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How Abstract Concepts Are Represented in the Brain Across Cultures and Languages

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Summary: Researchers explore the impact of different cultures and languages on the development of abstract thoughts in the brain, reporting those who grew up in different cultures and speak different languages form abstract concepts in the same brain region. **Source:** Carnegie Mellon University

where concrete and abstract concepts materialize. A new study now explores if people in the same regions of the brain.

Researchers at Carnegie Mellon University have explored the regions of the brain

who grow up in different cultures and speak different languages form these concepts "We wanted to look across languages to see if our cultural backgrounds influence how we understand, how we perceive abstract ideas like justice," said Roberto Vargas, a

doctoral candidate in psychology at the Dietrich College of Humanities and Social Sciences and lead author on the study. Vargas is continuing fundamental research in neural and semantic organization initiated by Marcel Just, the D.O. Hebb University Professor of Psychology. Just began this process more than 30 years ago by scanning the brains of participants using a functional

magnetic resonance imaging (fMRI) machine. His research team began by identifying the regions of the brain that light up for concrete

objects, like an apple, and later moved to abstract concepts from physics like force and gravity.

the regions of the brain that fire for abstract objects based on language. In this case, the researchers studied people whose first language is Mandarin or English. "The lab's research is progress to study universalities of not only single concept

representations, but also representations of larger bodies of knowledge such as scientific

The latest study took the evaluation of abstract concepts one step further by exploring

and technical knowledge," Just said. "Cultures and languages can give us a particular perspective of the world, but our mental filing cabinets are all very similar." According to Vargas, there is a fairly generalizable set of hardware, or network of brain regions, that people leverage when thinking about abstract information, but how people

use these tools varies depending on culture and the meaning of the word. This was one of the first studies to examine the degree of commonality in the neural basis for representing abstract concepts across languages while providing a framework for identifying language-specific differences in the meaning of individual abstract

concepts.

representation from those who speak English and Mandarin. Participants were given 28 individual abstract concepts that spanned seven categories: social, emotion, metaphysics, law, religiosity, mathematics and scientific. While in the fMRI machine, participants would think about a prompt from one of these

categories, like sacrilege in the religiosity category, for three seconds. Between each

prompt, the participant would clear their mind by staring at a shrinking, blue ellipse for

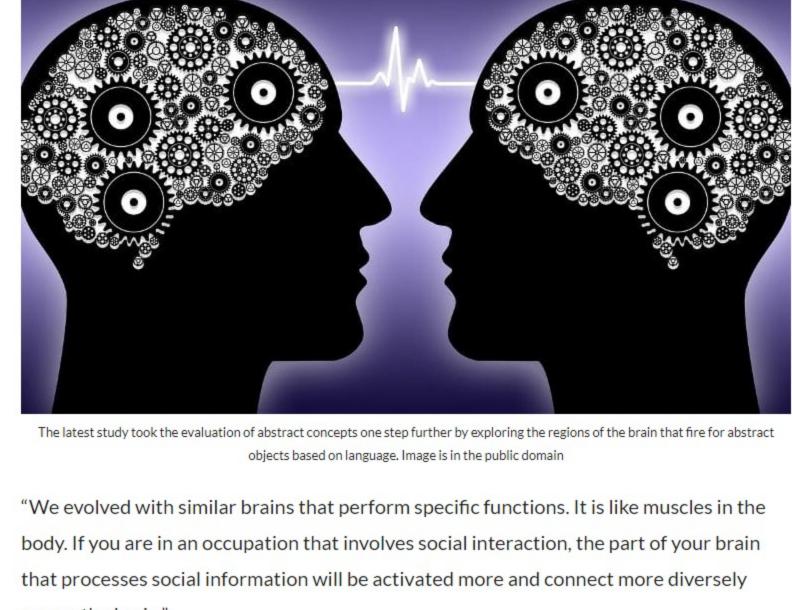
During the study, Vargas and Just gathered brain scans from 20 participants, with equal

seven seconds. The series was repeated six times to provide multiple datasets for statistical analyses and to train and test models.

The study shows that a common neural infrastructure does exist between languages.

While the underlying neural regions are similar, how the areas light up is more specific to

each individual. "I think the more that I conduct this line of research the more I realize that humans are not so unique with how they think about things," Vargas said.



across the brain." The similarity for the math-focused concepts may lie in the high cross-language similarity

of math and science. The similarity in emotion and social concepts may lie in the common circumstances and relationships behind these concepts. "These findings speak to the universal way that brains from all cultures deal with abstract information," Just said. "Despite each culture developing its own somewhat differing

conceptions of the world, all brains organize the abstract concepts the same way, using

the same brain systems."

This study, as well as previous work completed by Vargas and Just, was based on samples of less than 20 participants each. Vargas hesitates to make any larger sweeping statements about how this work applies in a larger cultural context due to the small sample size and comparison of only two languages.

"Now that I have a sense of how abstract concepts are generalizable across individuals, I can start asking wild questions about abstract concepts in the context of our social world," Vargas said.

He wants to continue this work but take it in a new direction, specifically focusing on how

abstract concepts manifest in a sociological or cultural context.

healthcare, and how these concepts differ across racial groups.

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Vargas will continue this work through two projects. One will examine how social identity affects decisions on reward and punishment. The second examines the way people think about concepts related of our societal environment, such as police and

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About this neuroscience research news

Original Research: Open access. "Similarities and differences in the neural representations of abstract concepts across English and Mandarin" by Roberto Vargas et al. Human Brain

Abstract Similarities and differences in the neural representations of abstract concepts across **English and Mandarin**

Recent research suggests there is a neural organization for representing abstract

To investigate the possible role of language on the representation of abstract concepts,

multivariate pattern analytic (MVPA) techniques were applied to fMRI data to compare

concepts that is common across English speakers.

the neural representations of 28 individual abstract concepts between native English and Mandarin speakers. Factor analyses of the activation patterns of the 28 abstract concepts from both

languages characterized this commonality in terms of a set of four underlying

neurosemantic dimensions, indicating the degree to which a concept is verbally

represented, internal to the person, contains social content, and is rule-based. These common semantic dimensions (factors) underlying the 28 concepts provided a sufficient basis for reliably identifying the individual abstract concepts from their neural signature in the other language with a mean rank accuracy of 0.65 (p < .001).

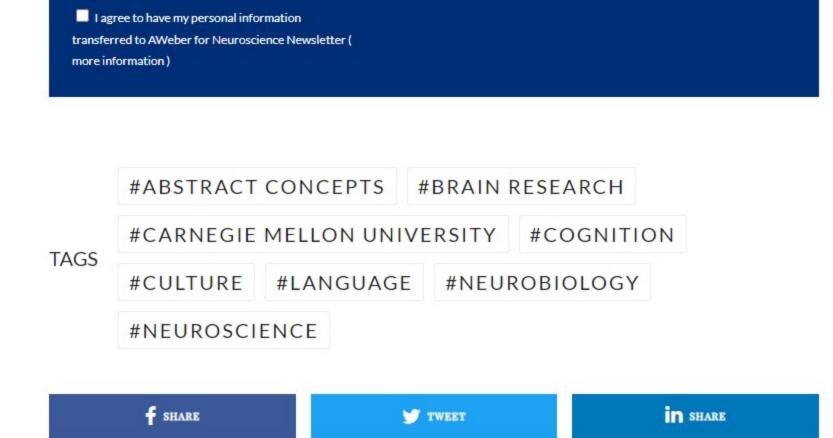
accommodated in terms of differential salience of particular dimensions. These semantic dimensions constitute a set of neurocognitive resources for abstract concept representations within a larger set of regions responsible for general semantic

Although the neural dimensions used for representing abstract concepts are common

across languages, differences in the meaning of some individual concepts can be

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