https://doi.org/10.1038/s41583-024-00903-0

Language is widely distributed throughout the brain

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Published online: 6 January 2025

Fedorenko and coauthors argue that language is localized to a small static set of brain regions, in a single segregated network (Fedorenko, E., Ivanova, A. A. & Regev, T. I. The language network as a natural kind within the broader landscape of the human brain. *Nat. Rev. Neurosci.* **25**, 289–312; 2024)[1]. We challenge this traditional view of the neurobiology of language and argue that language is widely distributed throughout the brain.

Language in a vat?

Empirical evidence from modern neuroimaging suggests that functional localization inadequately explains brain–behaviour relations: local regions perform multiple functions determined by connectivity across complex subnetworks, distributed throughout the whole brain[2,3]. Yet Fedorenko et al. argue that the brain shows no sensitivity to linguistic variables outside the 'language network', making it a neural 'natural kind'[1]. As an 'intuition pump'[4], does this mean we could excise the 'language network', put it in a vat and feed it text, and it would still comprehend language? This seems implausible, especially considering there is no fixed definition of language, and language itself is not thought to be a natural kind[5]. As elaborated below, neither the methods nor evidence for the 'language network' support the modular 'natural kind' conclusion.

Averaging and evidence

Using a 'language localizer' to define the 'language network' is tautological. The circularity takes the following form: the language network is defined as activity resulting from connected compared to noisy or scrambled language, and language selectivity is then tested in these same regions. Further, such methods create an exaggerated impression of selectivity because they average across tens of thousands of positive and negative voxel-wise 'activity' or connectivity values and many different cytoarchitectonic and functional zones within the identified (non)-'language' regions[1]. Rather, this isolated 'language network' only appears when averaging over data resulting from heterogeneous linguistic representations and processes unfolding over multiple timescales[6–8]. When these have been considered individually (such as with different syntactic forms), they are shown to be distributed across the entire brain[6–9]. Last, the stimuli and tasks used in this approach do not consider language as we comprehend and produce it in daily life (as a multimodal, socially embedded phenomenon). As such, the resulting 'language network' is 'defined' in a manner that scarcely resembles what most would endorse as language.

Alternatives

Thus, despite the large number of studies using the 'language localizer' approach, results do not necessarily constitute evidence for a 'language network'. Alternative neurobiological models should account for both the 'language localizer' and distributed language data and language as a real-world activity[6]. The apparent specialization of regions in the 'language network' might reflect the frequent engagement of these regions due to their connectivity and role within task-relevant networks, but this does not limit them to language processing alone. Hence, the 'language network' could more simply be conceived of as a collection of hierarchically organized auditory association cortices communicating with functional connectivity hubs that coordinate a whole-brain distribution of contextually determined and, thus, highly variable 'peripheral' regions (with a similar model able to account for signed languages)[6,7,10].

We suspect that studies incorporating natural language comprehension and production, fewer subtractions, less averaging, and more individual, spatiotemporal and network analyses will demonstrate that the neurobiology of language does not operate in a vat. It is widely distributed across the brain.

There is a reply to this letter by Fedorenko, E., Ivanova, A. A. & Regev, T. I. *Nat. Rev. Neurosci.* https://doi.org/10.1038/s41583-024-00904-z (2025).

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Acknowledgements

L.D. would like to thank P. Hagoort for discussion.

Competing interests

The authors declare no competing interests.

Additional information

Peer review information *Nature Reviews Neuroscience* thanks Samuel Nastase and the other, anonymous, reviewer(s) for their contribution to the peer review of this work.