

# Study of Cantonese lexical tone shows language evolution possibly linked to genes

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A research group led by Professor Patrick Chun Man Wong, Stanley Ho Professor of Cognitive Neuroscience of the Department of Linguistics and Modern Languages, recruited more than 400 native speakers of

Cantonese for a study. The results show that participants with a specific genotype of the ASPM gene are better at perceiving lexical tone in Cantonese, and those without it may improve their abilities through musical training. The research offers clear evidence for the hypothesis that subtle differences in genetic makeup may form the basis of languages people speak in different regions of the world. In this case, because most Chinese people have an ASPM genotype that favors lexical tone processing, they adopted lexical tone in their language. The findings were recently published in the journal *Science Advances*.

More than 7,000 languages are currently spoken around the world. These languages can be divided into two types according to how pitch is used; one type that uses pitch to mark word meaning, such as Cantonese, Putonghua and Yoruba; and the other that does not, such as English. For example, in Cantonese, /si/ spoken in a high and a low falling pitch pattern means "teacher" (ㄟ [si1]) or "time" (ㄟ[si4]) respectively. This type of language is called a "tone language."

Back in 2007, a large-scale statistical research study by Dan Dediu and D. Robert Ladd, linguists at the University of Edinburgh at the time, found that individuals with specific genotypes of the ASPM and MCPH [genes](#) are more likely to speak a tone language. These genes are related to brain growth, and certain genotypes are more likely to be found in populations in sub-Saharan Africa and East and Southeast Asia. Interestingly, languages in these regions are more likely to be tone languages. The findings generated what is now called the Genetic-Biasing Hypothesis of Language Evolution. However, the study itself did not provide direct evidence of the association between those brain-growth-related genes and tone perception.

Professor Wong's sought to obtain direct evidence for the hypothesized association between these genes and the perception of lexical tone in Cantonese speakers. Since 2015, more than 400 native speakers of

Cantonese in Hong Kong have been given listening tests encompassing Cantonese tone, memory, musical pitch and rhythms. Saliva samples from the participants were collected for genetic testing conducted by Professor Richard Kwong Wai Choy, associate professor of the Department of Obstetrics and Gynaecology, Faculty of Medicine, and deputy director of the Prenatal Genetic Diagnosis Centre at CUHK. The results showed that about 70% of participants carry a pair of the T alleles representing the TT [genotype](#) of the ASPM gene, and intriguingly, these individuals also have higher tone perception ability in Cantonese. About 30% of the participants who have another genotype encountered greater difficulties with Cantonese tones. The study suggests the reason why Chinese people adopted lexical tone in their language could be because most of them have the TT genotype. As such, the lexical tone feature of Chinese is favored and retained during language evolution. This TT genotype was not associated with behaviors tested other than Cantonese tones. Other genes related to brain growth and language were also studied, but they were not associated with Cantonese tones.

Previous research by Professor Wong's team has demonstrated that tone perception was highly associated with musical training. In the current study, musical experience seems to improve tone perception ability of those who do not have the TT genotype of the ASPM gene and are at genetic risk. Those who have the TT genotype performed almost equally well on the tone perception task regardless of their previous musical training. "This gene x music interaction is important, because it suggests that those who might be at genetic risk could still improve their performance if they receive the right kind of intervention. But more research is needed to understand this interaction effect," said Professor Wong.

The study also has important clinical implications. Tone perception is an important marker for communication disorders in Chinese speakers. For example, Chinese speakers with developmental [language](#) disorder and

autism spectrum disorder often have tone perception deficits. If supported by further research, screening for ASPM could be an avenue for early detection of communication disorders as well as a clinical marker for early intervention.

This research represents a cross-disciplinary effort between linguistics and genetics, and the question also concerns anthropology and evolutionary science. Professor Wong said that it was one example of "how the study of genetics could offer a potential explanatory mechanism to address longstanding questions in linguistics. The central question is that of linguistics, and our study attempts to identify an answer that hopefully begins to meet the standard of explanatory adequacy."

To obtain additional evidence for the genetic-biasing hypothesis, further study could examine [native speakers](#) of Putonghua and other [tone](#) languages.

**More information:** Patrick C. M. Wong et al. ASPM-lexical tone association in speakers of a tone language: Direct evidence for the genetic-biasing hypothesis of language evolution, *Science Advances* (2020). [DOI: 10.1126/sciadv.aba5090](https://doi.org/10.1126/sciadv.aba5090)

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