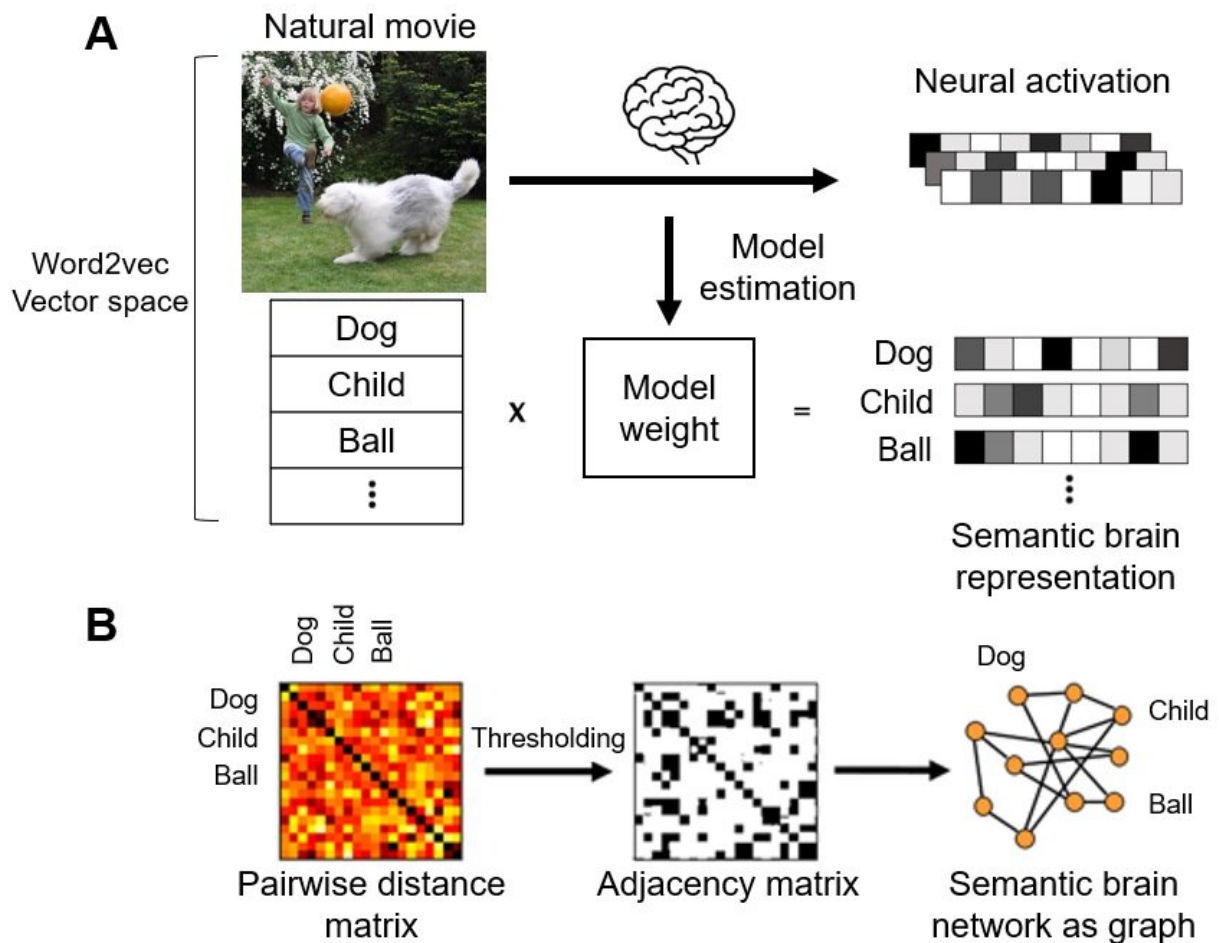


Evidence showing the 'loosening of associations' found in schizophrenia

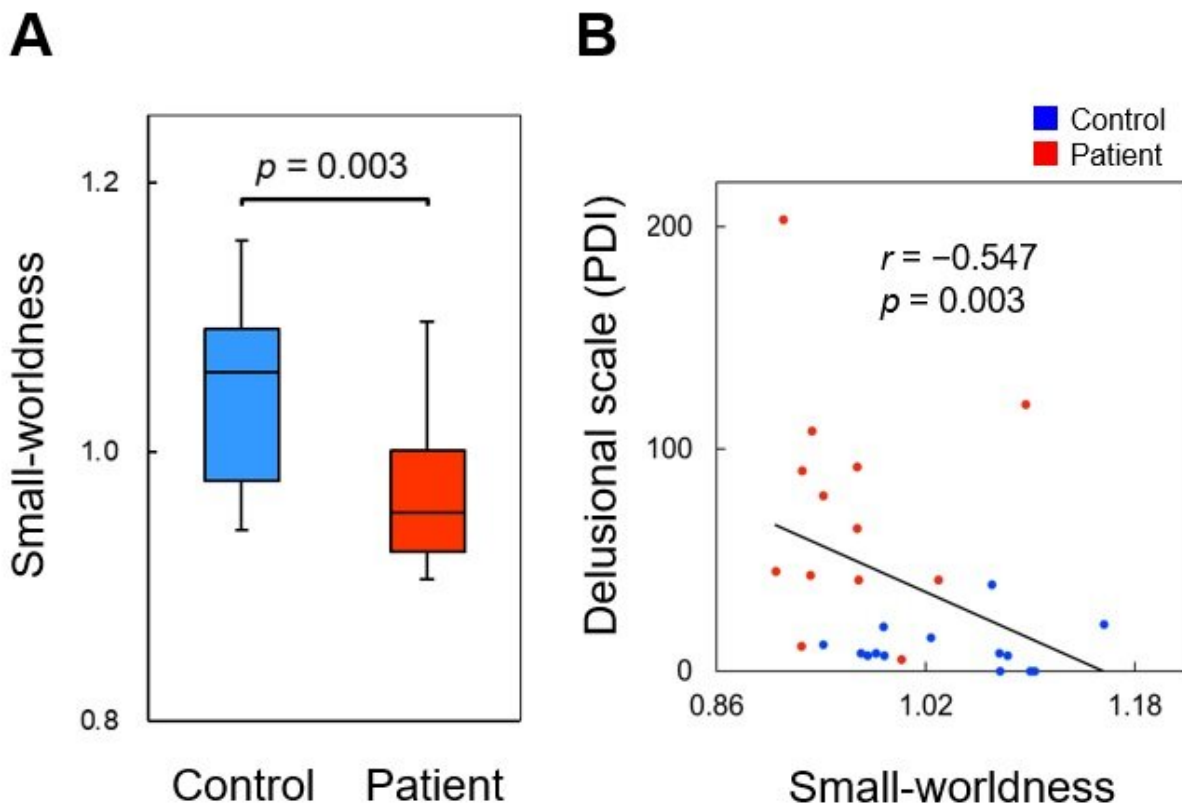
January 17 2023



(A) Encoding modeling of semantic brain representations. (B) Network analysis of semantic brain representations. Credit: Department of Psychiatry and Behavioral Sciences, TMDU

In a study published last month in *Schizophrenia Bulletin*, researchers from Tokyo Medical and Dental University (TMDU) revealed that the semantic networks in the brains of schizophrenia patients are very different from those in healthy humans.

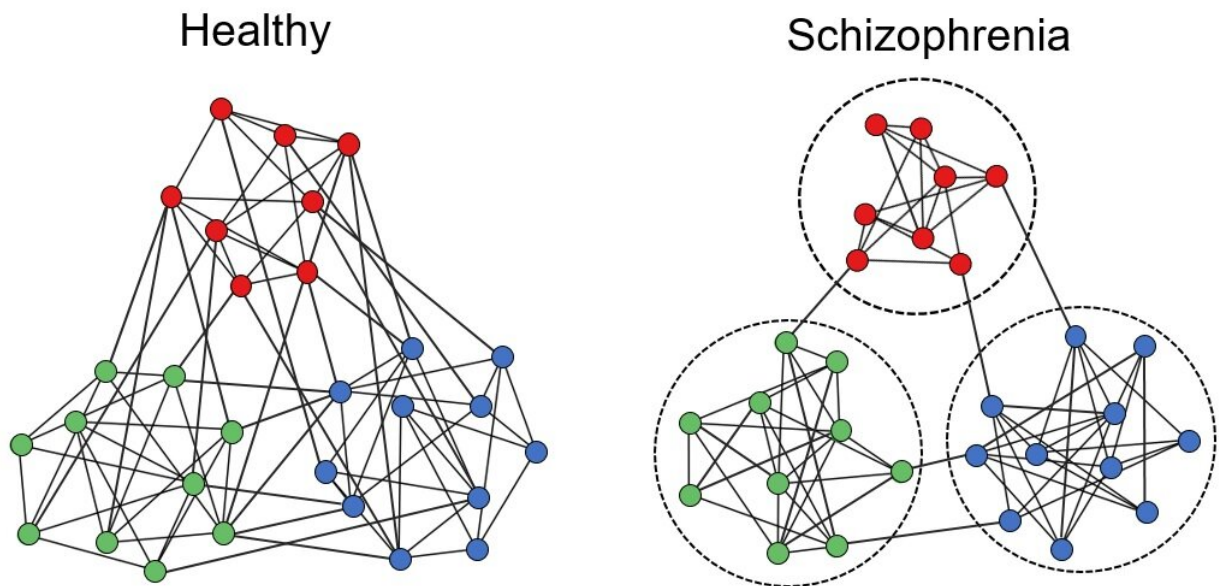
Schizophrenia is a [mental illness](#) that usually presents with delusions, hallucinations, and incoherent speech and behavior. The fundamental feature of the disease is "loosening of associations" between ideas, which disrupts patients' thought processes. Now, researchers from Japan have tried to study the structural characteristics of the semantic networks in the brain that reflect thought disorder in schizophrenia.



(A) Group comparison of small-worldness. (B) Correlation between the Peters et al. Delusions Inventory (PDI) scores and small-worldness. r , correlation coefficient; p , p-value. Credit: Department of Psychiatry and Behavioral

Semantic processing seems to be impaired in patients with schizophrenia because of the functional disconnection between neurons. To characterize this pathology, researchers from TMDU investigated the [brain activity](#) of 14 patients with schizophrenia and 17 healthy individuals. All of the participants underwent [functional magnetic resonance](#) imaging (fMRI) while watching soundless color movies.

"It is now possible to quantitatively evaluate the semantic representations of individual words in the brain, thanks to fMRI showing brain activity and language processing techniques," says Hidehiko Takahashi, senior author. To understand the difference in brain characteristics, the team analyzed a large-scale connectivity structure of neuronal representations, or a "semantic brain network," using [network analysis](#) or [graph theory](#), which deals with the mathematical characteristics of such graphs.



Different colors represent different categories that serve as predefined modules.
Credit: Department of Psychiatry and Behavioral Sciences, TMDU

The team found that the semantic networks in the brains of healthy individuals have small-world properties similar to natural languages, meaning that concepts are organized into specific semantic domains and are globally connected, enabling coherent thought and speech. In contrast, the semantic networks of schizophrenia patients were highly modular with distinct categories, and the structure within each category was disorganized and randomized. These impairments in semantics and associations contribute to thought disorder, including delusion.

This study provided evidence for the "loosening of associations" observed in patients with schizophrenia. This new approach can help us understand how the brains of patients with schizophrenia or any other thought disorder perceive the world. It can even help to inform the development of new treatments for psychiatric diseases.

More information: Yukiko Matsumoto et al, Disorganization of Semantic Brain Networks in Schizophrenia Revealed by fMRI, *Schizophrenia Bulletin* (2022). [DOI: 10.1093/schbul/sbac157](https://doi.org/10.1093/schbul/sbac157)

Provided by Tokyo Medical and Dental University

Citation: Evidence showing the 'loosening of associations' found in schizophrenia (2023, January 17) retrieved 23 June 2024 from <https://medicalxpress.com/news/2023-01-evidence-loosening-associations-schizophrenia.html>

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