How the limits of the mind shape human language

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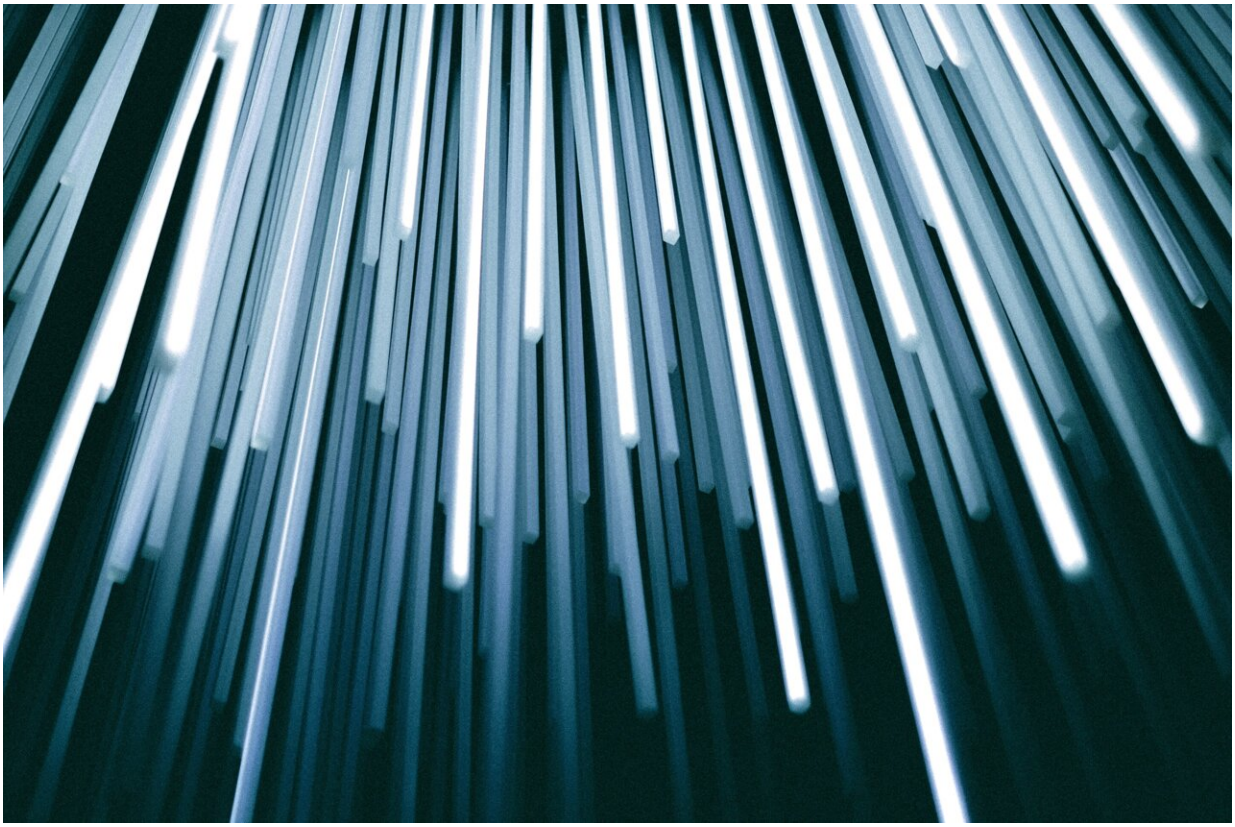

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When we speak, our sentences emerge as a flowing stream of sound. Unless we are really annoyed, We. Don't. Speak. One. Word. At. A. Time. But this property of speech is not how language itself is organized.

Sentences consist of words: discrete units of meaning and linguistic form that we can combine in myriad ways to make sentences. This disconnect between speech and language raises a problem. How do children, at an incredibly young age, learn the discrete units of their languages from the messy sound waves they hear?

Over the past few decades, psycholinguists have shown that children are "intuitive statisticians", able to detect patterns of frequency in sound. The sequence of sounds *rktr* is much rarer than *intr*. This means it is more likely that *intr* could occur inside a word (*interesting*, for example), while *rktr* is likely to span two words (*dark tree*). The patterns that children can be shown to subconsciously detect might help them figure out where one word begins and another ends.

One of the intriguing findings of this work is that other species are also able to track how frequent certain sound combinations are, just like human children can. In fact, it turns out that that we're actually worse at picking out certain patterns of sound than other animals are.

Linguistic rats

One of the major arguments in my new book, Language Unlimited, is the almost paradoxical idea that our linguistic powers can come from the limits of the human mind, and that these limits shape the structure of the thousands of languages we see around the world.

One striking argument for this comes from work carried out by researchers led by Juan Toro in Barcelona over the past decade. Toro's team investigated whether children learned linguistic patterns involving consonants better than those involving vowels, and vice versa.

They showed that children quite easily learned a pattern of nonsense words that all followed the same basic shape: you have some consonant,

then a particular vowel (say a), followed by another consonant, that same vowel, yet one more consonant, and finally a different vowel (say e). Words that follow this pattern would be *dabale*, *litino*, *nuduto*, while those that break it are *dutone*, *bitado* and *tulabe*. Toro's team tested 11 month old babies, and found that the kids learned the pattern pretty well.

But when the pattern involved changes to consonants as opposed to vowels, the children just didn't learn it. When they were presented with words like *dadeno*, *bobine*, and *lulibo*, which have the same first and second consonant but a different third one, the children didn't see this as a rule. Human children found it far easier to detect a general pattern involving vowels than one involving consonants.

The team also tested rats. The brains of rats are known to detect and process differences between vowels and consonants. The twist is that the rat brains were too good: the rats learned both the vowel rule and the consonant rule easily.

Children, unlike rats, seem to be biased towards noticing certain patterns involving vowels and against ones involving consonants. Rats, in contrast, look for patterns in the data of any sort. They aren't limited in the patterns they detect, and, so they generalize rules about syllables that are invisible to human babies.

This bias in how our minds are set up has, it seems, influenced the structure of actual languages.

Impossible languages

We can see this by looking at the Semitic languages, a family that includes Hebrew, Arabic, Amharic and Tigrinya. These languages have a special way of organizing their words, built around a system where each word can be defined (more or less) by its consonants, but the vowels

change to tell you something about the grammar.

For example, the Modern Hebrew word for "to guard" is really just the three consonant sounds sh-m-r. To say, "I guarded," you put the vowels a-a in the middle of the consonants, and add a special suffix, giving *shamarti*. To say "I will guard," you put in completely different vowels, in this case e-o and you signify that it's "I" doing the guarding with a prefixed glottal stop giving *`eshmor*. The three consonants sh-m-r are stable, but the vowels change to make past or future tense.

We can also see this a bit in a language like English. The present tense of the verb "to ring" is just *ring*. The past is, however, *rang*, and you use yet a different form in *The bell has now been rung*. Same consonants (r-ng), but different vowels.

Our particularly human bias to store patterns of consonants as words may underpin this kind of grammatical system. We can learn grammatical rules that involve changing the vowels easily, so we find languages where this happens quite commonly. Some languages, like the Semitic ones, make enormous use of this. But imagine a language that is the reverse of Semitic: the words are fundamentally patterns of vowels, and the grammar is done by changing the consonants around the vowels. Linguists have never found a language that works like this.

We could invent a language that worked like this, but, if Toro's results hold up, it would be impossible for a child to learn naturally. Consonants anchor words, not vowels. This suggests that our particularly human brains are biased towards certain kinds of linguistic patterns, but not towards other equally possible ones, and that this has had a profound effect on the languages we see across the world.

Charles Darwin once said that human linguistic abilities are different from those of other species because of the higher development of our

"mental powers." The evidence today suggests it is actually because we have different kinds of mental powers. We don't just have more *oomph* than other species, we have different *oomph*.

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