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Beta band oscillations during basic sentence comprehension in patients with schizophrenia

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Comprehending a sentence requires us to bind individual words together to form a coherent message-level representation. There is evidence that, during incremental processing, we are able to use this message-level representation to predict which words are likely to come up next.

In patients with schizophrenia, there is evidence that top-down language processing mechanisms like prediction are impaired (Kuperberg, 2010, Boudewyn et al., 2012). Most of this evidence comes from event-related analyses of electrophysiological measures, which index the consequences of top-down prediction for processing an incoming individual word. Here, we took a complementary approach, carrying out a frequency analyses of MEG data, focusing on power in the beta band. In healthy individuals, beta activity is increased to sentences versus random word lists (Bastiaansen et al. 2010). This increase is thought to more directly reflect the build-up of the message-level representation that is used to predict upcoming words (Weiss & Mueller, 2012). If predictive impairments in schizophrenia stem from impairments in building this message-level representation, beta band modulation should be abnormal.

To test this hypothesis, we conducted an MEG experiment in which 20 patients with schizophrenia and 20 demographically-matched controls read sentences and random word lists, presented word by word. Epochs of 500 ms around each word, from the 3rd word onwards (resulting in 140 segments per condition), were computed, as well as a pre-sentence baseline of 500 ms. Frequency analyses on these entire segments were performed using multitapers. One-sided t-test were run using non-parametric cluster statistics (Maris & Oostenveld, 2007) over a frequency range from 4 to 30 Hz using an alpha level of 0.05.

As expected, in healthy controls, the frequency analysis showed significant increases in beta band power (15 to 25 Hz) in sentences compared to word lists. This effect was not seen in the schizophrenia patients. Moreover, a group comparison showed significant differences in the beta frequency range between the two groups.

To conclude, even at this basic level of sentence comprehension, oscillatory signatures are impacted in patients with schizophrenia. We tentatively suggest that this might reflect impairments in the build-up of a coherent sentence context to predict upcoming words during language comprehension.