

New CMU brain imaging research reveals why autistic individuals confuse pronouns

August 1 2011

Autism is a mysterious developmental disease because it often leaves complex abilities intact while impairing seemingly elementary ones. For example, it is well documented that autistic children often have difficulty correctly using pronouns, sometimes referring to themselves as "you" instead of "I."

A new brain imaging study published in the journal "*Brain*" by scientists at Carnegie Mellon University provides an explanation as to why autistic individuals' use of the wrong pronoun is more than simply a word choice problem. Marcel Just, Akiki Mizuno and their [collaborators](#) at CMU's Center for [Cognitive Brain Imaging](#) (CCBI) found that errors in choosing a self-referring pronoun reflect a disordered [neural representation](#) of the self, a function processed by at least two [brain areas](#) — one frontal and one posterior.

"The psychology of self — the thought of one's own identity — is especially important in social interaction, a facet of behavior that is usually disrupted in autism," said Just, a leading cognitive neuroscientist and the D.O. Hebb Professor of Psychology at CMU who directs the CCBI. "Most children don't need to receive any instruction in which pronoun to use. It just comes naturally, unless a child has autism."

For the study, the research team used functional magnetic resonance imaging (fMRI) to compare the brain activation pattern and the synchronization of activation across brain areas in young adults with high-functioning autism with control participants during a language task that

required rapid pronoun comprehension.

The results revealed a significantly diminished synchronization in autism between a frontal area (the right anterior insula) and a posterior area (precuneus) during pronoun use in the autism group. The participants with autism also were slower and less accurate in their behavioral processing of the pronouns. In particular, the synchronization was lower in autistic participants' brains between the right anterior insula and precuneus when answering a question that contained the pronoun "you," querying something about the participant's view.

"Shifting from one pronoun to another, depending on who the speaker is, constitutes a challenge not just for children with autism but also for adults with high-functioning autism, particularly when referring to one's self," Just said. "The functional collaboration of two brain areas may play a critical role for perspective shifting by supporting an attention shift between oneself and others.

"Pronoun reversals also characterize an atypical understanding of the social world in autism. The ability to flexibly shift viewpoints is vital to social communication, so the autistic impairment affects not just language but social communication," Just added.

Autism was documented for the first time in 1943, in a landmark article by Dr. Leo Kanner of Johns Hopkins University. In that first article, Kanner noted the puzzling misuse of pronouns by children with the disorder. "When he [the child] wanted his mother to pull his shoe off, he said: 'Pull off your shoe.'" Kanner added that, "Personal pronouns are repeated [by the child with autism] just as heard, with no change to suit the altered situation." Because his mother referred to him as "you," so did the child.

Just's previous brain imaging research in autism has shown that other

facets of thinking that are disrupted in autism, such as social difficulties and language impairments, also may be attributed to a reduced communication bandwidth between the frontal and posterior parts of the brain. He refers to this as the "Theory of Frontal-Posterior Underconnectivity." In each of these types of thinking, the processing is done by a set of different brain regions that includes key frontal regions, and the lower frontal-posterior bandwidth limits how well the frontal regions can contribute to the brain's networked computations.

The brain's communication network is its white matter, the 45 percent of the brain that consists of myelinated (insulated) axons that carry information between brain regions. An emerging view is that the white matter is compromised in autism, specifically in the frontal-posterior tracts. In a groundbreaking study published in 2009, Just and his colleagues showed for the first time that compromised white matter in children with reading difficulties could be repaired with extensive behavioral therapy. Their imaging study showed that the brain locations that had been abnormal prior to the remedial training improved to normal levels after the training, and the reading performance in individual children improved by an amount that corresponded to the amount of white matter change. Ongoing research at the CCBI is assessing the white matter in detail, measuring its integrity and topology, trying to pinpoint the difference in the autistic brain's networks.

"This new understanding of what causes pronoun confusion in autism helps make sense of the larger problems of autism as well as the idiosyncrasies," Just said. "Moreover, it points to new types of therapies that may help rehab the white matter in [autism](#)."

More information: www.ccbi.cmu.edu/publications.htm

Provided by Carnegie Mellon University

Citation: New CMU brain imaging research reveals why autistic individuals confuse pronouns (2011, August 1) retrieved 5 May 2024 from <https://medicalxpress.com/news/2011-08-cmu-brain-imaging-reveals-autistic.html>

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