Ability to navigate may be linked to genes, researcher says

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Imagine that you are emerging from the subway and heading for your destination when you realize that you are going in the wrong direction. For a moment, you feel disoriented, but a scan of landmarks and the layout of the surrounding streets quickly helps you pinpoint your location, and you make it to your appointment with time to spare.

Research tells us that human adults, toddlers, rats, chicks and even fish routinely and automatically accomplish this kind of "reorientation" by mentally visualizing the geometry of their surroundings and figuring out where they are in space. Until now, however, we haven't understood that genes may play a part in that ability.

Writing this week in the online Early Edition of the Proceedings of the National Academy of Sciences, a team led by Barbara Landau, the Dick and Lydia Todd Professor in the Department of Cognitive Science at The Johns Hopkins University, for the first time links genes to our ability to navigate the world.

"We found that people with a rare genetic disorder cannot use one of the very basic systems of navigation that is present in humans as early as 18 months and shared across a wide range of species," Landau said. "To our knowledge, this is the first evidence from human studies of a link between the missing genes and the system that we use to reorient ourselves in space."

Working with lead author Laura Lakusta of Montclair State University

in New Jersey and co-author Banchiamlack Dessalegn, a postdoctoral fellow at University of Chicago (both of whom recently received their Ph.D.s at Johns Hopkins under Landau's direction and carried out the research there), Landau's study involved people with a rare genetic disorder known as Williams syndrome. Named for its discoverer, New Zealander Dr. J. C. P. Williams, the syndrome is caused when a small amount of genetic material is missing from one human chromosome. People with Williams syndrome are extremely social and verbally adept, but have difficulty with tasks such as assembling simple puzzles, copying basic patterns and navigating their bodies through the physical world. Williams syndrome occurs in one in 7,500 live births.

In the study, Landau's team challenged people with Williams syndrome to watch while someone hid an object beneath a small cloth flap in one corner of a small rectangular room with four solid black walls that had no landmarks. Subjects were then blindfolded and spun around (think "Pin the Tail on the Donkey") for about 10 seconds to disorient them. Once the blindfold was taken off, the subjects were asked to find the hidden object.

According to Landau, the people with Williams syndrome searched the four corners randomly; indicating that their ability to mentally visualize the layout of the room and quickly find which corner held the hidden object is severely impaired.

"They searched the room for the hidden object randomly, as if they had never before seen the overall geometry of the room or the lengths of the walls and their geometric - left and right - relation to each other," Landau explained. "If they could imagine the overall shape of the room's layout - that there are four walls, two of them long and two of them short and that the toy was hidden in a corner that has a short wall on the right and the long wall on the left - then they should have guessed that one of the two 'geometrically equivalent corners' was the right place. This is

what typically developing humans do, as early as 18 months of age."

Control subjects (healthy college-aged students) responded more typically, searching for the object in one of the two geometrically equivalent corners, as has been found in studies by many other investigators.

According to Landau, the results of this study provides another clue to the link between how genes work, how brains develop and become specialized and what can go wrong to result in very basic cognitive system malfunctioning.

"Although we are quite far from understanding the links between the specific genes that are missing in Williams syndrome and the behavior they show, such as failure to reorient, it is clear that the missing genes ultimately have some effect on the brain," she said. "Our evidence is the first to directly show a substantial deficit in this reorientation system that is caused by missing genes in humans."

Provided by Johns Hopkins University

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