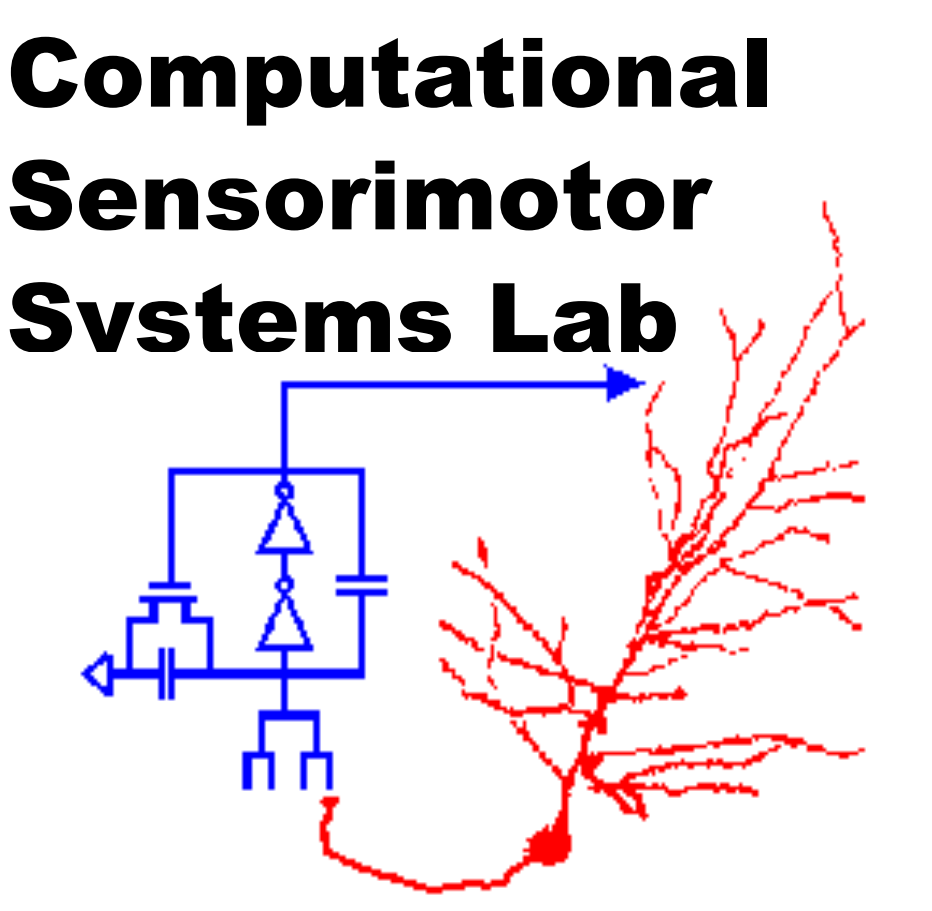


# Suppressing Auditory Background Speech: a Link to Auditory Hallucination in Schizophrenia

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## Introduction

Schizophrenia is a severe brain disorder, where a hallmark symptom is auditory hallucination. The origin of auditory hallucination, which dissociates auditory perception from acoustic stimuli, may be a fundamentally a bottom-up problem, caused by erroneous processing of diverse external auditory inputs, or a top-down modulation problem, e.g., from attentional deficits or due to a failure to appropriately segregate/communicate internally-generated contents with the externally-oriented primary auditory pathway.

This study uses magnetoencephalography (MEG) to investigate the latter hypothesis using a “cocktail-party” listening paradigm: listeners attend to one speaker, suppressing the presence of another, again dissociating auditory perception from acoustic stimuli.

## Methods

### Participants

- 24 schizophrenia patients, age 21-61, 17 male
- 28 healthy controls, age 22-61, 20 male

### Auditory Hallucination Index

- Evaluated for patients via Psychotic Symptom Rating Scales - AH (PSYRATS-AH)

### Stimulus Paradigm

- 60 s duration segments of a story
- Narrated by separate male and female adults
- Digitally mixed into a single channel
- Presented diotically (identical stereo channels)
- “Listen to only one speaker at a time”
- Switch to other speaker for next stimulus

### MEG Recording

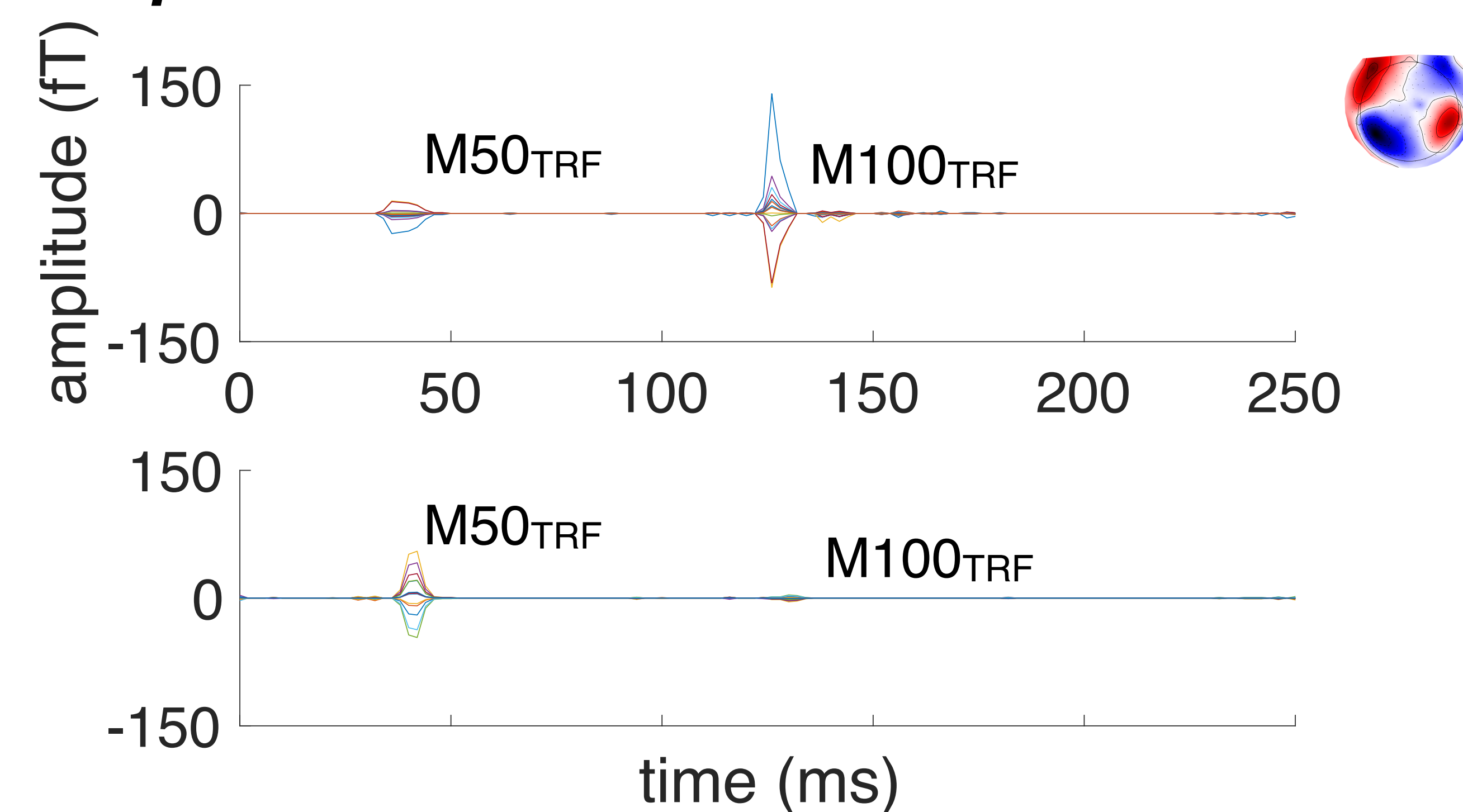
- 157 channel KIT/Eagle MEG Scanner
- 1 kHz sampling frequency
- Denoised by Time-Shift PCA (TSPCA).<sup>1</sup>
- Denoising Source Separation (DSS)<sup>2,3</sup> enhances response reliability over trials ( $D=6$ ).
- Neural responses bandpass filtered 2–8 Hz.

## Temporal Response Function Analysis

- Temporal Response Function (TRF)<sup>4</sup>: a temporal measure that uses a stimulus acoustic envelope to optimally predict neural responses.
- Separate TRFs computed for Attended and Unattended speech stimuli.
- M50<sub>TRF</sub> and M100<sub>TRF</sub> (peaks with latency ~50 ms and ~100 ms respectively) tabulated

## Results

### Representative Attended & Unattended TRFs

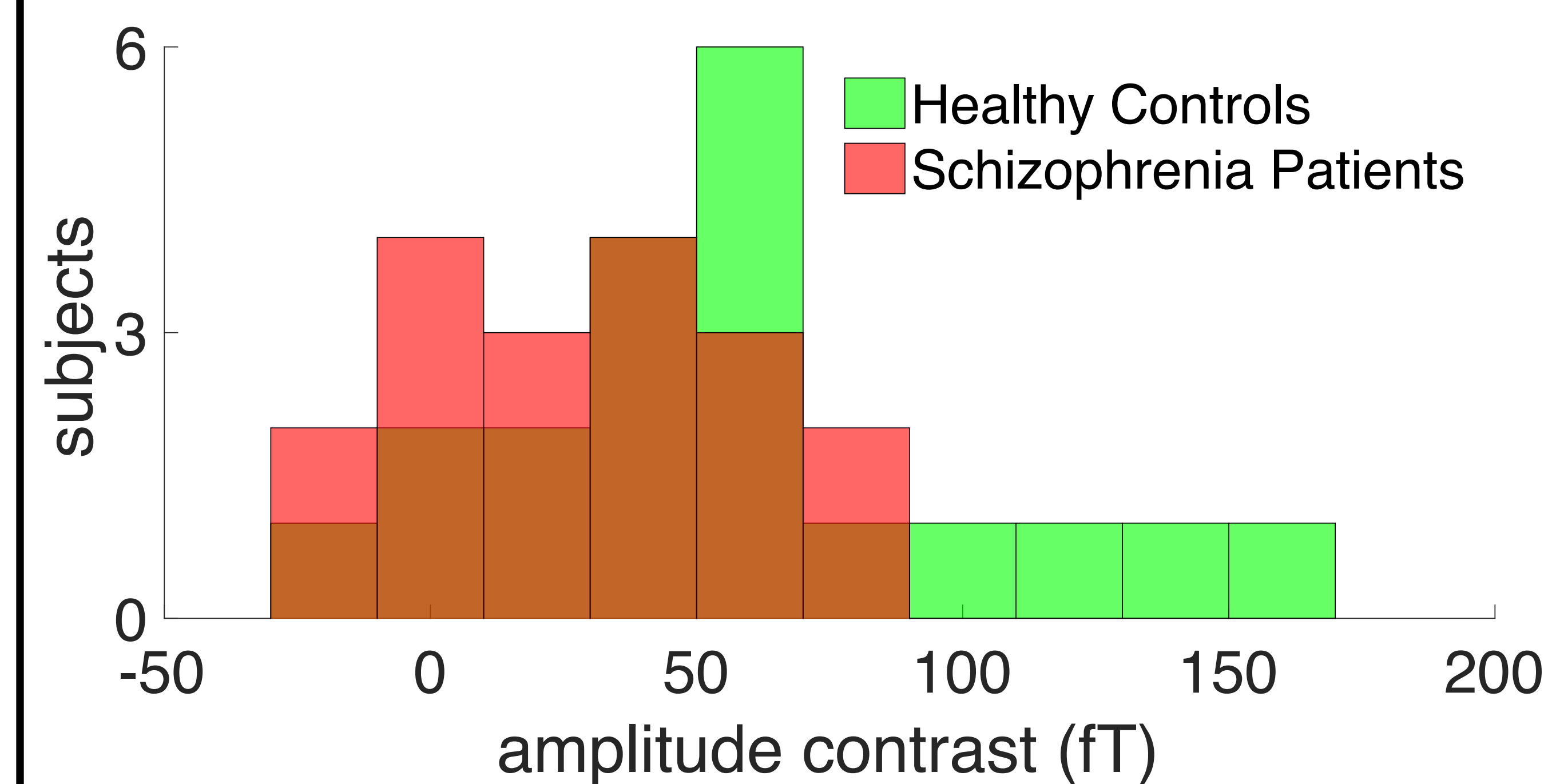


Attended (upper) and Unattended (lower) TRFs from a representative schizophrenia patient. The amplitude and timing of the two M50<sub>TRF</sub>s are typically similar, regardless of attention. The Attended M100<sub>TRF</sub>, in contrast, is typically larger and earlier than Unattended.

## References

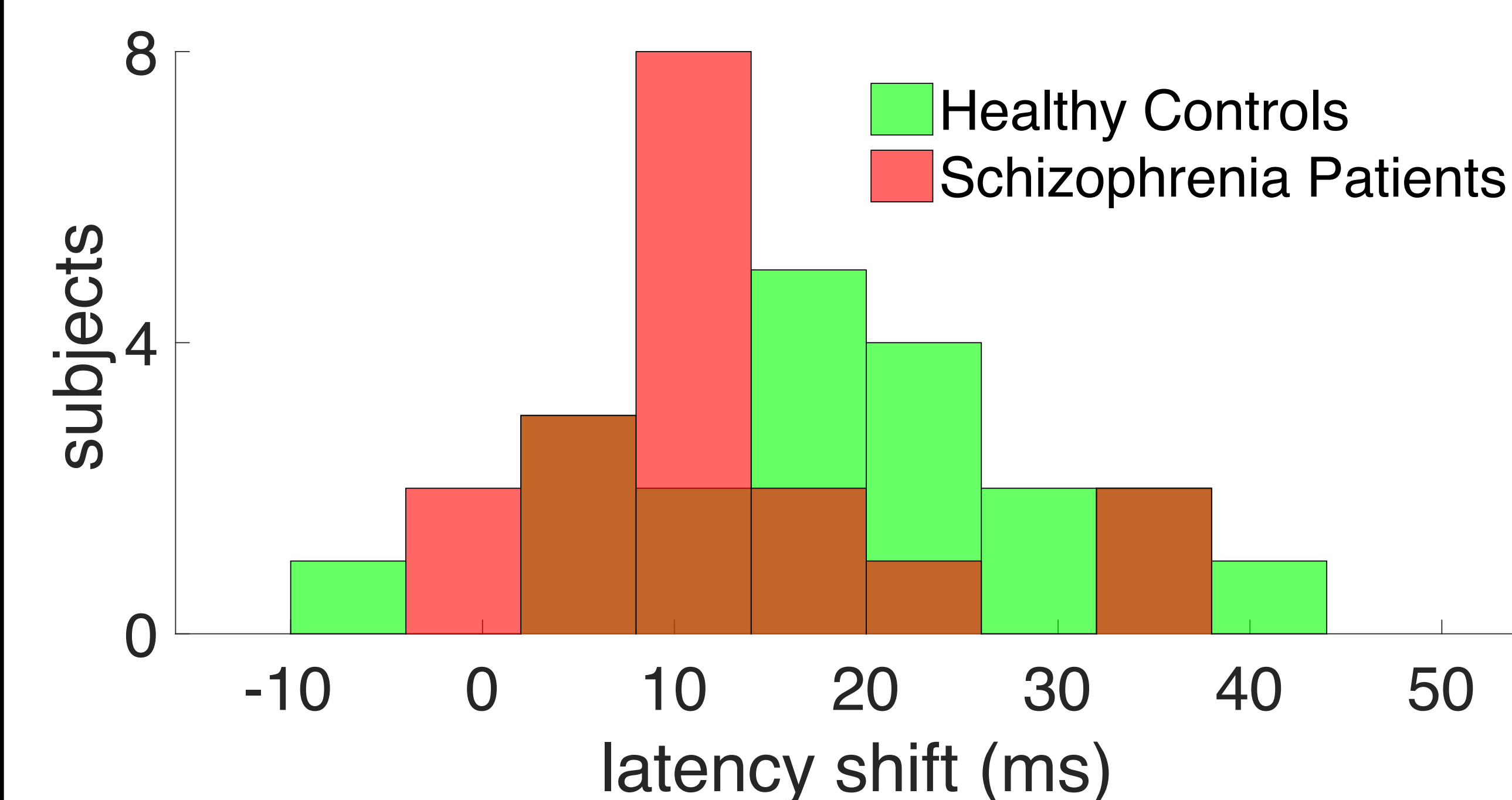
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### M100<sub>TRF</sub> Attentional Gain



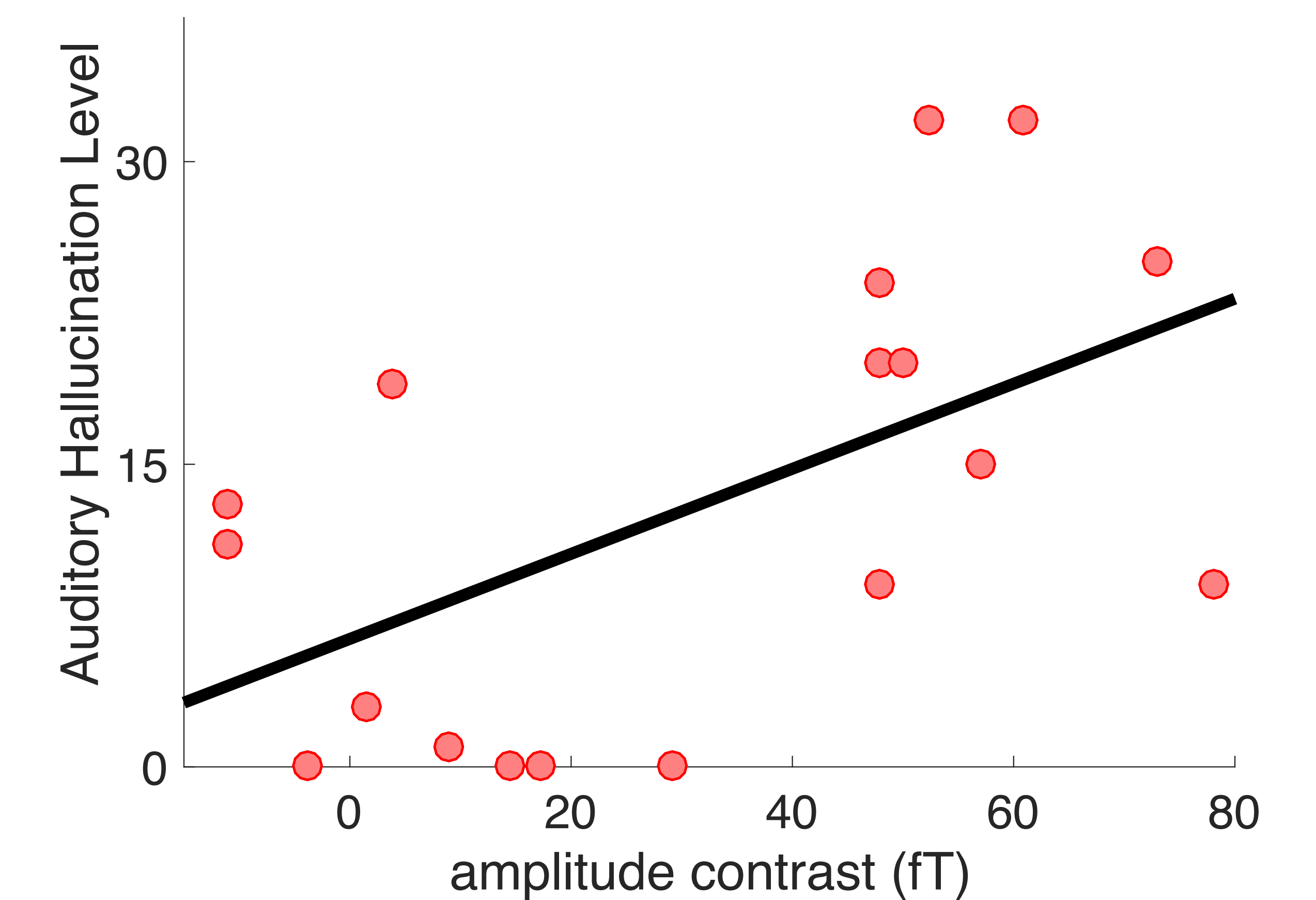
The M100<sub>TRF</sub> peak enhancement (gain) for Attended over Unattended TRFs is significantly reduced (population shifted left) for schizophrenia patients (red) relative to healthy controls (green).  $p = 0.028$  (permutation test,  $N = 100000$ )

### M100<sub>TRF</sub> Latency Enhancement



The M100<sub>TRF</sub> latency advantage of the Attended over Unattended is significantly reduced (population shifted left) for schizophrenia patients (red) relative to healthy controls (green).  $p = 0.032$  (permutation test,  $N = 100000$ )

### Auditory Hallucination Severity vs. M100<sub>TRF</sub> Attentional Gain



In schizophrenia patients, M100<sub>TRF</sub> peak enhancement (gain) is correlated with Auditory Hallucination Index.  $r = 0.557$ ,  $p = 0.016$ .

## Discussion

- Recent results from Puschmann et al. connect neural activity in right temporo-parietal junction (TPJ) to successful selectively listening in speech,<sup>5</sup> e.g., successful suppression of unattended speech.
- Auditory hallucinations are likewise connected to activity in both TPJ<sup>6</sup> and auditory cortical areas whose activity strongly locks to speech<sup>7</sup>.
- Deficits in speech-rate (delta band) auditory oscillations are associated with schizophrenia in general, and verbal working memory symptoms in particular.<sup>8</sup>

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