Interpreting the content of thought based on brain activity: We are not that different

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Meanings of nouns are widely thought to be grounded in experience. The experience of the world is unique for everyone, but many experiences are shared with other people. In her master’s thesis “Item-level decodability of semantic representations in the brain between individuals”, Lotta Lammi demonstrated that brain-level representations of the meaning of concrete items are partly individual and partly shared.

In this study, Lammi investigated how similar the brain activation is when two different persons think about the same item. The aim of the study was to predict, for each participant, the presented stimuli based on the participant’s brain activation, using a machine learning model which was trained on the brain data of the other participants. To achieve this, brain activation of 20 healthy volunteers was measured with magnetoencephalography (MEG), while each participant was shown black-and-white photographs of the same set of concrete items. MEG is a non-invasive brain-imaging technique that measures weak magnetic fields generated by neural activity, at high temporal resolution. This study was done at the Department of Neuroscience and Biomedical Engineering (NBE), Aalto University, Finland.

The prediction accuracy of the model was significantly above the chance level, which means that the model trained on other participants’ data was able to successfully interpret the brain data of an individual and identify the item that this participant thought about. Most commonalities in semantic processing between participants were found at 150–250 ms and 350–550 ms after the stimulus onset. Some participants had more similar brain responses than others, but differences in signal-to-noise ratio did not influence prediction performance. Cross-participant decoding did not reach the accuracy of within-participant decoding, suggesting that all aspects of semantic processing are not shared.

These results bring new knowledge of individual differences in the brain. More research is needed to uncover the factors that may cause individual differences in semantic representations and in decoding of such representations in the cortex using machine learning methods.

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