Friendly to a fault, yet tense: Personality traits traced in brain

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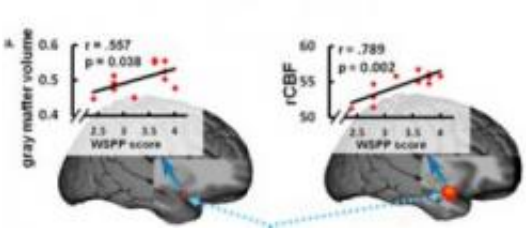


The severity of abnormalities in insula (red structure near bottom of brain), gray matter volume (left) and brain activity (right) predicted the extent of aberrant personality traits in Williams syndrome patients -- as reflected in their scores (red dots) on personality rating scales (WSPP). Credit: Karen Berman, M.D., NIMH Clinical Brain Disorders Branch

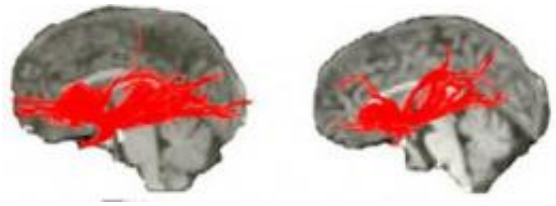
A personality profile marked by overly gregarious yet anxious behavior is rooted in abnormal development of a circuit hub buried deep in the front center of the brain, say scientists at the National Institutes of Health. They used three different types of brain imaging to pinpoint the suspect brain area in people with Williams syndrome, a rare genetic disorder characterized by these behaviors. Matching the scans to scores on a personality rating scale revealed that the more an individual with Williams syndrome showed these personality/temperament traits, the more abnormalities there were in the brain structure, called the insula.

"Scans of the brain's tissue composition, wiring, and activity produced converging evidence of genetically-caused abnormalities in the structure

and function of the front part of the insula and in its connectivity to other brain areas in the circuit," explained Karen Berman, M.D., of the NIH's National Institute of Mental Health (NIMH).

Berman, Drs. Mbemda Jabbi, Shane Kippenham, and colleagues, report on their imaging study in Williams syndrome online in the journal Proceedings of the National Academy of Sciences.

"This line of research offers insight into how genes help to shape brain circuitry that regulates complex behaviors – such as the way a person responds to others – and thus holds promise for unraveling brain mechanisms in other disorders of social behavior," said NIMH Director Thomas R. Insel, M.D.



Long distance connections, white matter, between the insula and other parts of the brain are aberrant in Williams syndrome. Neuronal fibers of normal controls (left) extend further than those of Williams syndrome patients (right). Picture shows diffusion tensor imaging data from each patient superimposed on anatomical MRI of the median patient. Credit: Karen Berman, M.D., NIMH Clinical Brain Disorders Branch

Williams syndrome is caused by the deletion of some 28 genes, many involved in brain development and behavior, in a particular section of chromosome 7. Among deficits characteristic of the syndrome are a lack of visual-spatial ability – such as is required to assemble a puzzle – and a tendency to be overly-friendly with people, while overly anxious about

non-social matters, such as spiders or heights. Many people with the disorder are also mentally challenged and learning disabled, but some have normal IQs.

Previous imaging studies by the NIMH researchers found abnormal tracts of the neuronal fibers that conduct long-distance communications between brain regions -- likely resulting from neurons migrating to the wrong destinations during early development.

Evidence suggests that genes influence our temperament and the development of mental disorders via effects on brain circuits that regulate behavior. Yet direct demonstration of this in humans has proven elusive. Since the genetic basis of Williams syndrome is well known, it offers a unique opportunity to explore such effects with neuroimaging, reasoned the researchers.

Although the insula had not previously been studied in such detail in the disorder, it was known to be related to brain circuitry and certain behaviors, such as empathy, which is also highly prominent in the disorder. Berman and colleagues hypothesized that the insula's anatomy, function and connectivity would predict patients' scores for Williams syndrome-associated traits on personality rating scales. Fourteen intellectually normal Williams syndrome participants and 23 healthy controls participated in the study.

Magnetic resonance imaging (MRI) revealed that patients had decreased gray matter – the brain's working tissue – in the bottom front of the insula, which integrates mood and thinking. By contrast, they had increased gray matter in the top front part of the insula, which has been linked to social/emotional processes.

Diffusion tensor imaging, which by detecting the flow of water in nerve fibers can identify and measure the connections between brain areas,

showed reduced white matter – the brain's long-distance wiring – between thinking and emotion hubs.

Tracking radioactively-tagged water in order to measure brain blood flow at rest, via positron emission tomography (PET), exposed activity aberrations consistent with the MRI abnormalities. The PET scans also revealed altered functional coupling between the front of the insula and key structures involved in thinking, mood and fear processing. These structural and functional abnormalities in the front of the insula correlated with the Williams syndrome personality profile.

"Our findings illustrate how brain systems translate genetic vulnerability into behavioral traits" explained Berman.

More information: The Williams syndrome chromosome 7q11.23 hemideletion confers hypersocial, anxious personality coupled with altered insula structure and function. Jabbi M, Kippenhan JS, Kohn P, Marenco S, Mervis CB, Morris CA, Meyer-Lindenberg A, Berman KF. *Proc Natl Acad Sci*. 2012 Mar 12. [Epub ahead of print] PMID: 22411788

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