

Language driven by culture, not biology

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(PhysOrg.com) -- Language in humans has evolved culturally rather than genetically, according to a study by UCL (University College London) and US researchers. By modelling the ways in which genes for language might have evolved alongside language itself, the study showed that genetic adaptation to language would be highly unlikely, as cultural conventions change much more rapidly than genes. Thus, the biological machinery upon which human language is built appears to predate the emergence of language.

According to a phenomenon known as the Baldwin effect, characteristics that are learned or developed over a lifespan may become gradually encoded in the genome over many generations, because organisms with a stronger predisposition to acquire a trait have a selective advantage. Over generations, the amount of environmental exposure required to develop the trait decreases, and eventually no environmental exposure may be needed - the trait is genetically encoded.

An example of the Baldwin effect is the development of calluses on the keels and sterna of ostriches. The calluses may initially have developed in response to abrasion where the keel and sterna touch the ground during sitting. Natural selection then favored individuals that could develop calluses more rapidly, until callus development became triggered within the embryo and could occur without environmental stimulation. The *PNAS* paper explored circumstances under which a similar evolutionary mechanism could genetically assimilate properties of language - a theory that has been widely favoured by those arguing for the existence of 'language genes'.

The study modelled ways in which genes encoding language-specific properties could have coevolved with language itself. The key finding was that genes for language could have coevolved only in a highly stable linguistic environment; a rapidly changing linguistic environment would not provide a stable target for natural selection. Thus, a biological endowment could not coevolve with

properties of language that began as learned cultural conventions, because cultural conventions change much more rapidly than genes.

The authors conclude that it is unlikely that humans possess a genetic 'language module' which has evolved by natural selection. The genetic basis of human language appears to primarily predate the emergence of language.

The conclusion is reinforced by the observation that had such adaptation occurred in the human lineage, these processes would have operated independently on modern human populations as they spread throughout Africa and the rest of the world over the last 100,000 years. If this were so, genetic populations should have coevolved with their own language groups, leading to divergent and mutually incompatible language modules. Linguists have found no evidence of this, however; for example, native Australasian populations have been largely isolated for 50,000 years but learn European languages readily.

Professor Nick Chater, UCL Cognitive, Perceptual and Brain Sciences, says: "Language is uniquely human. But does this uniqueness stem from biology or culture? This question is central to our understanding of what it is to be human, and has fundamental implications for the relationship between genes and culture. Our paper uncovers a paradox at the heart of theories about the evolutionary origin and genetic basis of human language - although we have appear to have a genetic predisposition towards language, human language has evolved far more quickly than our genes could keep up with, suggesting that language is shaped and driven by culture rather than biology.

"The linguistic environment is continually changing; indeed, linguistic change is vastly more rapid than genetic change. For example, the entire Indo-European language group has diverged in less than 10,000 years. Our simulations show the evolutionary impact of such rapid linguistic change:

genes cannot evolve fast enough to keep up with this 'moving target'.

“Of course, co-evolution between genes and culture can occur. For example, lactose tolerance appears to have co-evolved with dairying. But dairying involves a stable change to the nutritional environment, positively selecting the gene for lactose tolerance, unlike the fast-changing linguistic environment. Our simulations show that this kind of co-evolution can only occur when language change is offset by very strong genetic pressure. Under these conditions of extreme pressure, language rapidly evolves to reflect pre-existing biases, whether the genes are subject to natural selection or not. Thus, co-evolution only occurs when the language is already almost entirely genetically encoded. We conclude that slow-changing genes can drive the structure of a fast-changing language, but not the reverse.

“But if universal grammar did not evolve by natural selection, how could it have arisen? Our findings suggest that language must be a culturally evolved system, not a product of biological adaptation. This is consistent with current theories that language arose from the unique human capacity for social intelligence.”

Paper: 'Restrictions on biological adaptation in language evolution' by Nick Chater, Florencia Reali, and Morten Christiansen, is published in the *Proceedings of the National Academy of Sciences (PNAS)*.

Provided by University College London

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