

# Analysis of brain networks evoked during a language processing task in schizophrenia patients



Jessica Khangura<sup>1,4</sup>, Sofia Eickhoff<sup>2,4</sup>, Linda Chen<sup>3,4</sup>, Nicole Sanford<sup>1</sup> & Todd S. Woodward<sup>1,4</sup>

1. Department of Psychiatry, Faculty of Medicine, University of British Columbia, Vancouver, BC, Canada V6T 2A1

2. Department of Psychiatry and Psychotherapy, Faculty of Natural Sciences, University of Lübeck, Ratzeburger Allee 160, 23562 Lübeck, Germany

3. Department of Integrated Sciences, Faculty of Science, University of British Columbia, Vancouver, BC, Canada V6T 2A1

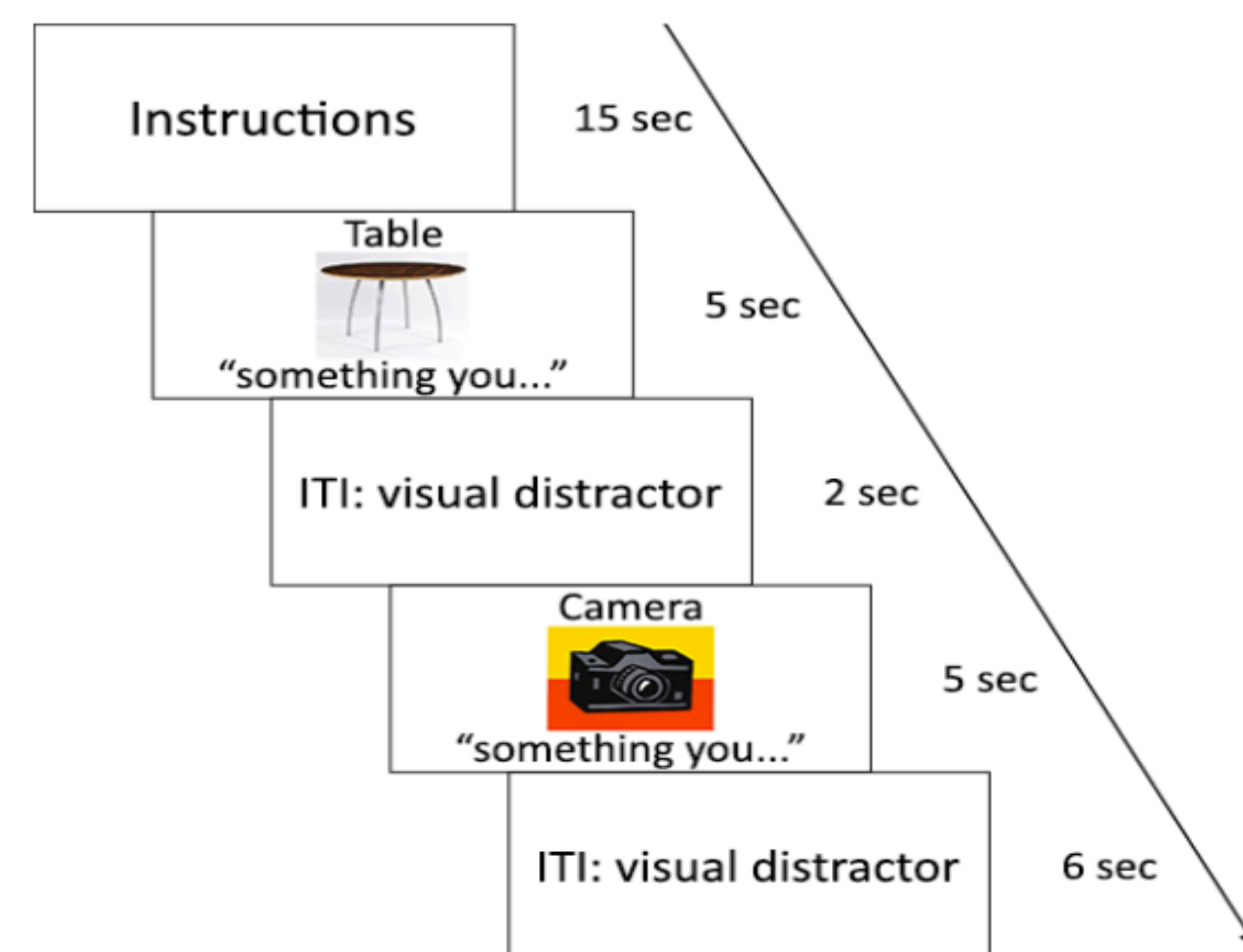
4. BC Mental Health & Addictions Research Institute in Child and Family Research Institute Building, BC Children's Hospital, Vancouver, BC, V5Z 4H4

## INTRODUCTION

Previous research has evidenced that individuals with schizophrenia exhibit impairments in the functional brain networks associated with internal thought (presumed to be linked to hallucinations) and speech perception.<sup>[1]</sup> These impairments may influence the performance of schizophrenia patients while they participate in tasks that engage these specific brain networks. The present investigation aims to identify the brain networks evoked during a language processing task known as the thought-generation task. The functionality of the evoked brain networks are compared between healthy controls and schizophrenia patients.

## METHODS

### Thought-Generation Task (TGT)



- Participant is presented with a noun and its respective image (i.e. table) for 5 seconds.
- Asked to (1) listen to a definition (e.g. "Something you eat dinner on.") or (2) mentally generate a definition for the presented noun.
- Trials involving the hearing condition were initiated with "listen..." and trials involving the generating condition were initiated with "something you..."
- Two experimental conditions: (1) hearing vs. (2) generating.
- Each run consisted of 15 trials of each condition with a 60-second break in between the two experimental conditions; each participant completed two runs of the task.
- Participants included healthy controls (n=32) and schizophrenia patients (n=29).

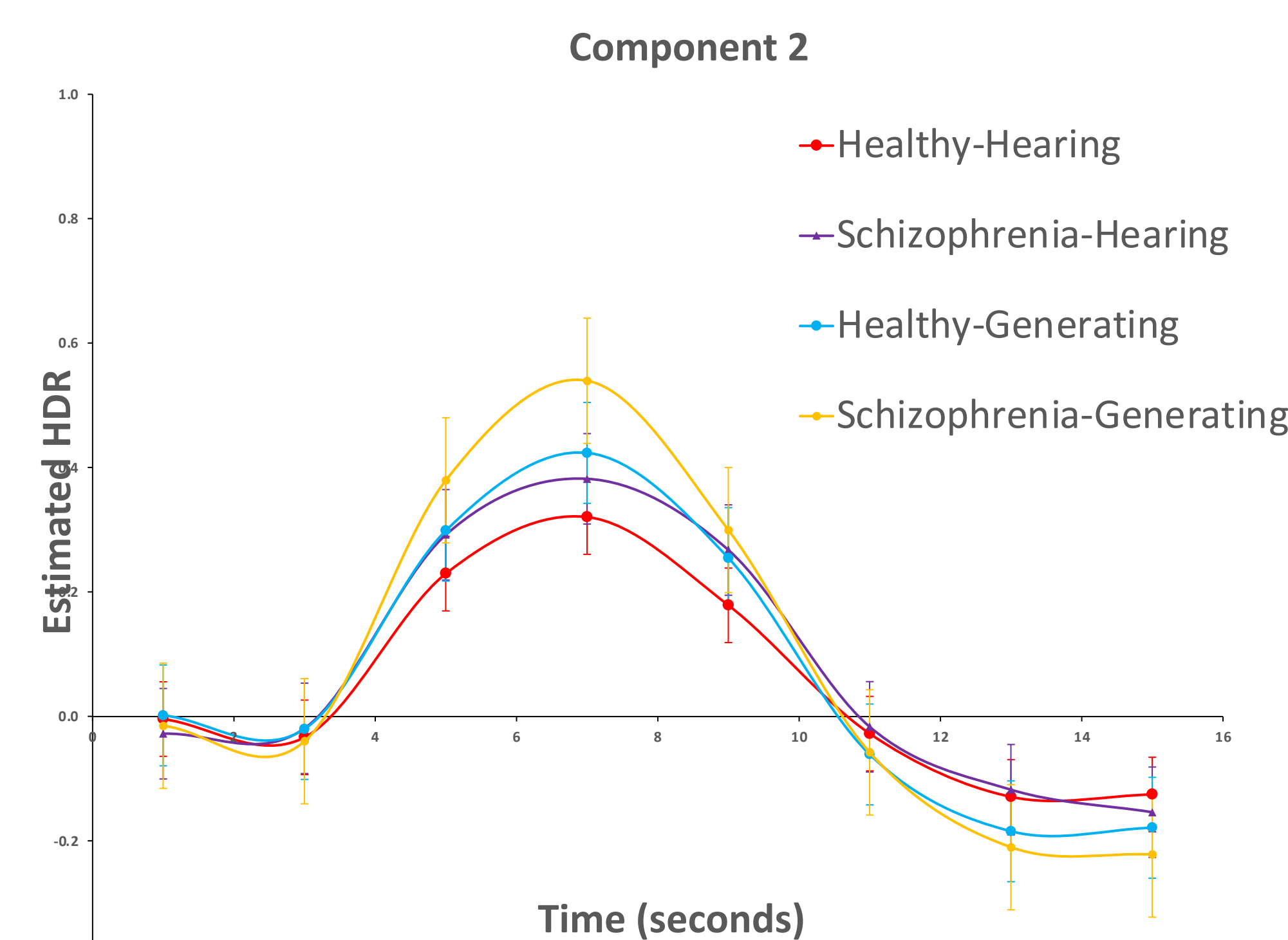
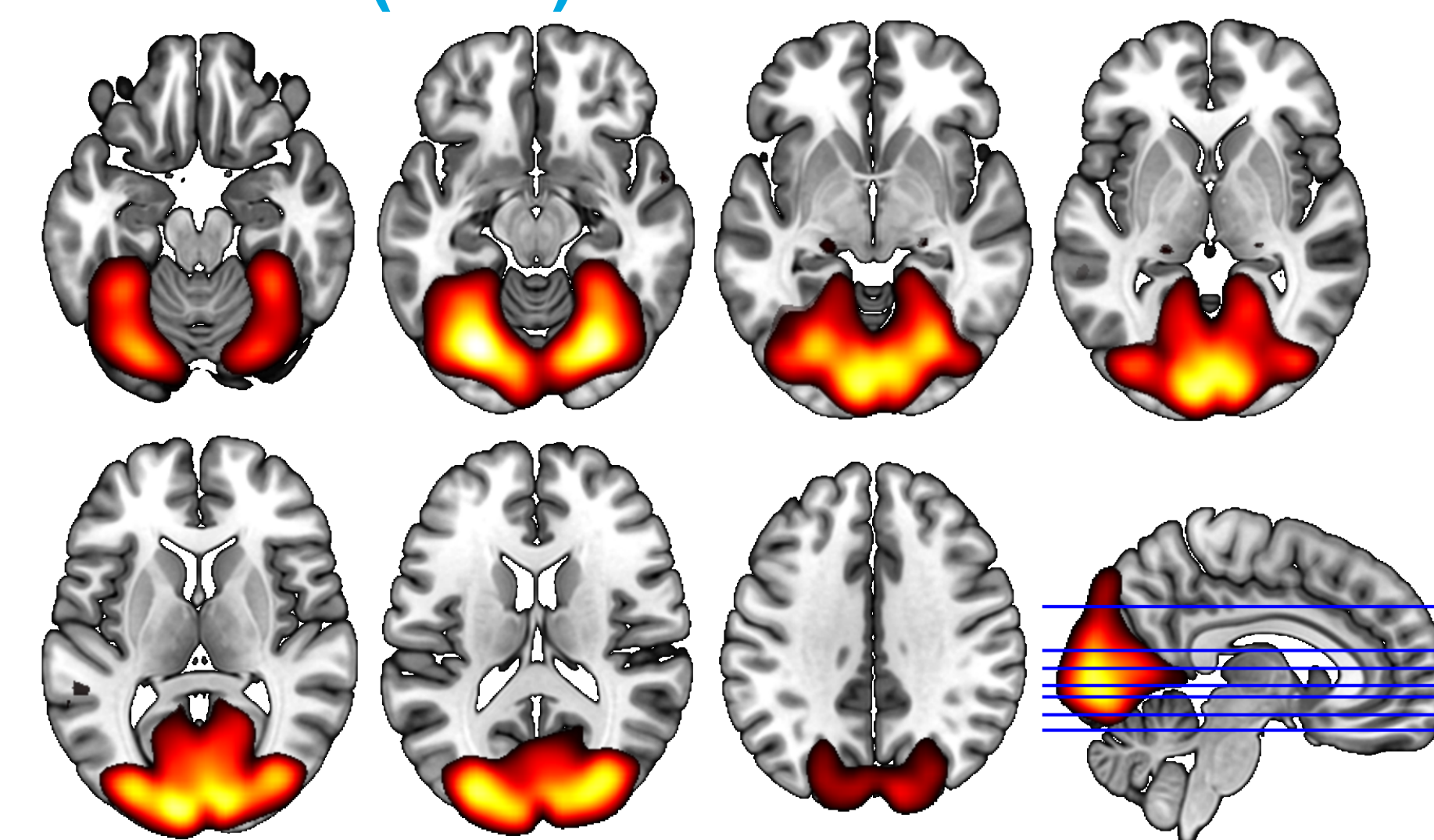
### Analysis

- Functional brain networks were extracted using Constrained Principal Component Analysis for fMRI (fMRI-CPCA).
- Component loadings were classified by correlating positive and negative loadings in select brain slices with previously established prototype brain networks.
- Analysis of estimated hemodynamic response (HDR) was performed using mixed model analysis of variance (ANOVA).

## RESULTS

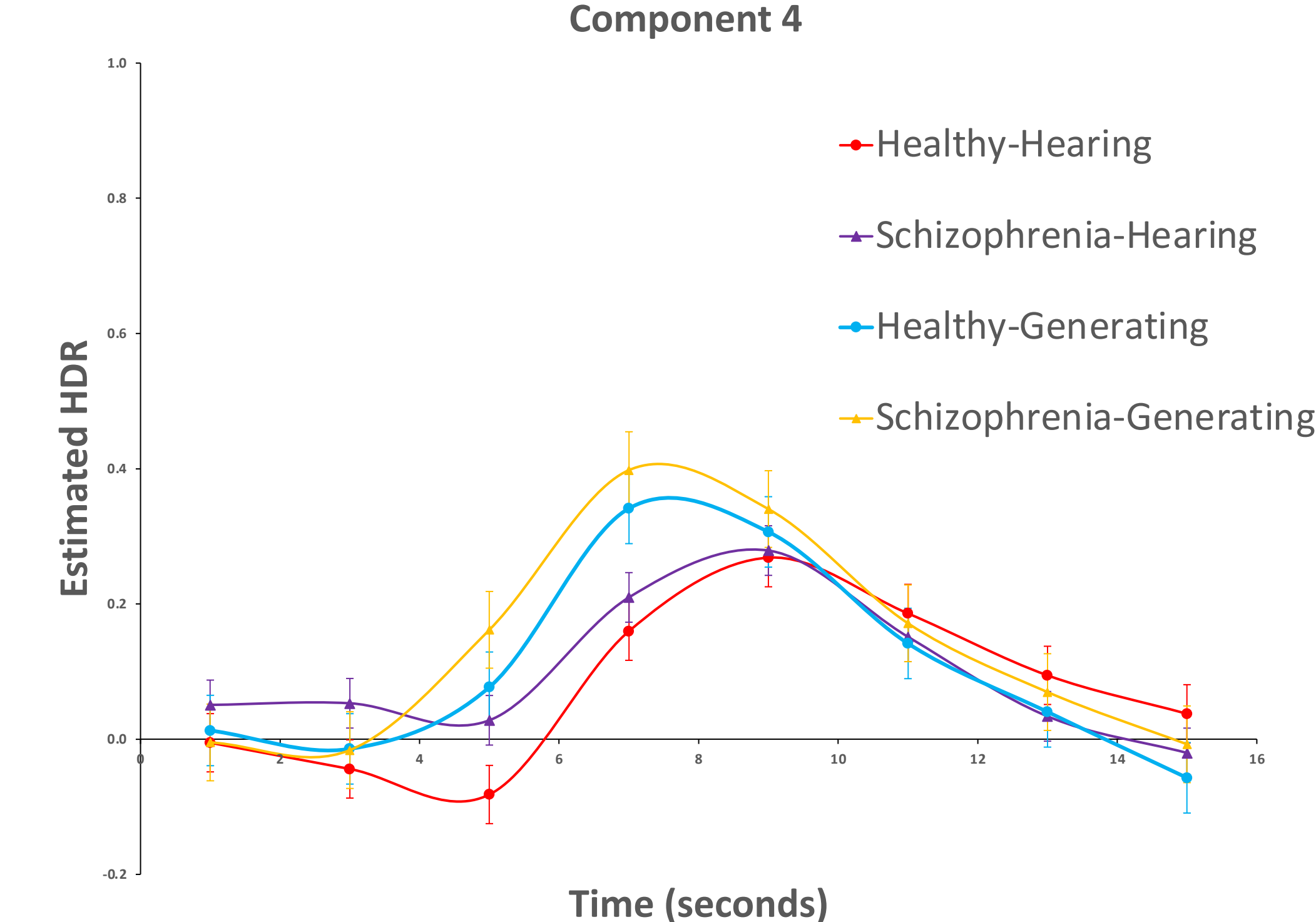
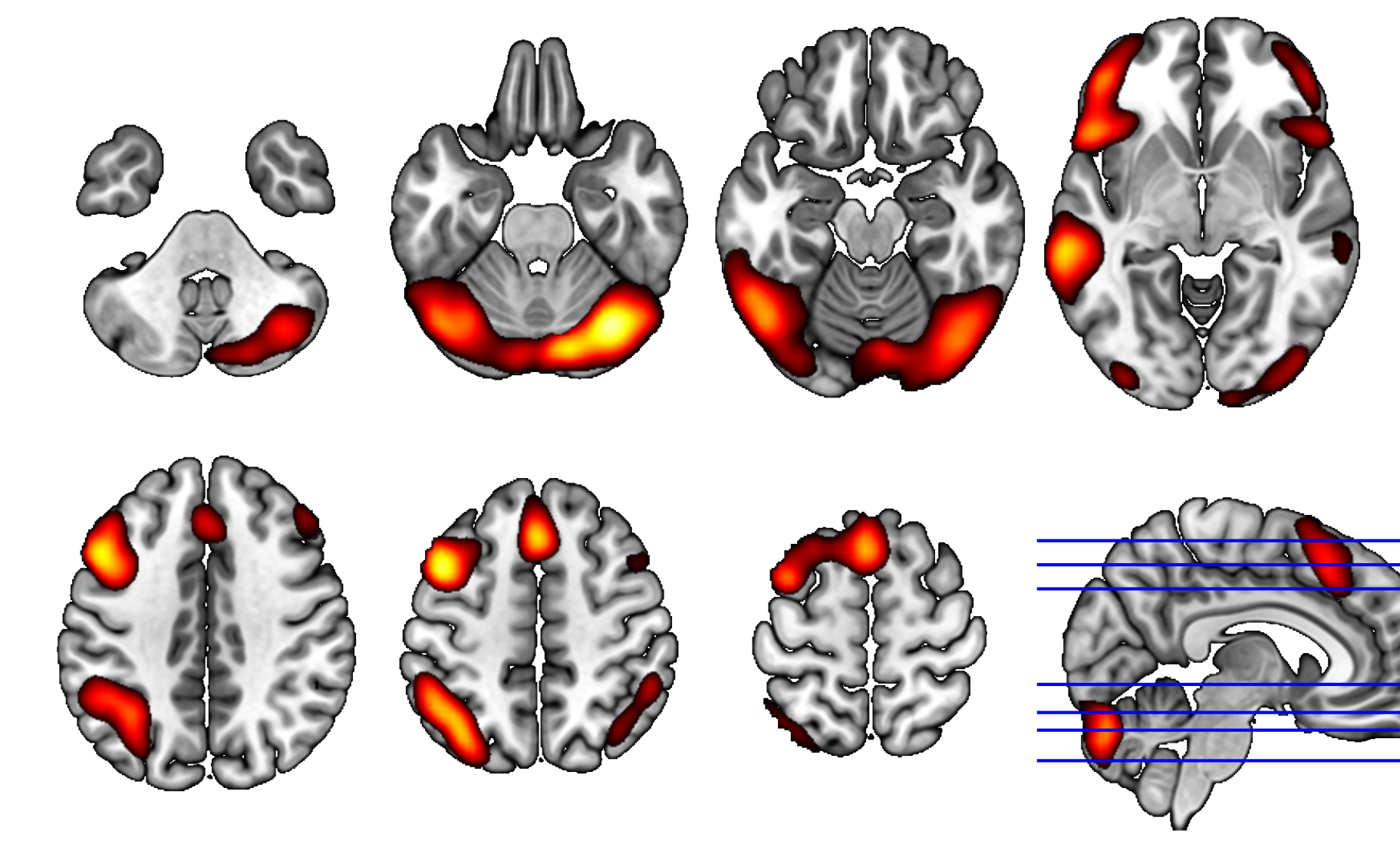
- Five functional brain networks were retrieved using fMRI-CPCA.
- While no significant differences were observed between the groups, patterns emerged in the focus on visual features (component 2), cognitive evaluation (component 4) and primary auditory (component 5) networks when averaged over the groups.
- These patterns aid in the functional interpretation of these networks.

### Component 2 – Focus on Visual Features (FVF)



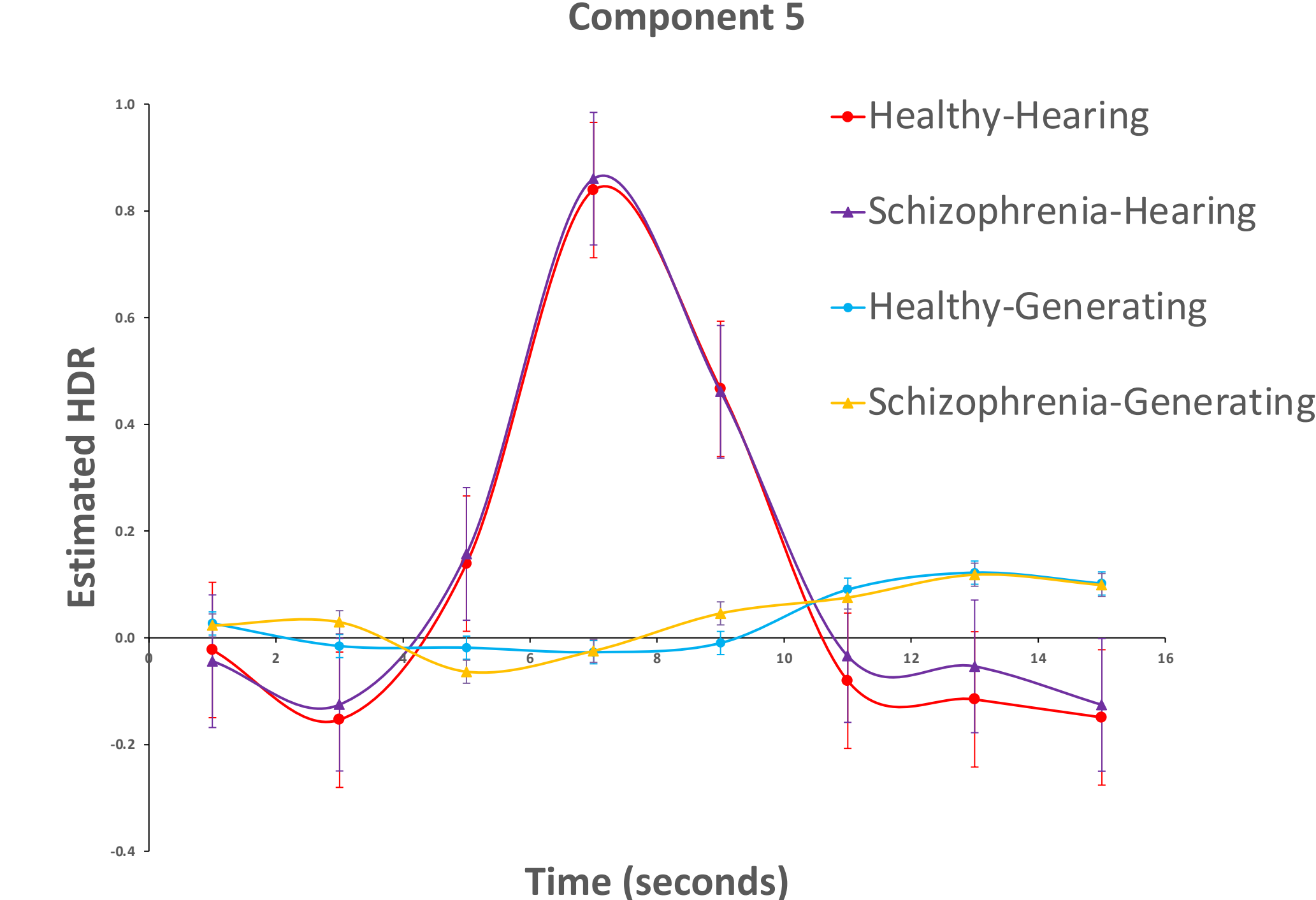
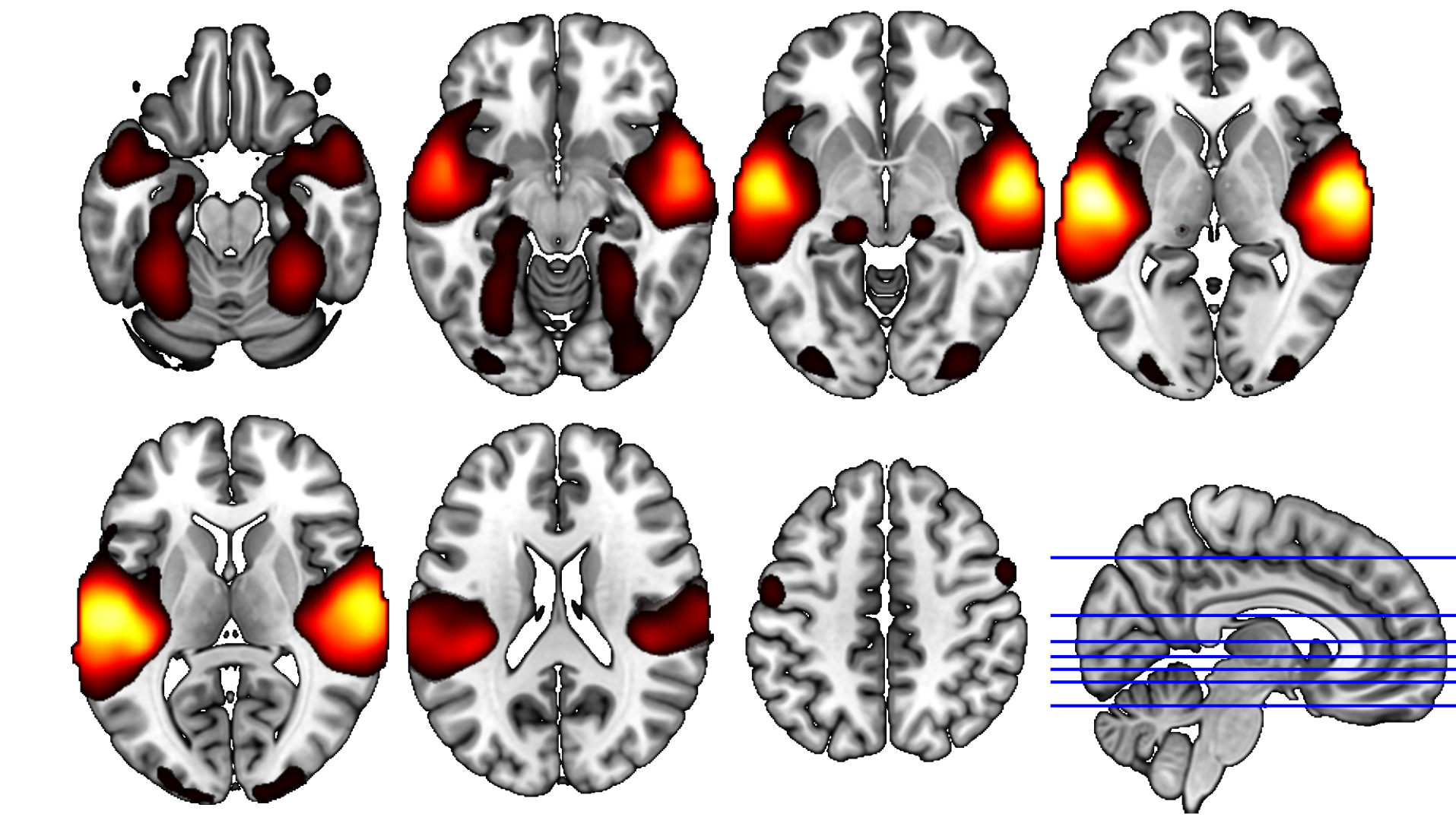
- The FVF displayed greater activity in both groups during the generating (inner speech) condition than the hearing (external speech-perception) condition.
- This network peaked at 7 seconds post-stimulus time.

### Component 4 – Cognitive Evaluation (CE)



- The CE displayed greater activity in both groups during the generating (inner speech) condition than the hearing (external speech-perception) condition.
- This network peaked later, between 8 and 9 seconds post-stimulus time.

### Component 5 – Primary Auditory (AUD)



- The AUD displayed greater activity in both groups during the hearing (external speech-perception) condition than the generating (inner speech) condition.
- This network peaked at 7 seconds post-stimulus time.

## CONCLUSIONS

- This set of results provides new information about the function of fMRI-detectable brain networks. Namely, we confirmed that:
  - Sensory-based (FVF and AUD) networks peak early in the trial and are differentially sensitive to their respective sensory demands (visual and auditory, respectively).
  - The internal-thought-based network (CE) peaked later in the trial, and is thought to be involved in reflecting on performance by reviewing task instructions.
- Comparing the functionality of task-evoked brain networks allows for greater understanding of the cognitive super-processes detectable by fMRI.

### REFERENCES

- Lavigne KM, Rapin LA, Metzack PD, et al. (2015) Left-dominant temporal-frontal hypercoupling in schizophrenia patients with hallucinations during speech perception. Schiz Bull, 41, 259-67.

### ACKNOWLEDGEMENTS

This research is supported by graduate studentships from UBC and BCCHRI.



THE UNIVERSITY OF BRITISH COLUMBIA

