How the brain controls our speech

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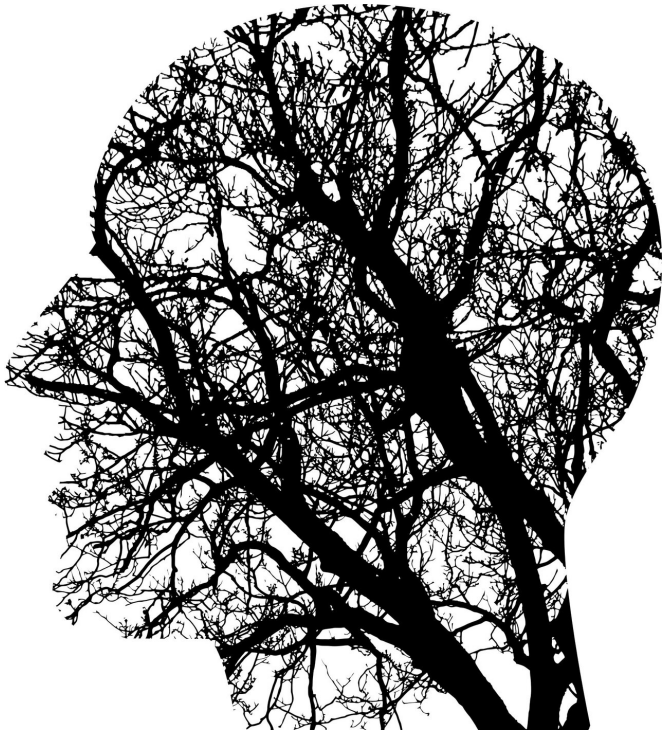

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Speaking requires both sides of the brain. Each hemisphere takes over a part of the complex task of forming sounds, modulating the voice and monitoring what has been said. However, the distribution of tasks is different than has been thought up to now, as an interdisciplinary team of neuroscientists and phoneticians at Goethe University Frankfurt and the Leibniz-Centre General Linguistics Berlin has discovered: it is not just the right hemisphere that analyzes how we speak—the left hemisphere also plays a role.

Until now, it has been assumed that the spoken word arises in the left side of the brain and is analyzed by the right side. According to accepted doctrine, this means that when we learn to speak English and for example practice the sound equivalent to 'th,' the left side of the brain controls the motor function of the articulators like the tongue, while the right side analyzes whether the produced sound actually sounds as we intended.

The division of labor actually follows different principles, as Dr. Christian Kell from the Department of Neurology at Goethe University explains: "While the left side of the brain controls temporal aspects such as the transition between speech sounds, the right hemisphere is responsible for the control of the sound spectrum. When you say 'mother,' for example, the left hemisphere primarily controls the dynamic transitions between 'th' and the vowels, while the right hemisphere primarily controls the sounds themselves."

His team, together with the phonetician Dr. Susanne Fuchs, was able to demonstrate this division of labor in temporal and spectral control of speech for the first time in studies in which speakers were required to talk while their brain activities were recorded using functional magnetic resonance imaging.

A possible explanation for this division of labor between the two sides of the brain is that the left hemisphere generally analyzes fast processes such as the transition between speech sounds better than the right hemisphere. The right hemisphere could be better at controlling the slower processes required for analyzing the sound spectrum. A previous study on hand motor function that was published in the scientific publication *eLife* demonstrates that this is, in fact, the case. Kell and his team wanted to learn why the right hand was preferentially used for the control of fast actions and the left hand preferred for slow actions. For example, when cutting bread, the right hand is used to slice with the knife while the left hand holds the bread.

In the experiment, scientists had right-handed test subjects tap with both hands to the rhythm of a metronome. In one version they were supposed to tap with each beat, and in another only with every fourth beat. As it turned out, the right hand was more precise during the quick tapping sequence

and the left hemisphere, which controls the right side of the body, exhibited increased activity. Conversely, tapping with the left hand corresponded better with the slower rhythm and resulted in the right hemisphere exhibiting increased activity.

Taken together, the two studies create a convincing picture of how complex behavior—hand motor functions and speech—are controlled by both cerebral hemispheres. The left side of the brain has a preference for the control of fast processes while the right side tends to control the slower processes in parallel.

More information: Mareike Floegel et al. Differential contributions of the two cerebral hemispheres to temporal and spectral speech feedback control, *Nature Communications* (2020). DOI: 10.1038/s41467-020-16743-2

Anja Pflug et al. Differential contributions of the two human cerebral hemispheres to action timing, *eLife* (2019). DOI: 10.7554/eLife.48404

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