

## **In search of the neuropsychophysiological underpinnings of impaired figurative language comprehension in schizophrenia: on the role of the salience gradability of meanings - behavioral, EEG, and MRI study**

Schizophrenia is nowadays more and more often regarded as the effect of brain disconnection. In a psycho-social manner, the most important characteristics of this illness are related to various cognitive, emotional, social and communication impairments. Some researchers suggest, that communication skills may be a core feature of schizophrenia, and this disease may be considered as a communication disorder. In particular, the disruptions of figurative language processing, such as metaphor, humor and irony, can be concerned as the core feature of psychosis. Importantly, since the figurative language impairment has been found in the prodromal phase of illness, it could be considered as a useful tool for early diagnosis within populations at risk and/or the individuals with first episode of psychosis. In a chronic state, improving these communication skills seem to be important for psychosocial rehabilitation.

Recent data indicates that problem of impaired figurative language in schizophrenia is not sufficiently studied. The analysis of literature data unequivocally indicates the presence of the communication deficits in schizophrenia at the behavioral level of expression, i.e. diminished ability to understand and use of humor, metaphor and irony, but the data on neural mechanisms of this vital area of deficits is only fragmentary and not sufficient to fully understand the phenomenon. To date, only a scarce neural evidence of altered figurative language in schizophrenia exists, and various aspects of figurativeness were investigated only in separation and often in limited groups of patients, which do not provide any comprehensive image of the disturbances of important language functions.

Importantly, even neurolinguistic theories on figurative language are still under debate, some of them indicate the relationship between hemispheric lateralization and salience aspects of figurativeness in a healthy brain. (e.g. Graded Salience Hypothesis - GSH). The GSH implies that salient (literal/familiar) content is processed bilaterally, but mainly within the left hemisphere (LH), while non-salient (figurative/unfamiliar) meaning, being more demanding, includes the bilateral network with excessive right hemisphere (RH) engagement. Yet, this GSH prediction on salience gradability lateralization shift in normotypics is coherent with our previous findings (OPUS 7/12), and far more, our pioneering findings on the shifted bilateral brain activity alterations and reversed lateralization of information flow in humor (non-salient content) and conventional metaphors (salient content) in schizophrenia.

Therefore, in the present project, we want to go a step beyond and verify the effect of the salience gradability within and between three major figurative domains (humor-metaphor-irony, each containing salience graded subcategories), which we want to describe and explain in a formulation of a unified model of figurative language comprehension in schizophrenia. Refers to GSH and step-by-step models, it breaks down the whole process into 1) incongruity detection – a conflict between context-based information and automated literal meaning 2) figurative language recognition and incongruity resolution - comprehension process related to 2a) fast lexical recognition and retrieval of salient meanings or 2b) context-based semantic shift of non-salient meanings, and 3) elaboration – higher cognitive processing leading to context-coherence.

Concluding from available data, we assume that the core neuropsychophysiological mechanisms behind mental processes of pragmatic ability to use and comprehend figurative meaning is already impaired in the prodromal phase of illness and is considerably affected in recent-onset and chronic subjects. At the neural level, this is manifested by insufficient activation of the key areas required to understand the figurative meaning as a result of the reversed lateralization of neural network activity, i.e. reversed directional lateralization of information flows and abnormal cortical sources activity. Furthermore, we assume that in schizophrenia, the primary disturbances of the initial incongruity detection process (altered processing of semantic conflict between context and literal meaning) result in compromised incongruity resolution (attenuated semantic-shift of meaning within contextual cues) and elaboration, which alterations are expected to be more pronounced during the processing of less salient meaning (e.g. conventional < novel metaphors). We assume that these abnormalities of neural mechanisms may be considered a persistent biomarker of schizophrenia, related to the primary disturbances during the incongruity detection process as a result of abnormal contextual semantic cues processing.

To test the proposed model and salience gradability effect, we plan two EEG and fMRI experiments, investigated on the groups of recent-onset (50) and chronic (50) schizophrenia subjects and matched healthy controls (100), with tasks containing stories with six types of figurative endings (i.e. conventional and novel metaphors, intended-to-be-funny jokes and social violation-based humor, simple irony and sarcasm) and two control conditions (literal/meaningless). The differences in specific brain activity in both clinical groups and healthy controls will be investigated during fMRI sessions. The crucial neurophysiological components of salience gradability effect and temporal distribution of impaired context processing will be investigated upon EEG-ERP methods, complemented with investigation on reversed sources and receivers activity (EEG-DTF), which abnormal information flow and attenuation of sources activity is seemingly responsible for brain regions hypofunction.

To the best of our knowledge, this is the first attempt to thoroughly study this problem by tackling three major domains of figurative language (i.e. humor, metaphor, irony), including clinical and behavioral assessment on two specific clinical groups followed by comprehensive network analysis using state-of-the-art neuroimaging methods including functional and effective connectivity. Summarizing, the presented project may give a deeper understanding of the primary cause of communication impairment in schizophrenia and determine its neural mechanisms and neuropsychophysiological biomarkers in recent-onset and chronic subjects.