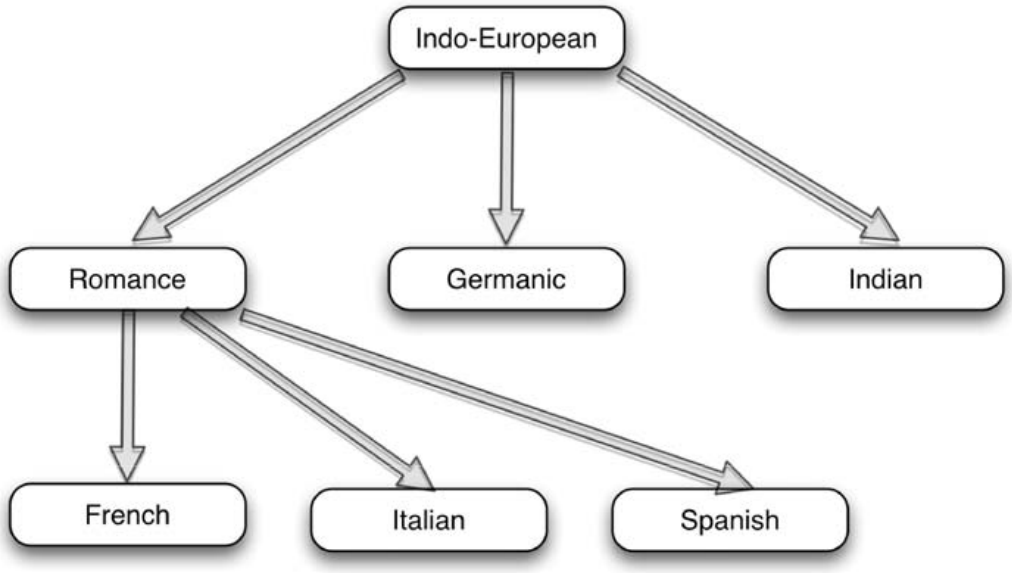

FIGURE 1.2 Part of a simplified family tree for some Indo-European languages

of northern Spain and south-western France, is thought to be an isolated remnant of a language spoken in Europe before the invasion of the peoples who spoke and spread Indo-European. Finnish and Estonian belong to the Finno-Ugric family; presumably the invasion of Indo-Europeans just didn't get that far. Hungarian Magyar is a more distant relative of the Ugric languages (and this observation suggests that we can learn about the movements of early peoples by looking at the distribution of related languages across the globe).

We can discover when languages split by looking at which words they share. All Indo-European languages have similar words for horses and sheep, but not for vines or palms, suggesting that the source language came from a place where horses were common but where there were no palms. Such observations suggest that the original speakers of Indo-European came from northern central Europe. Using such differences, and looking at the degree of similarity between words, we can construct a family tree of linguistic resemblance that shows how languages split from one another.

It's possible to construct similar family trees for other groups of languages. The Altaic language family includes Turkish and Mongolic languages of central Asia. The Sino-Tibetan family comprises 250 languages of East Asia, including the Chinese languages. The largest family, the Niger-Congo family, comprises over 1500 families. However, we've already noted that Basque doesn't have any obvious relation to Indo-European: there's a large number of other isolates that don't seem to fit into the predominant family of that area. The natural question then is if we go far enough back in time, will we find the ultimate great-great-grandmother language, the single language from which all other languages are descended, which means that language was "invented" just once (called the *monogenesis* theory)? Or were there several original languages? Those are questions about which it's easy to speculate, but difficult to say very much that's sensible. They do however touch on the ultimate origin of language.

Where did language come from?

In 1866 the Société de Linguistique de Paris (the Linguistic Society of Paris) banned all debate about the origin of language: there was too much conjecture and too little evidence. And there have been plenty of speculative theories: according to the "bow wow" theory, language began in imitation of natural sounds; the "heave ho" theory says that it originated in rhythmic chants of early men as they collaborated in heavy work; the "sing song" theory says that it came out of courtship, cooing, and laughing; and the "eureka!" theory (my personal favourite) says that some clever early man consciously invented it. But what can science tell us about the origin of language?

For a long time I wondered how on earth there could be any hard evidence

about how language originated, let alone too little. But there are two main sources of evidence, none complete, and even in total leaving much to speculation. First, we can hypothesise about how language has evolved by looking at changes in the structure of the jaw and skull in the fossil evidence. Second, there's what we can learn from the analysis of remnants of DNA in these fossils.

When did language evolve? Obviously spoken language must have arisen some time after the genus *Homo* split away from other primates, with *Homo habilis* about 2.5 million years ago, and the modern behaviour by the first true human, *Homo sapiens*, about 50,000 years ago. The best we can do to be more specific is estimate this by looking at when humans possessed the articulatory apparatus to produce speech similar to the way we do now. There are indications from fossils that early hominids, as long as two million years ago, possessed a well-developed Broca's area – a region towards the front of the brain on the left-hand side that we know plays a significant role in producing speech. However, it's now known that great apes show signs of this same sort of asymmetry (Cantalupo & Hopkins, 2001). Perhaps in humans Broca's area took over some other function, such as making complex hand manoeuvres.

The Neanderthals were very close relatives of humans (some think a subspecies) that became extinct about 30,000 years ago. For some time it was believed that the shape of the skull of Neanderthal man strongly suggested that they were incapable of making complex speech sounds: their larynx, or voice box, was not in an appropriate position, being closer to the position in other primates than in humans, and they lacked fine control over the movements of their tongue (Lieberman & Crelin, 1971). More recent evidence suggests that Neanderthals might not have been as incapable as originally thought. In 1983 a Neanderthal hyoid bone – the bone in the neck that supports the base of the tongue – was discovered in Israel; the fact that this bone existed at all suggests Neanderthals were capable of some speech, but the structure of the bone was remarkably similar to that of humans (Arensburg et al., 1989). Recent extraction of DNA from bones suggested that Neanderthals possessed a version of the FOXP2 gene similar to that found in modern humans; as we will see, this gene is thought to play a significant role in language (Krause et al., 2007).

In 2008 Robert McCarthy, an anthropologist from Florida, used computer modelling to produce speech as it might have been spoken by Neanderthals. The speech is croaky and high-pitched, and they lacked the ability to produce the rich vowel sounds we do, but it could easily have formed a rich communication system. (Samples of the speech are widely available on the net.) Neanderthals used tools, buried their dead, controlled fire, lived in shelters, and possibly might even have practised rituals and religion and made music, and I find it hard to see how they could have reached this level of sophistication without language. If Neanderthals did share our FOXP2 gene, and did use language, these genetic changes must have taken place before modern humans and Neanderthals diverged 300,000 to 400,000

years ago. This line of reasoning is controversial, because the mutated FOXP2 gene might just have been present in the sample because of some interbreeding between *Homo sapiens* and Neanderthals.

Modern human behaviour can be traced to a flowering of human art, technology, and culture at least 40,000 years ago – and possibly much earlier in Africa – with the transition from the Palaeolithic to Neolithic phases of the Stone Age. Stone tools became more complex, art flourished, and personal jewellery appeared for the first time. Corballis (2004) argued that this cultural and technological flowering was made possible by the development of language and the changes in the ways of thinking that language allows. With proper language, humans could move beyond the here-and-now, and could talk about things and ideas other than objects immediately in front of them. They could reason about possibilities. They could speculate, talk about the future, make plans, and talk hypothetically about "what if?" They could form complex conditional plans for the future ("if you do this I'll do that or else if . . ."). Fossil evidence shows that the articulatory apparatus – the tongue, teeth, larynx, and muscles that control them – hasn't changed significantly in the past 50,000 years – since about the same time as this cultural flowering. Here then is a more conservative estimate of the origin of true language: something happened about 50,000 years ago. Whatever it was fixed our vocal apparatus in its modern form, enabled modern language to develop, which in turn freed our hands for other uses, and these changes in turn led to the development of culture. What might have happened about then? The likely answer is a mutation in what is known as the FOXP2 gene within the past 100,000 years that led to its current form. In other primates this gene is responsible for controlling complex movements, and co-ordinating sensory input and output. The mutation led to an enlarged Broca's region of the brain and an enhanced ability to produce complex sequences – which is just what we need for language (Fisher & Marcus, 2006). We'll meet the FOXP2 gene again, but it's worth noting here that some researchers argue that damage to the gene in humans today leads to difficulty in acquiring language, particularly in the ability to order sounds. Consistent with this date for the emergence of language is that language must almost certainly have developed before humans spread out of Africa, around 60,000 years ago (Renfrew, 2007); it's inconceivable that language could have evolved in the same way in parallel in many different locations.

Primates use calls to communicate with each other, as we will see in the next chapter. The simplest suggestion for the origin of speech is that the enhanced development of the brain of early man meant that these calls could become increasingly complex and put into sequences. But higher primates make a great deal of use of gesture to communicate. A chimp, for example, extends an open hand when it sees another chimp with something it wants, such as food. We've already noted that great apes have broadly similar brains, and that in them Broca's area might control hand movements. Perhaps spoken language originated from hand and arm

gestures? This idea is a popular one; the famous developmental psychologist Jean Piaget suggested in the 1930s that language arose from vocal gestures made to supplement manual gestures. Corballis (2004) argued that the mutation in the FOXP2 gene meant that we could make complex sequences of vocal gestures, and no longer needed to rely on the hands to communicate. This development meant that a more complex communication system could develop, and also that we could communicate while our hands did other things, such as simultaneously making tools. These developments in turn enabled culture to flourish. Although the differential reliance of evolution on calls and gestures is a current controversy in the literature, perhaps they shouldn't be seen as alternatives. The freeing of the brain from gestures meant that the vocal repertoire could be developed and extended.

It's also probably a mistake to see language as all or nothing: that we either have it or we don't. Bickerton (1990) postulated the existence of a proto-language that's intermediate between human language and primate communication systems. With proto-language early humans would have been able to label a large number of objects, but not to combine those labels with a rich syntax.

However and whenever language evolved, it conferred a significant evolutionary advantage, at some cost: the position of the structures in the throat that enable us to make so many rich sounds means that we are at perpetual risk of choking on our food, in a way that all other animals are not.

How do we do psycholinguistics?

We have some idea now what language is and where it came from. We're interested in how we produce, understand, and remember language, and how language interacts with other psychological processes. That is, we're interested in the psychology of language – a subject that we can give the name *psycholinguistics*.

It's nice to be able to date things exactly, isn't it? The origin of psycholinguistics is often traced to a conference held in the summer of 1951 at Cornell University in the USA, and the word is first used in print in Osgood and Sebeok's (1954) book describing that conference. But scientists were doing psycholinguistic-like things well before the term was coined. The early neurologists, such as Paul Broca (1824–1880) and Carl Wernicke (1848–1905), studied how the brain was linked to language by looking at the effects of brain damage (the structure of the brain, including Broca's area and Wernicke's area, is shown in Figure 1.3). The idea is a simple one. Brain trauma (perhaps by a stroke, which cuts off the blood supply to part of the brain, or a head injury) destroys part of the brain, which leads to a change in behaviour. After the person's death an autopsy will reveal exactly which part of the brain was affected. Wernicke in particular pieced together an account of how the brain processes language that isn't very different from that in favour today. We'll look at the relation between brain and language in depth

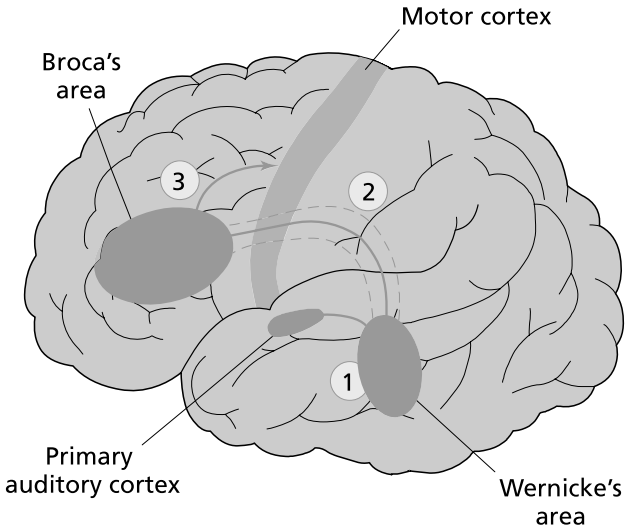

FIGURE 1.3 The location of Wernicke's area (1) and Broca's area (3). When someone speaks a word, activation proceeds from Wernicke's area through the arcuate fasciculus (2) to Broca's area

later. At the turn of the century, two German researchers, Meringer and Mayer, collected and analysed slips of the tongue in a way that is remarkably similar to more modern studies. (Their 1895 book was called *Versprechen und Verlesen: Eine Psychologisch-Linguistische Studie* [To mis-speak and to misread: A psychological–linguistic study], and I think Meringer and Mayer should get the credit for the first use of the word "psycholinguistic".) Freud picked up on their analysis of slips of the tongue in his 1901 book *The Psychopathology of Everyday Life*; although he tried to explain slips in terms of the repressed unconscious, he too was concerned with why we make slips of the tongue and the psychological processes involved in their occurrence. This emphasis on the psychological processes is the hallmark of psycholinguistics.

As a very crude generalisation, early psychologists were concerned with measurement or introspection. Then, throughout the 1930s, 1940s, and 1950s, *behaviourism* became the predominant paradigm in psychology. Behaviourism, popularised by J.B. Watson and B.F. Skinner, studied how an input, the stimulus, was related to an output, the response, without the necessity of hypothetical intervening constructs such as the mind. For behaviourists, thinking is just covert speech – speech we don't articulate aloud. Children learn language in the same way as rats learn to navigate a maze for the reward of a food pellet. The inadequacy of this approach was demonstrated by the American linguist Noam Chomsky in his influential 1959 book review of Skinner's *Verbal Behavior* – this is a rare example of a book review becoming more famous than the book on which it was based. Chomsky showed that the principles of learning derived from animal research were inadequate in accounting for how children learn language, and the creativity of

both children and adults: we can produce an infinite variety of sentences, which of necessity we could not have heard before. Instead, a much richer account of language and how children learn it is necessary. Most psychologists believe that Chomsky's review spelt the end for behaviourism as an account of human psychology, and ushered in the information-processing account that still underlies cognitive psychology today: we're concerned with the mental processes and representations involved in behaviour.

Modern psychology is a science. That often comes as a surprise to students, many of whom think it's all going to be about Freud, or helping people, or helping them to understand themselves. Then they arrive at university and it's suddenly all statistics and computers and carrying out experiments. Psychology is harder than people think, and psycholinguistics is hardest of all: across the psychology degree curriculum it's usually the subject that most students find difficult to understand. It's difficult because the ideas are complex; there's a great deal of terminology, and few definitive answers. Psycholinguistics is not for the faint-hearted; it's not for wimps. But because language is at the heart of what it means to be human, and is so central to so much of what we do, the study of psycholinguistics can be exceptionally rewarding.

What does it mean to say it's a science? We form hypotheses, conjectures about how something works, and then carry out experiments to test those hypotheses. I'm using "experiment" pretty loosely here. For me, collecting slips of the tongue in the pub or systematically recording every utterance a young child makes in the attempt to test an idea about how the mind works is as much an experiment as using a computer to measure how quickly people respond in different conditions (although, admittedly, this particular technique has played a particularly important role in psycholinguistics). So we do psycholinguistics by carrying out experiments on how humans use language: how they speak, listen, understand, write, read, acquire, and remember language.

We psycholinguists are pretty methodologically promiscuous; across the past half century we've used many techniques and ideas borrowed from other fields. Given the importance of the brain to psychology, it is hardly surprising that we use data from neuropsychology (the study of the relation between the brain and the mind), and, given that psycholinguistics is about the processes involved in language, we would expect it to link with linguistics (the study of language itself). Psycholinguistics has also drawn from computing (in constructing models based on and using computers), anthropology, philosophy, and of course other fields of psychology. That's why psycholinguistics is often said to be an interdisciplinary subject.

Are there any answers in psycholinguistics? This might strike you as an odd question. Of course there must be answers, I hear you think. Of course psychologists must know a lot about how the mind works! You just said psychology's a science, didn't you? I did science subjects at school and university. (I mean

"traditional" or "other" science subjects, before I did psychology.) I used textbooks for physics and chemistry, and they were stuffed full of answers; they were full of what we know.

But psychology texts, particularly I think ones in psycholinguistics, aren't like that. Of course there must be answers to all our questions, but we often don't yet know what they are. Or rather, different people think they know the answers, but they often can't agree on what these answers are. So psycholinguistics texts are full of conflicting accounts, each account apparently being bolstered by experiments finding contradictory results. Another psycholinguist might argue about why you got that particular result; perhaps you didn't do that experiment quite properly, perhaps you forgot to take into account how common the words you used are, perhaps you didn't make the task quite difficult enough; or perhaps the findings of your experiment are just a special case, and my account is more general, subsuming your findings and explaining when we get them – and when we don't. The list of excuses can be pretty big when you put your mind to it. I have a memory of a television show where two puppets representing celebrities would stand in a ring and start fighting; one would get knocked down, get up, and then knock the other one down, and this process would be repeated several times. Psycholinguistics is like that. It's rare for a researcher to say "you're right! I'm wrong"; after being set an apparently insuperable hurdle, they'll be back.

So there are some answers in psycholinguistics, but not as many as there should be, and we will come across many occasions where researchers have exactly opposite views. And that's one reason why psycholinguistics is not for wimps.

What is an explanation?

What constitutes a good explanation in psycholinguistics? What would make a psycholinguist dance with joy? We carry out experiments and collect masses of numerical data, and then what?

We want a *model* of our experimental results. A model is an account that explains the data we've collected, but which goes beyond it. A *theory* is a more overarching account covering a wider range of phenomena and results. We might have a model of the time it takes to recognise a word, but a theory of word recognition in general. However, the terms are often used interchangeably, and it's not a distinction we should get too agitated about.

Here's a very simple example. Suppose we carry out an experiment to discover whether how long it takes us to be able to start to name a word aloud is related to the length of the word in letters. We carry out the appropriate experiment and find the following (rather made-up) results (and let's not worry about exactly how we should measure the time it takes us to start speaking):

3 letters 400 milliseconds (a millisecond is a thousandth of a second)
4 letters 500
5 letters 600

Let's draw a graph of the results. Plot the number of letters in the word on the *x*-axis and the naming time on the *y*-axis. What do we get in this experiment? A straight line. The most simple relationship between two variables we can find; we say there's a linear relationship.

So we've accounted for the results of our specific experiment, but can we go further? How long would it take to name a word containing six letters? You could probably work it out just by looking at these figures, but if you have any mathematical or statistical expertise you'll know that we can easily derive an equation that relates word length to naming time that takes the form:

$$y = ax + b$$

Here it would be:

Naming time in milliseconds = (number of letters in word × 100) + 100

This apparently simple mathematical model is pretty powerful. Not only have we got an account of how naming time and word length are related, but we can now go beyond the data we have already collected. How long will it take to start reading aloud a seven-letter word? Type the numbers into the equation above, and you have the answer: it should take 800 milliseconds. (That's nearly a whole second; I said I'd made the numbers up.) So now we're using our model to make predictions. We could carry out another experiment to test these predictions. Suppose we find that six-, seven-, eight-, and nine-letter words all take 600 milliseconds, just like five-letter ones; in that case, I'd think we'd all agree that the model hasn't done a very good job of generalising to novel data; it's been falsified. Back to the drawing board in search of another model that does a better job. And this is, supposedly, the way science works.

I think mathematical models are among the most satisfying accounts of behaviour in psychology. They have an elegance and a simplicity: all those data reduced to one line. But some of you might still be left a little dissatisfied. Is this equation really an explanation? Why should the relation be linear? It need not have been; a polynomial function (involving curves) is on the face of it just as plausible. So we shouldn't be overly impressed by the maths; we need to explain why the relationship is as it is. Really this model isn't much more than a rigorous description of the data that makes it easy for us to make some predictions. Why is the equation as it is?

We're almost back where we started. What would be a good explanation?

We could explain the results in terms of other psychological processes. Perhaps we can relate it to the speed with which we can retrieve information from memory. Perhaps it's the time it takes us to start assembling all the sounds of the words we're going to say. Perhaps it's both of these. But then we can push back our enquiry further: why should the time it takes to retrieve words from memory be related to their length in this way? Should we try to relate our findings to the way in which the neurons of the brain are connected together and the rate at which they fire? What would ultimately be a satisfactory account?

I think to be satisfactory a model has to have two characteristics. First, it has to make predictions that are in principle *falsifiable*. Falsifiable means that there is an obvious way of testing the prediction that could prove it wrong. So for our model above we predict that for a seven-letter word the reaction time to start speaking should be 800 milliseconds. That's a falsifiable prediction, because we could run an experiment to measure the reaction time. If the prediction's not verified, the model is wrong (or at least needs revision). If it is, good; the model lives to fight another day. The more novel and outrageous the prediction, the better: I predict that Torquay won't win the Premiership before 2020. No offence is meant to the players and supporters of Torquay; I suspect they'll agree with my prediction. But when (if) this prediction is proved right, you'll hardly be impressed by my football acumen, will you? But if I say I have a complete model of psychology and society and it predicts that Torquay *will* win the league in 2019, and they do, then that's impressive. My model must be good. Second, the explanation should not be circular. It should involve concepts that are from outside our original domain of thinking. Ideally we could derive our equation from a theory of memory, or how neurons in the brain are connected together. Good models should *transcend levels of description*. I think there's a limit, though, on how much looking at neurons and even whole brains can tell you. Ultimately all behaviour and psychological processes are grounded in the brain, but you can't do without psychology: not now, not ever. We still need to cross-reference what the brain is doing to what the person is thinking, feeling, and doing, and how a person is interacting with others. This book is about the psychology of language, not the neurology.

Quite often psychological models are based on metaphors. For example, we could have a model for how we search the mental dictionary based on a library, with words stored in particular places on mental shelves and a catalogue system for looking them up. Indeed, one of the best known models of word recognition, the serial search model, uses this analogy. One of the most commonly used metaphors in psycholinguistics is that of *activation*; you'll read about some words having a high activation level and others a low one, and words being in competition and the most highly activated one winning. Activation is a quantity rather like energy or temperature; some items have a lot, some not very much, but it's a continuous scale. So what would a good model of some psycholinguistic phenomenon look like? What about word recognition? A complete model of word recognition

should explain what makes it hard, how long it takes to recognise words, the difference between recognition times for different sorts of words, what happens when we recognise a word, the difference between recognising and being able to name and access the meaning (if any), the difference between spoken and written word recognition, what happens during the recognition process in different parts of the brain, what makes recognition easier or harder, how it relates to other psychological processes, how it's affected by brain damage, and how it develops. That's quite a list of requirements.

What is a statistical model?

Let's step back a bit and look at two broad types of model. Psychology abounds in metaphors. Across the years we've had the mind as spirit, pump, rat, computer, gas, even tin cans; the mind has further been likened to cars, calculators, chocolate factories, radios, television sets, and smoke coming out of factories. Through much of the 1960s through to the 1980s the dominant metaphor was that the mind was like a digital computer: it had memory, a processor, it carried out operations that transformed one representation into another. Computers at that time were also pretty much serial: they just did one thing at a time. Now if you know anything about computer programming you might know something about the principles of good programming practice: try to make your code as modular as possible and as easy to debug as possible. Stick commonly used bits of codes in separate subroutines, and don't let your subroutines fiddle around with the insides of other subroutines. The East Coast model is typically serial – one thing happens at a time, modular, and bottom-up; it starts work on the input and grinds away without using any external information.

I remember in 1983 thinking that the computer was the ultimate metaphor for psychology; the mind was indeed a computer. The next year the importance of connectionist modelling became apparent, as was the fact that I was wrong in my conviction of just the year before.

Connectionist models typically use many very simple processing units that are simultaneously active and massively interconnected. The analogy is often made between connectionism and the brain: the brain is made up of a huge number (about 100 billion) of very simple nerve cells – neurons – and each neuron is connected to thousands of other neurons. All human behaviour, language, thoughts, feelings, actions, and consciousness emerge from this massively interconnected network of neurons. Each neuron is pretty dumb; it either fires in a certain situation or it doesn't, but out of this mass dumbness comes great cleverness.

An advantage of connectionist networks is that we don't just tell them how to behave; they learn. They use a variety of complex algorithms, which do things like ensuring that if two things occur together, the link between them is strengthened, or

if we are trying to get the network to learn to recognise a pattern, we see what its current best guess is and then tell it how wrong it is. Because the networks learn, we can examine how they learn, and furthermore how that learning depends on the input we supply. One of the key points here is that the networks don't learn because they're told an explicit rule; they learn implicitly, by discovering statistical regularities in the input, and their subsequent behaviour is then guided by these regularities rather than rules (this sort of approach would be the West Coast thing again).

What is a statistical regularity? It's a pattern that occurs quite frequently. It's time for a literary diversion. Here is a little message written in a cipher.

Uif dbu dibtfe b mjuumf npvtf. Uif eph uifo dibtfe uif dbu, uif npvtf ftdbqfe.

Stop and think before reading on. Any ideas on how to go about breaking this cipher? If you've never come across this technique before, what do you think is going on? It seems that one letter has been substituted for another to render the original message meaningless. How do we work out what the correspondence is between the two sets of letters, the original and the cipher? Look at the message. There's one three-letter string that's used several times – more than any other, in fact. Now what's the most common three-letter word in English? (If you're still stuck, and need a hint, it was used in that sentence.) There's also a single-letter word: which is one of only two single-letter words in English? (Same hint as the last.) You might not even have needed that second clue, but should now have enough information to be able to decode this message. Congratulations: you have just made use of statistical regularities in English. Some words of certain lengths are more common than others. (This was a literary diversion because the technique of frequency analysis is explained much more elegantly – and entertainingly – in Arthur Conan Doyle's Sherlock Holmes short story *The Adventure of the Dancing Men*, and Edgar Allen Poe's short story *The Gold Bug*, both well worth reading.)

For a more psycholinguistic example consider the difficulties facing an infant trying to understand speech. If you listen carefully to someone speaking, there aren't many pauses in normal speech; words and sounds slur into each other. So one of the first difficulties facing a child trying to learn what words mean is trying to distinguish separate words in the first place. But the task isn't as impossible as it might at first sound. Imagine you know no language and hear:

Themanlovesthewomanandthewomanlovesthemanthemansdogchasedthe womanscatthewomanlovedhercat

Hardly an inspiring sentence for a baby to hear, but some sounds seem to stick together quite a bit: "the". So it's likely that "the" is a distinct word. "C", "a", and "t" turn up together a few times too, so it wouldn't be a bad guess that "cat" is

another word. And off the child goes. I'm not saying that the child reasons like this; the learning is done unconsciously. Connectionist models aren't conscious, yet they can easily detect these sorts of statistical regularities.

Statistical regularities are important in language. They simplify the task of children learning a language and people trying to understand what other people are saying.

What are the issues in psycholinguistics?

Psycholinguistics today is dominated by four controversies. Many studies cast light on one or more of these issues, even if at first sight that is not the primary concern of the researchers. It's worth spending some time outlining these controversies because they recur so often.

First, is our language behaviour governed by the use of rules or by multiple constraints and statistical regularities? When we hear a complex sentence, do we try to work out its structure according to the rules of grammar, or make use of our experience to tell us what the structure of that sort of sentence has usually been in the past?

Second is the issue of nature versus nurture: where does knowledge come from? Is it innate and in our genes, or is it learned? The question of how much knowledge a baby is born with has been a central one in the history of philosophy. According to the *nativism* view, we are born with particular information; we can say that the knowledge is hard-wired into the brain. According to the blank slate, or *empiricist*, view, we are born an empty canvas, and have to learn things from experience. No one would say that everything's innate or learned; for example, even if you think you learn everything, you have to ask where does the learning mechanism itself come from. You have to start with something. So the question is one of degree: how much specific knowledge about language are we born with? Is some knowledge about language encoded in our genes, or do we just pick it up using general-purpose cognitive mechanisms?

Third, is processing modular or interactive? A *module* is a self-contained unit. University courses are now often taught as modules – separate teaching units with their own assessment and structure. In a modular degree you might be able to pick and choose from a history module, a geography module, a biochemistry module, and of course a psychology module. Importantly, in a modular system you would only be examined in your psychology module exam on psychology; you wouldn't be expected to know any history or biochemistry. The courses are separate from each other. You can buy modular furniture, where you can choose from a range of furniture modules to customise the precise layout of your bedroom or living room to your taste. You can, I see from Google, even design modular concrete houses to your own specification. All of these systems have in common the fact that you can

pick and choose from a set of existing modules (courses, furniture, houses), but you can't change the contents of the module itself. So you can choose a psychology module but you can't choose whether you get social or cognitive psychology (unless they're modules in their own right, of course).

So a module is a self-contained unit that does something specific. The philosopher Jerry Fodor argued in 1983 in his landmark book *The Modularity of Mind* that the mind is made up of distinct modules responsible for carrying out specific tasks, such as parts of visual processing. Fodor describes several characteristics of modules, such as processing inside a module being fast, not accessible to consciousness, and mandatory (once it starts, it finishes; you can't not choose to read a word, and when you start you can't help but finish it), but the most important is that processes within a module are immune from outside interference – "you can't tinker around inside a module". It makes sense to argue further that the mind has evolved in this way: for example, suppose, as many psychologists believe, there is a face-processing module; that module has evolved under evolutionary pressure to enable us to recognise faces quickly and automatically because it confers an advantage to be able to do so. A final step in the argument is the unsurprising one that if these cognitive modules have evolved, they almost certainly correspond to distinct and identifiable regions of the brain.

This idea of modularity might seem to be getting away from language. But many psycholinguists argue that there are language-processing modules that carry out specific tasks, such as word recognition and syntactic processing. For example, when we try to understand language, do we process word order using just information about word order, or do we use other sorts of knowledge, such as meaning? When reading or listening we often come to a point of syntactic ambiguity, where there is more than one possible syntactic structure for what we have so far: so when we hear "The policeman arrested . . .", we could have either a structure as in "The policeman arrested the burglar" (most likely) or a different structure, as in "The policeman arrested by the fraud squad made a run for it". You're probably not aware of this ambiguity, but it's there. Do we then resolve that ambiguity using just syntactic (to do with word order) information or do we use semantic (to do with meaning) information to assist us? The former view is *modular*, the latter *interactive*. I discuss this issue in more detail in the chapter called "Understanding". We can take another example from the production of words; obviously we move from the general direction of meaning to sound, but perhaps sound-level information can influence our choice of words? The account where no such interaction is permitted is the modular one. The interactive account is not as implausible as it first might seem, and I discuss it in the chapter called "Speaking".

So we have two broad accounts of how we process language: a modular one, where lots of simple little modules carry out their individual tasks in splendid isolation, and an interactive one, where different sorts of process are talking to and interfering with each other all over the place.

An East Coast view: conservative and modular

In this sense language itself might be one big module (albeit in turn made up of smaller ones). This brings us to the fourth issue, one we touched upon when asking what is innate in language, that of whether the knowledge and processes we use to produce and understand language are specific to language, or whether they are general-purpose. Chomsky argued that language forms a separate mental organ – that we have a language faculty that occupies a distinct region of the brain and whose structure is innate (e.g. Chomsky, 1975). On this view, language processes run along nicely without any help or interference from other cognitive processes. The alternative view is that there's nothing special about language; instead of there being dedicated language processes, language makes use of the same cognitive processes that run the rest of our lives. There isn't a separate pool of linguistic knowledge, just a pool of

A West Coast view: liberal and hang loose

language. (This argument is of course the same as that of my friend at the start of this chapter.)

To give a concrete example, when we process the structure of sentences, we have to make use of some sort of memory. When you hear "the woman the man kissed laughed" you have to store "the woman" somewhere while you're processing the bit about her being kissed by a man until you get to the main verb of the sentence – "laughed". Where do you store it? Is there some special store that only syntactic processing can use (in which case sentence processing shouldn't impinge on other memory tasks) or does it use the same sort of memory we use when trying to remember a telephone number (in which case syntactic processing definitely should impinge on other memory tasks)? Or consider children learning language; do they learn language independently of everything else, or does its development depend on general cognitive development?

These could possibly be independent issues, but in practice they're related. People who argue that language is governed by rules tend to argue that we make use of language-specific knowledge that's in part innate and that processing is modular. People who think that language processing makes use of statistical regularities and constraints tend to believe that it's interactive and learned through general-purpose mechanisms.

It has also been observed that in the USA, people who believe in innate

modular rules tend to live on the east coast (mostly in and around Boston), and those who believe in the laid-back general patterns acquired by experience tend to live on the west (mostly around Los Angeles). It's true. I like to think of them as conservative versus liberal, while making no claims about the political beliefs of anyone. The conservatives will argue that when formulating a model we should make the minimum number of assumptions about what's going on: we should go for the simplest account. Parsimony is often held up as a virtue in science: make as few assumptions as possible. Unfortunately, it isn't always obvious which is the simplest. And making few assumptions about one thing might entail having to make a lot about something else. Life is hard, and so is psycholinguistics.

Enough background. Let's look a bit more closely at what language is, and one of the most interesting ways of doing that is to look at how other animals communicate.