Powers of Babel

Even the world's most commonly used languages are only spoken by a minority of people. How did one species come to communicate in so many different ways, asks **David Robson**

ALONGSIDE almost every creation myth about the origin of the Earth or the genesis of humankind, you'll find another story about the diversity of language. In the Old Testament, "confounding the one language" is God's punishment on humans for building the Tower of Babel. In Greek mythology, Hermes divides language to spite his father Zeus. The Wa-Sania people of east Africa put it down to a jabbering madness brought on by famine, while the Iroquois story tells of a god who directed his people to disperse across the world.

Creation myths are just myths, of course, but the question of linguistic diversity is a genuine problem. If Americans and the British are two peoples divided by a common language, then the whole world is one united by the mutual incomprehension of nearly 7000. Language is perhaps the defining feature of our species, and yet also the most divisive. Why is it that we communicate in so many different ways?

Science has come only so far in addressing this question. During the past century, the existence of different languages had been explained by a process not unlike the Iroquois origin myth. Isolated societies adapt existing words and phrases and coin new ones and, over time, the changes accumulate to the point where their language is no longer intelligible to outsiders.

This process of cultural evolution is similar to biological speciation, where two populations of the same species become separated from one another and diverge until they can no longer interbreed. But while biologists have used evolutionary theory to explain the variety of life, linguists have been slow to explain the staggering diversity of human languages.

Why, for example, does Latin have complex grammar while its daughters, the modern Romance languages, follow simpler rules? How come some languages, such as Mandarin, are tonal, so that the pitch of a word changes its meaning? And why does linguistic diversity mirror biodiversity, with more around the equator than in the temperate regions?

Thanks to a spate of recent studies, we can now start to answer these questions. In the same way that species are adapted to fit certain habitats, languages evolve to suit the particular needs of their speakers. Everything from a population's genetic and social make-up to the climate and plant cover of the place they live seem to exert an influence. Understand these factors, and we might be able to predict how the world's languages will change in the face of globalisation.

It's no wonder that linguistic diversity fascinates us – the enormous variation in our languages is one of humanity's oddest characteristics. If you take a chimp born in

London Zoo and place it back in its African homeland, it will have little trouble communicating. That's because all chimps share a small repertoire of grunts, barks and hoots. Humans need to be more flexible. Our brains can handle a huge range of abstract concepts, so we have evolved an open-ended form of communication to express our thoughts. It is built from a set of discrete sounds, called phonemes, which we string together in elaborate combinations to form words and sentences, structured by the rules we call grammar. Each language is a unique combination of these elements. "We are capable of effectively infinite variety," says Mark Pagel at the University of Reading, UK.

Cultural wedge

This flexibility is one of the drivers of linguistic diversity. It opens the door to cultural evolution, which can quickly drive a wedge through a language. Following a split, it takes as little as 500 years for one language to diverge into two. Pagel and colleagues have found that many of the changes occur immediately after the split, perhaps because people invent new ways of speaking to assert their group identity (*Science*, vol 319, p 588).

The cultural wedge may also explain why languages, like living organisms, proliferate in the tropics. Around 60 per cent of the world's nearly 7000 languages are found in two areas coinciding almost exactly with the two great belts of equatorial forest, one in Africa and the other across southern Asia and the Pacific (see map, page 37). The richest place of all is Papua New Guinea, home to 1 in 7 of the world's languages. One explanation is that a climate that favours biodiversity also makes it easier for people in small splinter groups to grow food and survive on their own (*Journal of Anthropological Archaeology*, vol 17, p 354). Equatorial regions also tend to have a higher incidence of infectious disease, which might lead groups to isolate themselves from others (*Oikos*, vol 117, p 1289).

Over the millennia, cultural evolution has carved out thousands of mutually unintelligible tongues, most of which are now extinct. Pagel has estimated that half a million languages may have lived and died since modern humans first evolved.

Few researchers have been interested in explaining their differences, however. That's partly due to Noam Chomsky's influential theory of universal grammar, which stated that, despite their superficial differences, all languages follow the same set of basic rules. ›

SARAH J COLEMAN

"As Chomsky's universal grammar has fallen out of favour, linguists are becoming more interested in the forces that push languages apart"

With this in mind, most researchers focused on similarities rather than differences, says Gary Lupyan at the University of Wisconsin-Madison. "It wasn't considered crucial to look at language diversity," he says. But as universal grammar has fallen out of favour (*New Scientist*, 29 May 2010, p 32), linguists are becoming more interested in the forces that push languages apart.

Ancestral groups

Tracking humankind's first movements out of Africa seems a good place to start. Quentin Atkinson at the University of Auckland, New Zealand, was inspired by the "serial founder effect", which explains why human genetic diversity declines as you get further away from Africa. Bands of migrating humans took only a subset of genes from the gene pool in their place of origin, reducing genetic diversity as they migrated further and further away.

He suspected migration might have whittled down language in a similar way. As groups splintered off the ancestral population in Africa, they may have left behind some of the lesser-used phonemes, which were perhaps only spoken in minority dialects. Each subsequent migration from the splinter group would have further diminished the repertoire.

An analysis of 504 languages offers some evidence in support. Atkinson found the highest phoneme diversity in Africa and the lowest in South America and Oceania. Taa, spoken in Botswana, uses about 110 phonemes whereas the Papuan language Rotokas has just 11 (English uses about 50). Atkinson concluded that the serial founder effect accounts for about 30 per cent of the variation in the phoneme content of the world's languages (*Science*, vol 332, p 346).

What might explain the other 70 per cent? Since the 11 phonemes of Rotokas can convey just as much meaning as the 110 of Taa, it's clear that we don't need a huge inventory of sounds to make ourselves understood. This redundancy creates a lot of room for random shifts. Each language could add or lose phonemes without reducing its usefulness, building linguistic diversity over time in much the same way that genetic drift can amplify the differences between species.

The result is a huge amount of random variation that might mask other more systematic changes. Perhaps that can explain why it took so long for researchers to consider another important factor: the challenges of conversing in difficult surroundings.

Robert L. Munroe, an anthropologist at Pitzer College in Claremont, California, first began to ponder this possibility during field trips to Belize, Kenya and American Samoa. He noticed that languages in these tropical places tend to separate their consonants with vowels – they barely have any words like "linguistics", for instance, with its bunches of consonants rubbing shoulders. Since vowels are easier to hear at a distance than most consonants, Munroe began to suspect that people in warmer countries use sounds that help them communicate outdoors. In contrast, people in chillier climates might be more likely to talk indoors, so it's not as important to use sounds that carry.

Subsequent studies by Munroe and his colleagues have confirmed that people in warmer climates do tend to use more vowels. Think of the distinctive rhythm of Italian, with its evenly spaced vowels and consonants – spaghetti, tortellini, Pavarotti – not found in northern European languages. Climate seems to influence the consonants we use too. Nasal sounds like "n" and "m" are more common in warm regions, while "obstruents" like "t", "g" and the Scottish "och" sound are more common in cooler ones.

What's more, studies by Carol and Melvin Ember at Yale University have found that these effects are less pronounced in areas with dense vegetation. Foliage standing between you and another speaker makes it more difficult to communicate at a distance, so sonorous sounds are less useful. Conversely, a certain amount of tree cover can take the chill out of a wind in a colder region, so people in these areas might spend more time outside than they would on a frigid plain – and their language adapts accordingly (*American Anthropologist*, vol 109, p 180).

Another influence on language diversity may be hiding in our genes. Dan Dediu at the Max Planck Institute for Psycholinguistics in Nijmegen, the Netherlands, and Robert Ladd at the University of Edinburgh, UK, have found that certain variants of two genes associated with brain development are more common in places where people speak tonal languages, including China, south-east Asia and sub-Saharan Africa. It is not known if these gene variants are involved in language, but Dediu doubts that it is a coincidence. He has created a mathematical model showing that if the genes help people differentiate between pitches, in areas where they are common they will push language towards a tonal system (*Human Biology*, vol 83, p 279). This model is by no means proof that genes influence language, but it suggests the idea is worth pursuing.

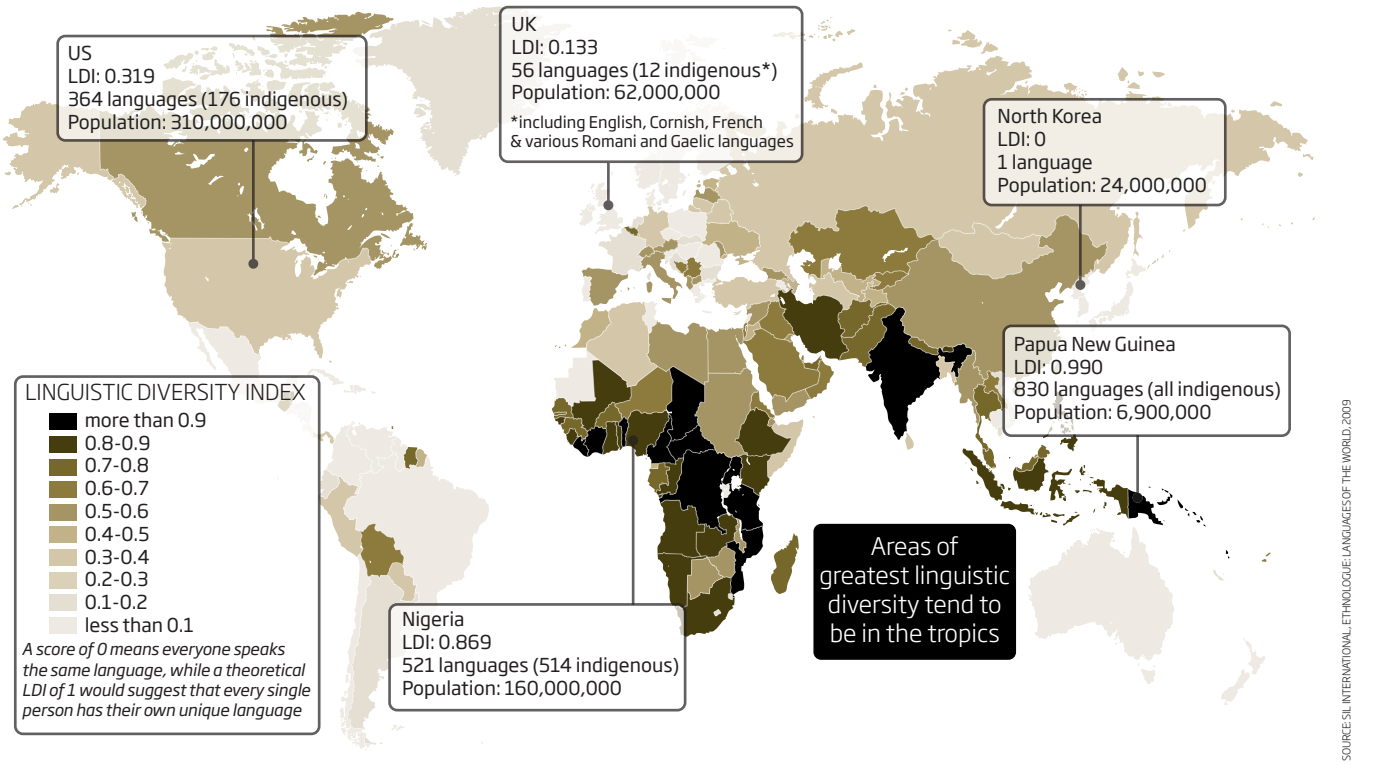
Even more so than the differences in sounds, it's difficult to see why different languages have such vastly divergent grammars. Consider the sentence "I walked the dog". English changes the ending of the verb "to walk" to signal that the event happened in the past. In Mandarin, the verb doesn't change – if the timing isn't obvious a word is simply added to make it clear. Speakers of the Peruvian language Yagua, on the other

People of the word: Papua New Guinea is home to 1 in 7 of the world's languages

JOHN BANAGAN / LONELY PLANET IMAGES

Babbling tongues

The world's 6909 languages aren't distributed evenly, as you can see from the Linguistic Diversity Index (LDI) of various countries, which attempts to capture linguistic variety by comparing the number of languages spoken in an area with its population



hand, must choose one of five verb endings depending on whether the walk happened hours, days, weeks, months or years ago.

Such diversity is mystifying until you look at who speaks the language, says Lupyan. In an analysis of more than 2000 languages, he found that complex grammars are more common in small languages whose speakers have little contact with outsiders. Those with simpler rules – such as English and Mandarin – tend to be spoken by larger populations that have contact with lots of other societies (*PLoS One*, vol 5, p e8559). The crucial factor is that many more people learn these languages as an adult than you would find learning the more insular languages – and this seems to influence the complexity of the grammar.

Linguistic cues

Lupyan points out that adults find it difficult to master intricate or irregular rules so they tend to simplify when they learn a language. Children, in contrast, seem to favour complexity, as the additional linguistic cues help clarify the sentence's meaning. Lupyan's latest computer simulations suggest that grammar is swayed by the need to balance these competing demands. Pidgins and creoles, which emerge when groups of people who don't share a common language are forced to work together, would seem to reinforce this argument – both tend to use simpler grammars than you would find in other languages.

It's not hard to imagine how this may have shaped the linguistic past. As the Romans civilised the ancient world they also spread their language. Latin has complex rules in which a noun's ending changes in one of six ways depending on its role in the sentence. As adults in the provinces began to learn the lingo, they simplified it into vulgar forms that eventually became Italian, Spanish, French and other languages – each of which lacks some of Latin's complexities. English tells a similar story. Successive waves of invasion brought in huge numbers of immigrants who would have had to converse with their new neighbours. "They were forced to become bilingual," says Lupyan, which may explain why English is missing many of the rules you see in its sister Germanic languages.

Lupyan has also studied recent language change, analysing Google's archive of literature to compare American and British English. He found that Americans seem to use more regular forms of words which would be easier for an adult to learn. This fits with his hypothesis, since America's historically high rate of immigration means a greater proportion of second-language learners.

Other linguists are cautiously welcoming of Lupyan's ideas. "It's definitely plausible," says Stephen Levinson, also at the Max Planck Institute for Psycholinguistics.

The recent findings may be just a taster of what's to come. Having established that the differences between languages aren't arbitrary, the hunt is now on for more laws that dictate their evolution. "We have got an interesting few years ahead of us," says Atkinson.

With an increased understanding of language evolution, linguists may be able to answer a harder question: what will languages sound like in the future? English, in particular, is being pulled in many different directions (*New Scientist*, 29 March 2008, p 28). "With exposure to the common media, you might expect differences to diminish, but they're not going away, since we use language to confirm our social identity," says Lupyan. For this reason, he foresees widening gulfs between British, American and Australian English.

Sadly, many smaller languages won't be able to exert their independence in this way. "Mass extinction is the future," says Pagel. Around half of the world's languages are in danger and the majority haven't even been documented yet. Once they're gone, their intricacies will be lost forever. The need to study and explain the confusion of the tongues has never been more urgent. ■

David Robson is a feature editor at *New Scientist*