

Hearing bad grammar results in physical signs of stress, new study reveals

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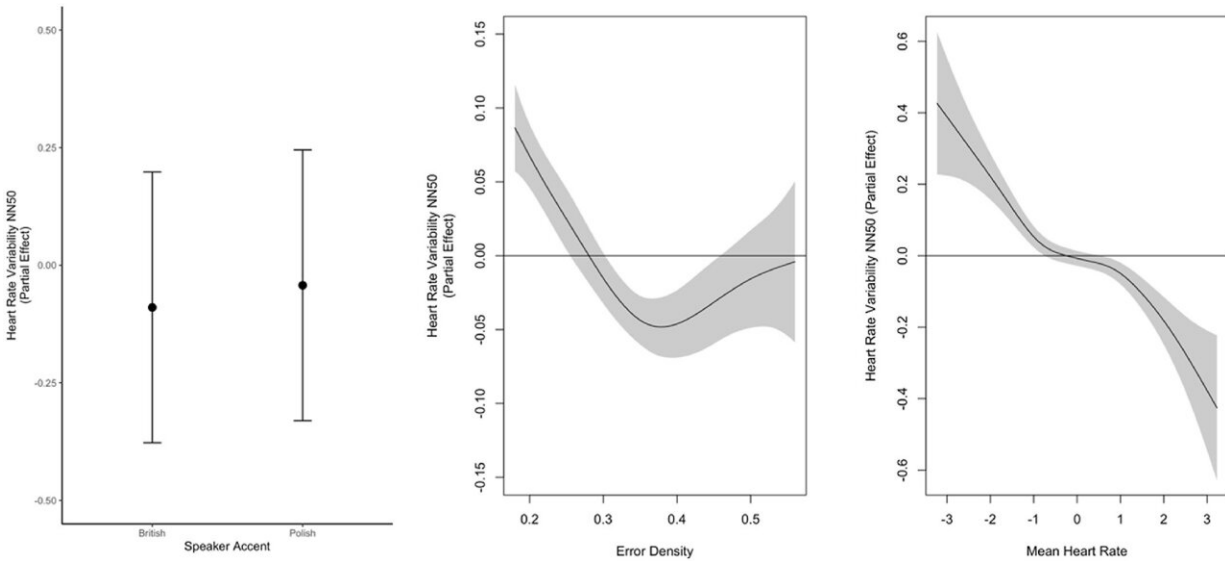
A new study by professors at the University of Birmingham has revealed for the first time how our bodies go into stress-mode when hearing misused grammar.

The study, "Physiological responses and cognitive behaviours: Measures of [heart rate variability](#) index language knowledge" is [published](#) in the *Journal of Neurolinguistics*. The dataset used in the study is available [here](#).

For the research, professors Dagmar Divjak, Professorial Research Fellow in Cognitive Linguistics and Language Cognition at the University of Birmingham, and Professor Petar Milin, Professor of Psychology of Language and Language Learning, discovered a direct correlation between instances of bad grammar and subjects' Heart Rate Variability (HRV).

HRV captures the time between successive heart beats. The length of the intervals between a person's successive heart beats tends to be variable when they are relaxed but becomes more regular when they are stressed. The new study reveals a statistically significant reduction in HRV in response to grammatical violations. This reduction reflects the extent of the grammatical violations, suggesting that the more errors a person hears, the more regular their heartbeat becomes—a sign of stress.

Commenting on the findings, Professor Divjak, principal investigator of the study, said, "The results of this study bring into focus a new dimension of the intricate relationship between physiology and cognition. This relationship has been studied using techniques ranging from eye-tracking over electro-encephalography to brain imaging. But the relation between language cognition and the [autonomic nervous system](#) (ANS) has so far received less attention.



Effect of speaker accent (left panel), error density in the sample of items (mid panel), and average heart rate (right panel) on HRV as indexed by NN50. Credit: *Journal of Neurolinguistics* (2023). DOI: 10.1016/j.jneuroling.2023.101177

"The ANS comprises two parts: the sympathetic (SNS) and the parasympathetic (PNS) [nervous system](#). Simply put, the sympathetic nervous system activates the 'fight or flight' response during a threat or perceived danger, while the parasympathetic nervous system controls the 'rest and digest' or 'feed and breed' functions of the body. Our findings show that this system, too, responds to cognitive demands, and this suggests that cognitive effort reverberates through the physiological system in more ways than previously thought."

The research conducted by Divjak alongside Professor Milin from the University of Birmingham, and Dr. Hui Sun who was working as a postdoctoral researcher on the project at the time, has provided the first evidence to suggest that HRV can be used as an indicator of implicit linguistic knowledge.

Divjak explained, "Your knowledge about your first language is largely implicit, i.e., learning your [mother tongue](#) did not require you to sit and study, and using it does not require much, if any, thought. This also means that you will find it hard to pin down what exactly is right or wrong about a sentence and, even worse, explain why that is so, especially if you've not had formal language training.

"However, accurately assessing someone's linguistic abilities, regardless of age and physical or [cognitive abilities](#), is important for many questions pertaining to core areas of life relating to cognition, including brain health.

"This study provides us with a new method for tapping into aspects of cognition that are not directly observable. This is particularly valuable in work with [language](#) users who are unable to verbally express their opinion due to young or old age, or ill health."

More information: Dagmar Divjak et al, Physiological responses and cognitive behaviours: Measures of heart rate variability index language knowledge, *Journal of Neurolinguistics* (2023). [DOI: 10.1016/j.jneuroling.2023.101177](#)

Provided by University of Birmingham

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