

Temporal Auditory Coding in Auditory Hallucinations in Schizophrenia Patients

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Objectives

- ❑ **Specific Aim 1: The auditory steady state response (ASSR) using EEG/ERP data**
- ❑ **Specific Aim 2: multi-speaker listening using MEG**

Study 1 Design

1. “Hearing voices” is one of the more disturbing symptoms in patients with schizophrenia
2. Identifying the neural code underlying the auditory neural responses in schizophrenia may reveal the core mechanism of their auditory processing dysfunction
3. We will use ASSR to identify the neural timing differences that are associated with schizophrenia

Participants and Methods

1. 128 schizophrenia patients, 108 normal controls, and 55 non-psychotic, first-degree relatives (FDR)
2. 2.5, 5, 10, 20, 40, and 80 Hz ASSR

Grand averages of scalp topographies

Phase locking factor

2.5 Hz

5 Hz

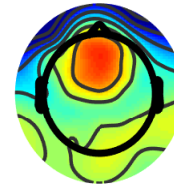
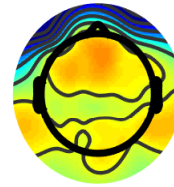
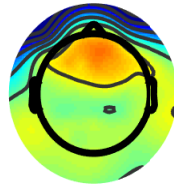
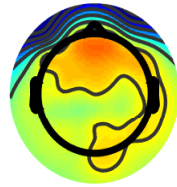
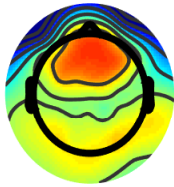
10 Hz

20 Hz

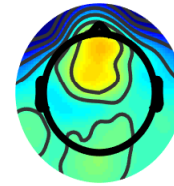
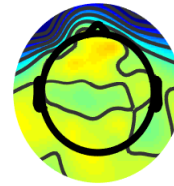
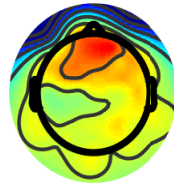
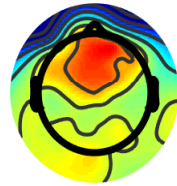
40 Hz

80 Hz

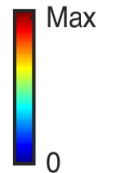
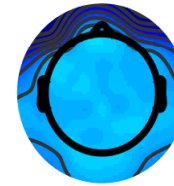
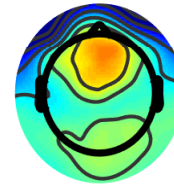
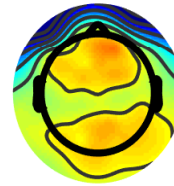
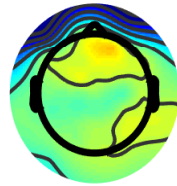
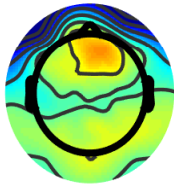
Healthy
Controls



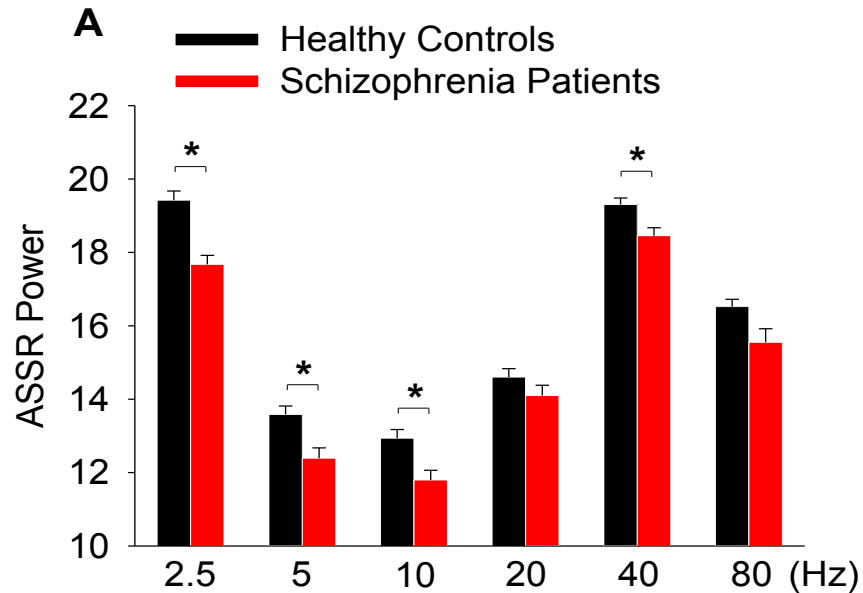
First degree
relatives



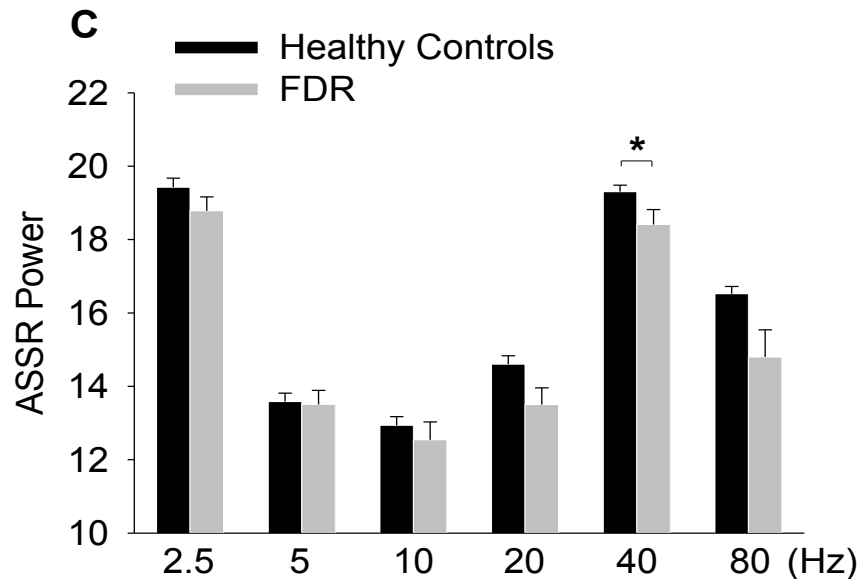
Schizophrenia
Patients



Normalized power at all SSR rates

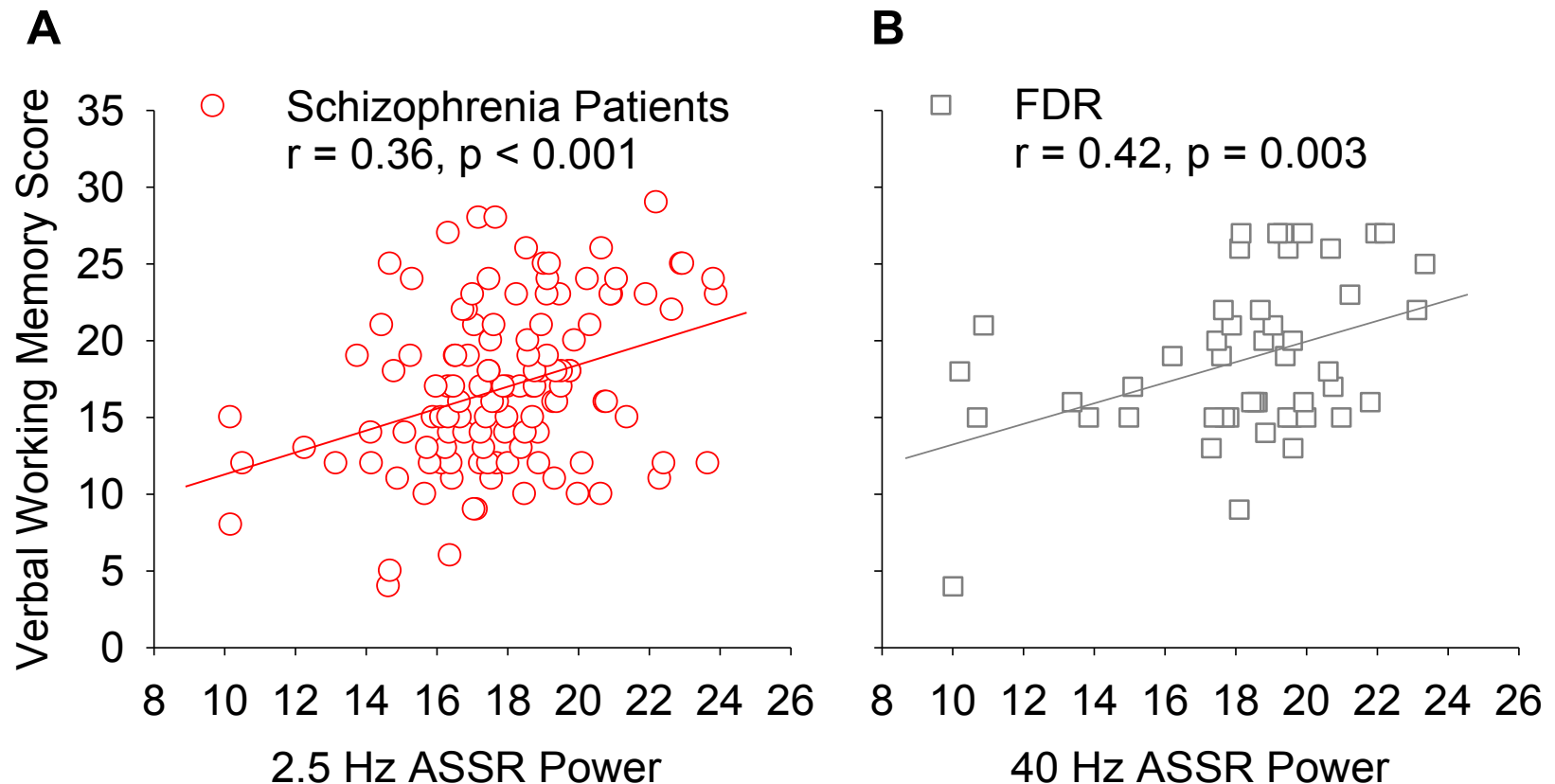


A: Normalized power at 2.5 Hz, 5 Hz, 10 Hz and 40 Hz are significantly lower for patients than normal controls after Bonferroni correction of multiple comparisons.



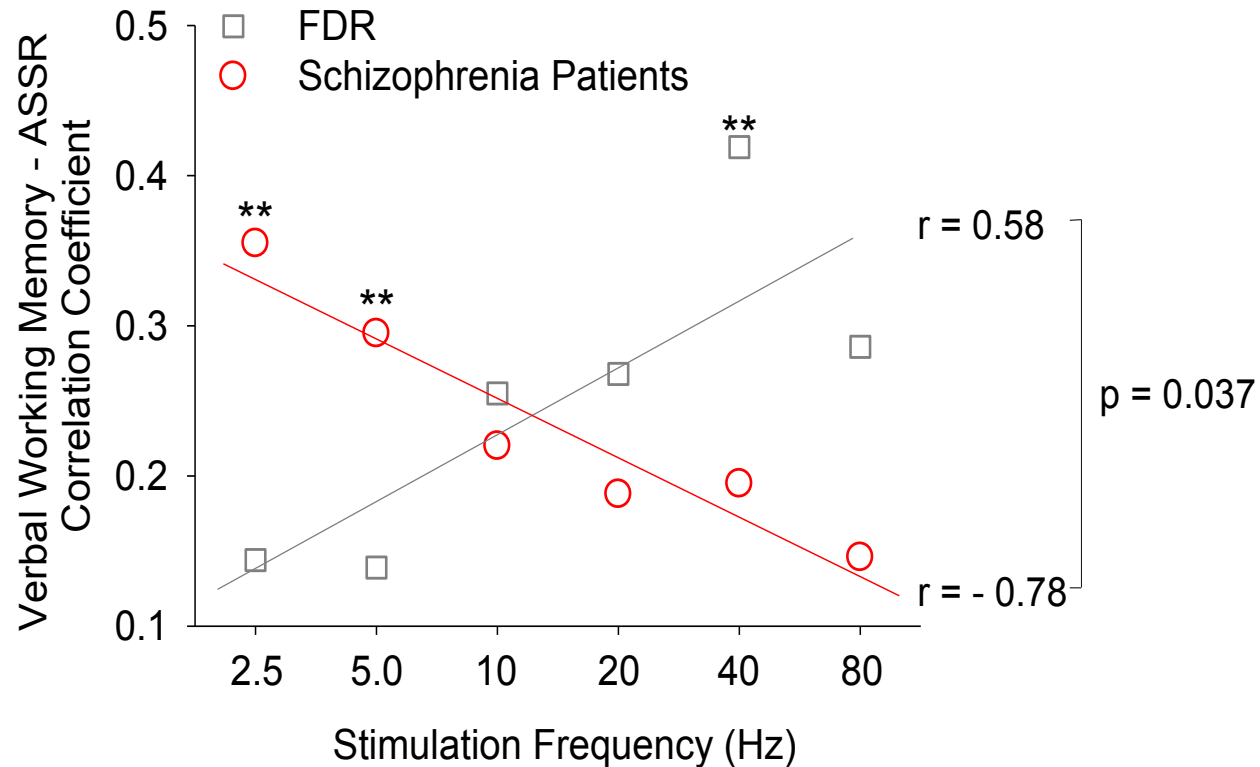
C: Replicable, significant findings in first degree relatives (FDR) showed replicable ASSR reduction only at 40 Hz.

Frequency-specific associations between verbal working memory and ASSR



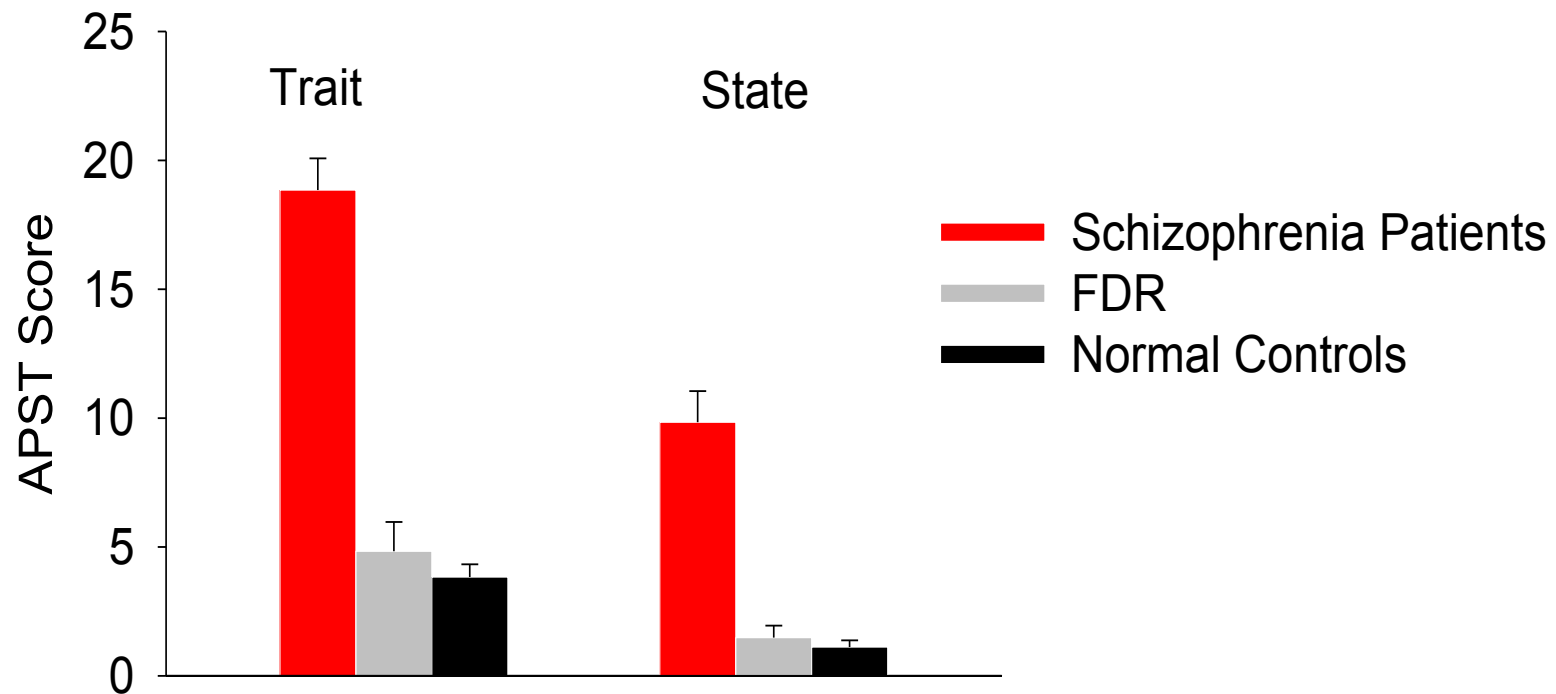
In schizophrenia patients, higher 2.5 Hz ASSR power was associated with better performance in verbal working memory. In first degree relatives (FDR), gamma frequency ASSR at 40 Hz was associated with verbal working memory

Frequency-specific associations between verbal working memory and ASSR



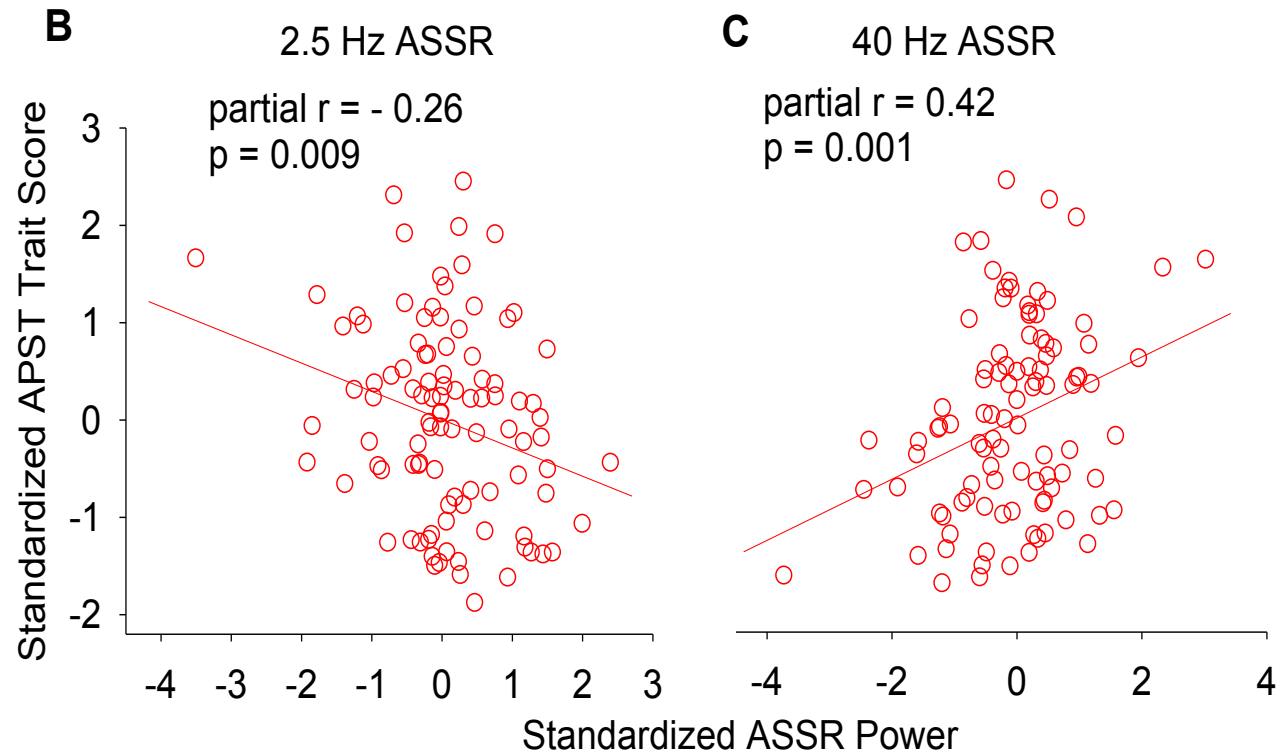
There were significantly different, opposite direction linear trends between patients and FDR in the ASSR - verbal working memory relationships across stimulus frequencies

Auditory perceptual experience as measured by Auditory Perceptual State and Trait (APST) scale



Auditory perceptual abnormalities experienced in lifetime (trait) or the past seven days (state), as expected, were significantly higher in schizophrenia patients but only slightly and insignificantly higher in first degree relatives (FDR)

Auditory perceptual experience as measured by Auditory Perceptual State and Trait (APST) scale



Regression analyses reviewed that 2.5 Hz (B) and 40 Hz (C) ASSR significantly contributed to the severity of trait auditory perceptual trait score but in only in schizophrenia patients, but in opposite directions.

Study 2 Design

1. “Cocktail party listening” is a healthy example of dissociation of auditory perception from physical acoustic stimuli; auditory hallucinations are an unhealthy example.
2. Experimental cocktail party listening paradigm, using magnetoencephalography (MEG) tests these hypotheses:
 - Schizophrenia patients show impaired timing neural representations at low frequencies, especially in speech/voice processing, making them vulnerable to auditory perception anomalies, especially for speech/voice.
 - These low frequency timing disruptions are exacerbated in listening situations that require accurate neural processing timing, such as cocktail party listening.

Illustration of Cocktail Party Experiment

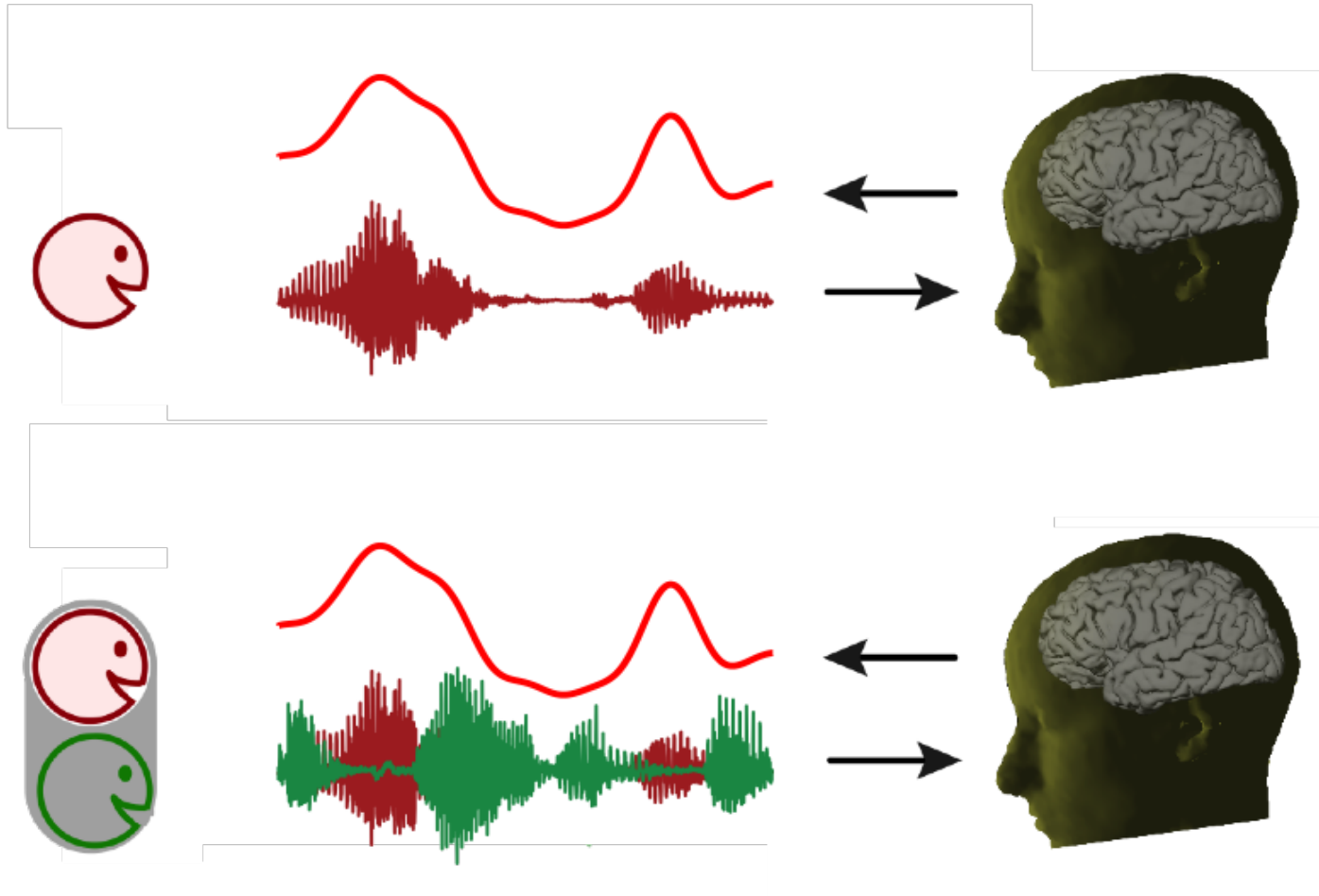
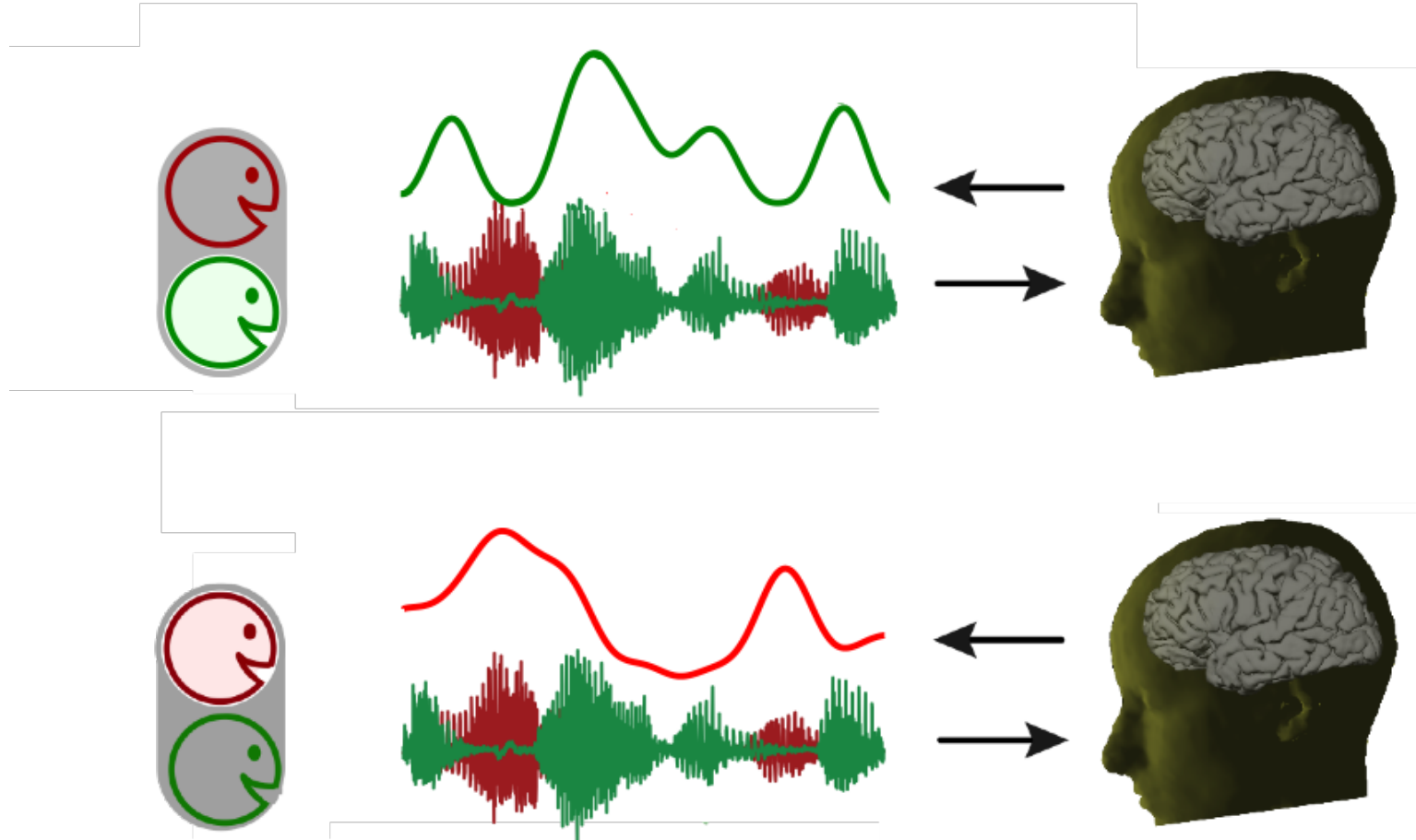


Illustration of Cocktail Party Experiment



Study 2 Progress

1. Plan: 15 schizophrenia patients with treatment resistant auditory hallucination, 15 schizophrenia without current and recent auditory hallucination, and 15 controls
2. Transport patients from MPRC to the UMCP MEG facility and collect these pilot data
3. IRB approvals by both campus
4. 27 subjects have completed MEG

Current plan:

- ❑ Submit ASSR study for publications
- ❑ Complete MEG pilot data and submit for publications
- ❑ Submit a joint R01