Characterization of hemodynamic response plots produced from task-based fMRI data

Trevor Fowler, Leonardo Arreaza[1,2], Reka Enz[3], Todd S. Woodward[1,2]

[1]Department of Psychiatry, Faculty of Medicine, UBC

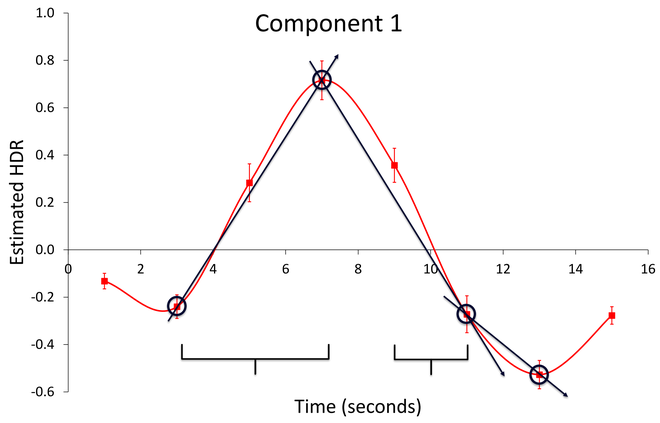
[2]BC Mental Health & Addictions Research Institute, PHSA

[3]Faculty of Cognitive Science, Universität Osnabrück

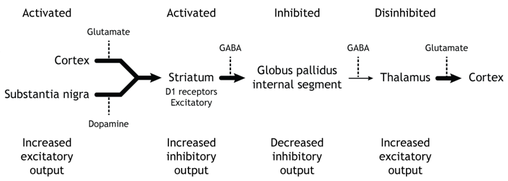
Summary

A set of parameters characterizing the hemodynamic response (HDR) plot were computed using data from three fMRI studies that included healthy controls and schizophrenia patients. These parameters include:

1. Start, Peak, End and Sub-Zero Peak (indicated with circles)
2. Mean values of all points from the start to the peak, and after the peak to the end (indicated with square brackets
3. Start to peak, peak to end, and slope to suppress slope values (indicated with arrows)



Results

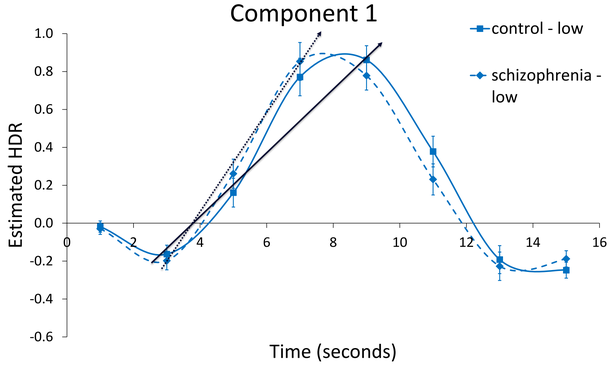


Three of the five extracted networks saw a difference in activation or deactivation between groups based on the results of a two-sample t-test comparing calculated slope values. Of these differences, only the decreased suppression of the One-Handed Response network in schizophrenia patients has been explained. This phenomenon is explained by other researchers to occur due to the heightened dopamine levels in schizophrenia patients, which ultimately increases the stimulation of motor output. This results in a dysfunctional return to baseline of the OHR network in schizophrenia patients after the completion of a task involving a motor response.

Conclusion

This analysis suggests that three of the five computed brain networks are reduced for schizophrenia patients, suggesting that dysfunction of these brain networks may underlie cognitive impairment in schizophrenia. This hypothesis will be tested in future work using advanced multivariate methods associating these brain activity parameters with individual differences in neuropsychological tests.

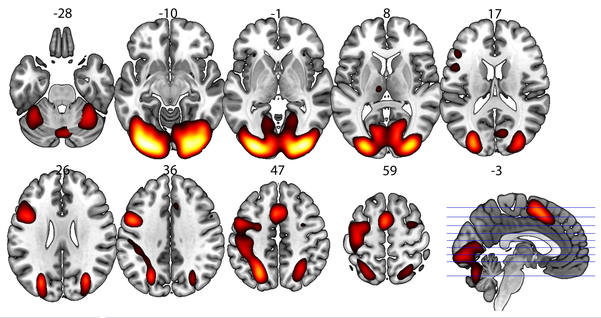
Component 1: Sustained Attention network



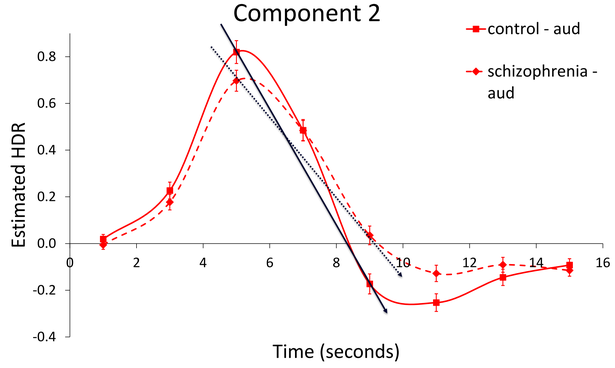
Component 1 (C1_SATT86_TDMN_1.26_0.6) Varimax HDR for the 'low' condition of the Semantic Association Task

Findings

The start-to-peak slope was sharper for healthy controls than it was for schizophrenia patients ($p < 0.01$)



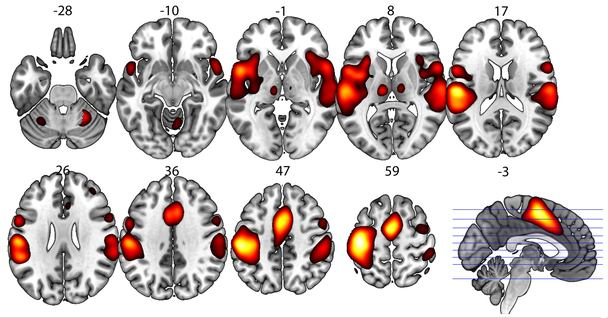
Component 2: One-Handed Response network



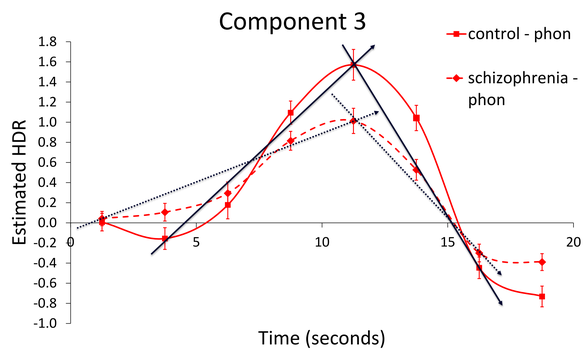
Component 2 (C2_1RESP91_TDMN_1.14_0.19) Varimax HDR for the fBIRN Auditory Oddball Task

Findings

The peak-to-end slope was sharper for healthy controls than it was for schizophrenia patients ($p < 0.001$)



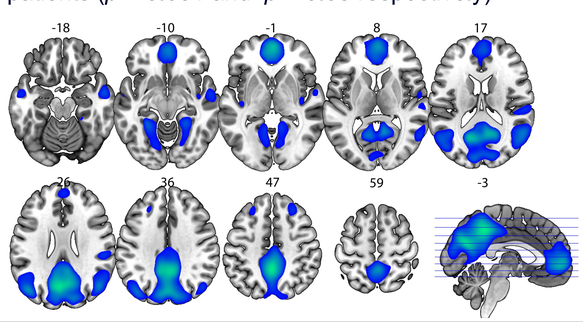
Component 3: Novel Default Mode Network

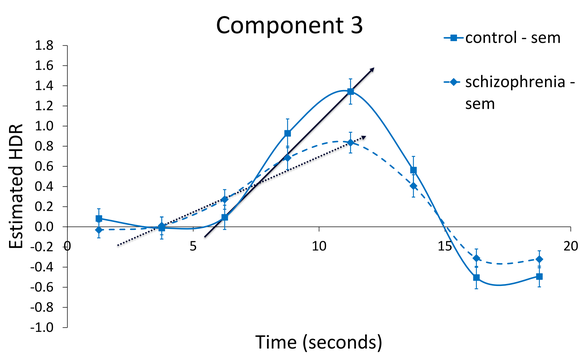


Component 3 (C3_NDMN82_LANG_1.41_0.85) Varimax HDR for the 'phonological' condition of the Metrical Stress Task

Findings

The start-to-peak and peak-to-end slopes were sharper for healthy controls than they were for schizophrenia patients ($p < 0.001$ and $p < 0.05$ respectively)





Component 3 (C3_NDMN82_LANG_1.41_0.85) Varimax HDR for the 'semantic' condition of the Metrical Stress Task

Findings

The start-to-peak slope was sharper for healthy controls than it was for schizophrenia patients ($p < 0.05$)

References

1. Enz, R. (2019). Identifying Impairment in Task-Related Functional Brain Networks in Schizophrenia [Unpublished honours thesis]. Universität Osnabrück.
2. Hui, K. H. (2022). Functional Brain Networks Underlying Delusions in Schizophrenia [Unpublished honours thesis]. University of British Columbia.

THE UNIVERSITY OF BRITISH COLUMBIA

CNoS Cognitive Neuroscience of Schizophrenia Lab

BC MENTAL HEALTH & SUBSTANCE USE SERVICES