# Noisy brain signals: How the schizophrenic brain misinterprets the world

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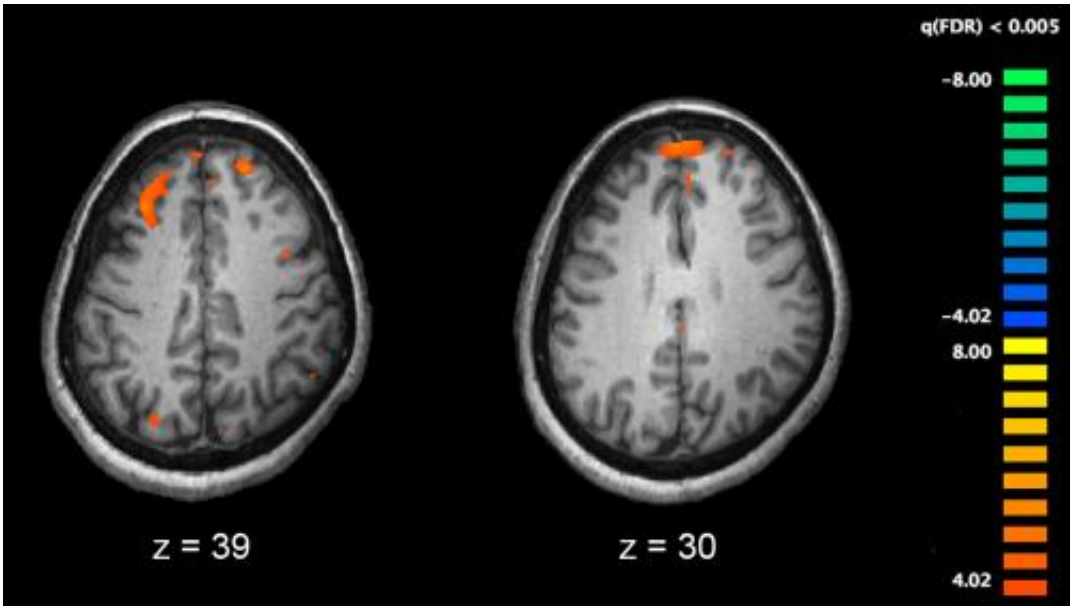


Functional magnetic resonance imaging (fMRI) and other brain imaging technologies allow for the study of differences in brain activity in people diagnosed with schizophrenia. The image shows two levels of the brain, with areas that were more active in healthy controls than in schizophrenia patients shown in orange, during an fMRI study of working memory. Credit: Kim J, Matthews NL, Park S./PLoS One.

People with schizophrenia often misinterpret what they see and experience in the world. New research provides insight into the brain mechanisms that might be responsible for this misinterpretation. The study from the Montreal Neurological Institute and Hospital – The

Neuro - at McGill University and McGill University Health Centre, reveals that certain errors in visual perception in people with schizophrenia are consistent with interference or 'noise' in a brain signal known as a corollary discharge. Corollary discharges are found throughout the animal kingdom, from bugs to fish to humans, and they are thought to be crucial for monitoring one's own actions. The study, published in the April 2 issue of the *Journal of Neuroscience*, identifies a corollary discharge dysfunction in schizophrenia, which could aid with diagnosis and treatment of this difficult disorder. It was carried out in collaboration with researchers Veronica Whitford, Gillian O'Driscoll, and Debra Titone in the Department of Psychology, McGill University.

"A corollary discharge is a copy of a nervous system message that is sent to other parts of the brain, in order to make us aware that we are doing something," said Dr. Christopher Pack, neuroscientist at The Neuro and lead investigator on the study. "For example, if we want to move our arm, the motor area of the brain sends a signal to the muscles to produce a movement. A copy of this command, which is the corollary discharge, is sent to other regions of the brain, to inform them of the impending movement. If you were moving your arm, and you didn't have the corollary discharge signal, you might assume that someone else was moving your arm. Similarly, if you generated a thought, and you had an impaired corollary discharge, then you might assume that someone else placed the thought in your mind. Corollary discharges ensure that different areas of the brain are communicating with each other, so that we are aware that we are moving our own arm, talking, or thinking our own thoughts."

Schizophrenia is a disorder that interferes with the ability to think clearly and to manage emotions. People with schizophrenia often attribute their own thoughts and actions to external sources, as in the case of auditory hallucinations. Other common symptoms include delusions and disorganized thinking and speech.

Recent research has suggested that an impaired corollary discharge can account for some of these symptoms. However, the nature of the impairment was unknown. In their study, Dr. Pack and his colleagues (including Dr. Alby Richard, neurology resident at The Neuro) used a test called a perisaccadic localization task, to investigate corollary discharge activity. In this test, subjects are asked to make quick eye movements to follow a dot on a computer screen. At the same time they are also asked to localize visual stimuli that appear briefly on the screen from time to time. In order to perform this task accurately, subjects need to know where on the screen they are looking – in other words they use corollary discharges signals that arise from the brain structures that control the eye muscles.

The results showed that people with schizophrenia were less accurate in figuring out where they were looking. Consequently they made more mistakes in estimating the position of the stimuli that were flashed on the screen. "What is interesting and potentially clinically important is that the pattern of mistakes made by the patients correlated with the extent of their symptoms," said Dr. Pack. ""This is particularly interesting because the circuits that control eye movements include the best-understood structures in the brain. So we are optimistic that we can work backward from the behavioral data to the biological basis of the corollary discharge effects. We have already started to do this with computational modeling. Mathematically we can convert the corollary discharge of a healthy control into the corollary discharge of a patient with schizophrenia by adding noise and randomness. It is not that people with schizophrenia have no corollary discharge, or a corollary discharge with delayed or weaker amplitude. Rather the patients appear primarily to have a noisy corollary discharge signal. This visual test is very easy thing to do and quite sensitive to individual differences. "

The study shows that patients with schizophrenia make larger errors in localizing visual stimuli compared to controls. These results could be

explained by a corollary discharge signal, which also predicts patient symptom severity, suggesting a possible basis for some of the most common symptoms of schizophrenia.

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