

Press release; European College of Neuropsychopharmacology (ECNP) congress, Copenhagen

“Speaking your mind”: analysis locates brain areas for understanding metaphors in healthy and schizophrenic people

Embargo until: 00.05 (CEST, Copenhagen) Saturday 7th September 2019

Type of study: Not peer reviewed/experimental study/people

Scientists have used MRI scanners to discover the parts of the brain which understand metaphors, in both healthy volunteers and people with schizophrenia. They found that people with schizophrenia employ different brain circuits to overcome initial lack of understanding. The researchers hope this identification of brain reactions and affected areas may help people with schizophrenia to better comprehend metaphors in everyday speech. This work is presented at the ECNP congress in Copenhagen.

People with schizophrenia have often problems in understanding some common figurative expressions, such as humour, irony, and spoken metaphors. They tend to take the metaphor at its literal meaning (for example, “a leap in the dark” may imply jumping and darkness for someone with schizophrenia): it may take some time for them to arrive at an understanding of what the metaphor is meant to imply. There has been little attempt to understand why this might be so at a neurological level.

A group of Polish and Czech researcher examined 30 patients who had been diagnosed with schizophrenia and 30 healthy controls. While undergoing a brain scan in a high-sensitivity MRI, they read 90 brief stories. 30 of the stories had a metaphorical ending, 30 had an absurd/nonsense ending, and 30 had a neutral ending (i.e. a literal ending). The scientists monitored brain activity while the subjects were reacting to the stories.

They found that compared to controls, the patient group showed increased brain activity in certain areas, but lower brain activity in others. For example, the healthy group showed brain activation in the prefrontal cortex (near the front of the brain) and left amygdala (at the centre of the brain, near the top of the brain stem), implying that these are the brain areas where metaphors are normally processed. Instead, schizophrenia patients showed a decreased activation in the temporal sulcus (an area ascending from the low central brain towards the back of the head). Researcher Martin Jáni, from the Jagiellonian University, Krakow, Poland said:

“Previous researchers studied brain areas that are connected to impaired metaphor understanding in schizophrenia, so comparing metaphors with literal statements. However, by adding the absurd punchline, we were able to explore the stage at which the deficit occurs. We also used everyday metaphors, which would be easily understood.

We found that biggest changes in brain activity in schizophrenia patients occur during the basic stage of metaphor processing, that is when a person needs to recognize there is incongruity between the opening sentence and the punchline. These activated areas of the brain are very different to the brain areas activated in healthy patients, as if the brain is struggling to find a compensatory mechanism, to bypass the circuits normally used to understand metaphor”.

It's likely that this inability to understand the sort of conventional metaphors we use in everyday life is socially isolating for people with schizophrenia. While this at the research stage, our hope is that we can develop practical skills in patients with schizophrenia – and indeed the people who know them - which will help them understand the speech the way it was intended”

Commenting, Dr Emilio Fernandez-Egea, University of Cambridge said;

“Understanding the neural basis of social cognition are of great relevance for people with schizophrenia. These deficits are often overlooked, despite the impact on the general functioning and in the ability to find and maintain social relationship and work. Expanding our knowledge of this often neglected domain will improve the recovery process in this population”.

This is an independent comment; Dr Fernandez-Egea was not involved in this work.

EXAMPLES:

The metaphors themselves were commonly used in everyday Polish speech. They were incorporated in brief stories, such as:

Metaphor

On the street, man on the bike accidentally hits a pedestrian “I am sorry, are you alright?” asked the cyclist, to which the pedestrian replied “No, I am sorry, I shouldn't walk with my head in the clouds”.

Comment: People with schizophrenia had more difficulty in pulling the metaphorical meaning away from the literal “head in the clouds” meaning.

Neutral

A man comes back home after unusually long day at work. His partner asks “Why are you so late? The dinner is already cold” He replies “I am very sorry. I had to finish an important project”.

Comment: This is literal – there's no hidden meaning here.

Absurd (nonsensical)

Two colleagues are talking at work. One says “I can't believe that John is earning money than me for the same position!” The other says “The copy machine broke yesterday”.

Comment; In this case the reply is not relevant to the question.

ENDS

Notes for Editors

European College of Neuropsychopharmacology (ECNP)

The ECNP is an independent scientific association dedicated to the science and treatment of disorders of the brain. It is the largest non-institutional supporter of applied and translational neuroscience research and education in Europe. Website: www.ecnp.eu

The 31st annual ECNP Congress takes place from 7th to 10th September in Copenhagen. It is Europe's premier scientific meeting for disease-oriented brain research, annually attracting up to 6,000 neuroscientists, psychiatrists, neurologists and psychologists from around the world. Congress website: <https://2019.ecnp.eu/>

P.372

Neural substrates of metaphor comprehension impairments in chronic schizophrenia outpatients - an fMRI study

M. Jáni^{1,2}, P. Adamczyk¹, O. Płonka^{1,3}, M. Wyczesany¹, A. Daren⁴, P. Bładziński⁴, A. Kalisz⁴, A. Cechnicki⁴, K. Cepuch³, T. Marek³

¹Institute of Psychology- Jagiellonian University, Psychophysiology Laboratory, Krakow, Poland

²Faculty of Medicine- Masaryk University, Department of Psychiatry, Brno, Czech Republic

³Institute of Applied Psychology- Jagiellonian University, Department of Cognitive Neuroscience and Neuroergonomics, Krakow, Poland

⁴Chair of Psychiatry- Medical College- Jagiellonian University, Department of Community Psychiatry, Krakow, Poland

Aim:

Difficulties with understanding figurative meaning of language (such as metaphors, irony and humor) represent one of the key features of schizophrenia, with patients accepting literal meaning over the figurative one [1]. Previous studies on neural correlates of metaphor comprehension suggested abnormal engagement in left inferior/medial frontal gyrus [2], [3], temporal lobe [2], and inferior parietal lobule [3]. These studies were focused on metaphor comprehension as a whole, however, it is not yet established on which stage of metaphor processing the deficit arises. Our aim is to evaluate metaphor comprehension according to its stage of processing and respective neural correlates of its impairments in outpatients with schizophrenia.

Method:

Thirty outpatients diagnosed with schizophrenia and 30 sex, age and education matched healthy controls were recruited for the study. We assessed metaphor processing by fMRI punchline-based metaphor comprehension task, which consisted of 90 stories, whereas 30 of them had metaphorical, 30 absurd (nonsensical) and 30 neutral (literal) endings. The stories were presented in randomised order in 3 runs. After reading the story, participants decided whether the ending fit the story and whether it was metaphorical. We analyzed three between group contrasts: absurd vs neutral stories (incongruity detection), metaphor vs absurd (incongruity resolution and elaboration) and metaphor vs neutral (complete metaphor processing). Neuroimaging data were acquired with Siemens Skyra 3T scanner with 64 - channel coil and analyzed using FSL (v6.0). Results were thresholded at uncorrected voxel level $p < 0.001$ and cluster $n > 10$. Behavioral data were analyzed using JASP (Version 0.9).

Results:

During incongruity detection, the clinical group revealed decreased activation in the left lateral orbitofrontal and middle occipital/cuneus cortices as well as increased activation in the left lingual, postcentral and superior temporal gyri, inferior parietal lobule, supramarginal gyrus and sensorimotor cortex, and in the right postcentral gyrus, rolandic operculum, middle cingulate and putamen. During complete metaphor comprehension schizophrenia outpatients revealed decreased activation in the left dorsolateral prefrontal cortex compared to healthy controls. No between group differences in activation were found during incongruity resolution and elaboration contrast. On behavioral level, the clinical group had longer reaction times on all levels of metaphor processing and their ratings were less accurate in terms of comprehensibility and metaphoricality than healthy controls.

Conclusion:

Our results indicate the abnormal incongruity detection processing (absurd vs neutral) in schizophrenia outpatients, manifested by left hemisphere alterations accompanied by hyperactivation of the left temporo-parietal, right middle cingulate and bilateral frontal cortices compared to healthy controls. This might suggest existence of some form of compensation mechanisms during the early phase of metaphor processing in individuals with schizophrenia, which may be considered the neural basis of deficit. Finally, the essential difference revealed by the complete metaphor processing contrast (metaphorical vs neutral) - the lesser engagement of the left dorsolateral prefrontal cortex - might be considered further in terms of the neurocognitive deficit and neuropsychopathology of schizophrenia in general.

References

- [1] Rossetti, I., Brambilla, P., Papagno, C., 2018. Metaphor Comprehension in Schizophrenic Patients. *Front. Psychol.* 9.
- [2] Kircher, T.T.J., Leube, D.T., Erb, M., Grodd, W., Rapp, A.M., 2007. Neural correlates of metaphor processing in schizophrenia. *Neuroimage* 34(1), 281-9.
- [3] Mashal, N., Vishne, T., Laor, N., Titone, D., 2013. Enhanced left frontal involvement during

FUNDING: Polish National Science Center.