EEG-Based Identification of Schizophrenia Subtypes Using Brain Connectivity

Revealing distinct brain activity and connectivity patterns across treatment-response subtypes

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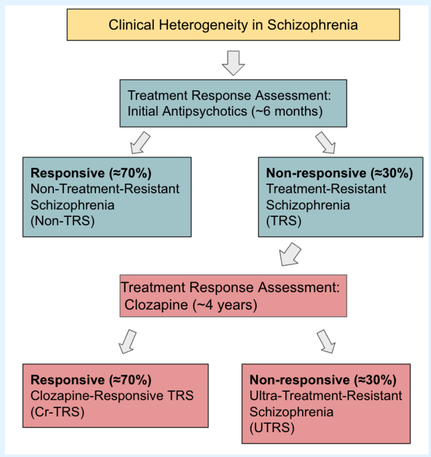
Introduction

Schizophrenia, due to its heterogeneity, can be a complex mental disorder to diagnose and treat.

Therefore, identifying an adequate medication quickly for an individual patient is crucial.

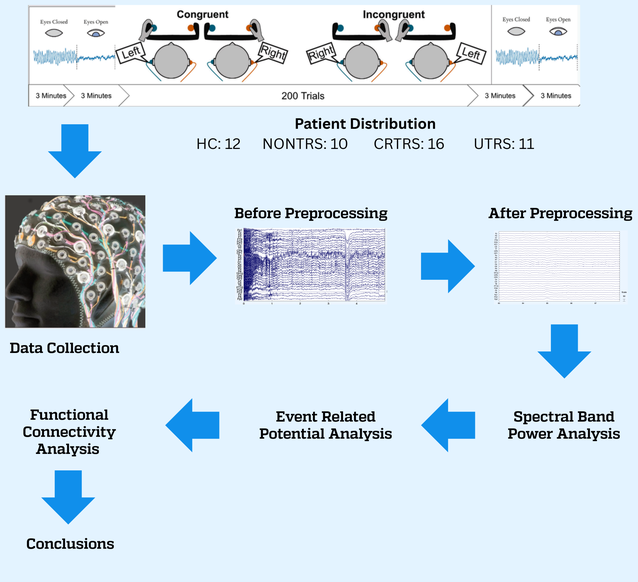


Objectives

Goal: Identify EEG-based biomarkers (spectral + connectivity) that distinguish schizophrenia treatment response subtypes.

- Identify brain **activity differences** across schizophrenia subtypes
- Understand how **brain regions communicate differently** in each group
- Use EEG to reveal **objective neural signatures of treatment response**

Methods



Results

Spectral Findings from Resting State

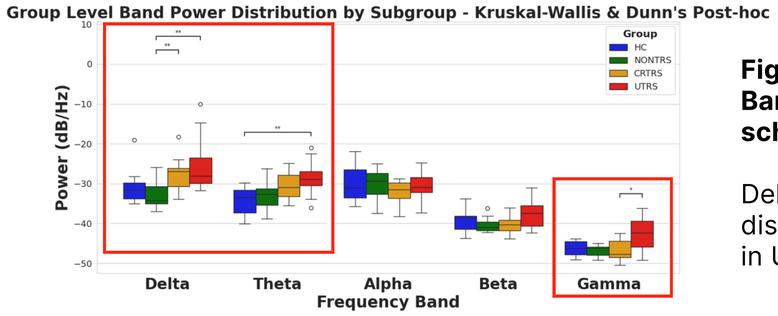
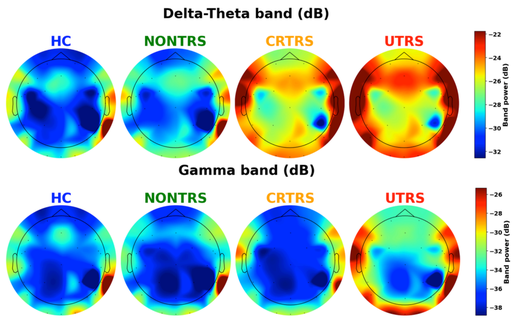


Figure 2
Topographic maps of low frequency band (Delta, Theta), and gamma band power.

Delta and theta are elevated in crTRS and UTRS (frontal/temporal regions), while gamma shows increased activity in UTRS.

Figure 1
Band power differences across schizophrenia subgroups.

Delta and theta increase with disease severity; gamma is elevated in UTRS.



Event-Related Potentials (ERP) from Task Based

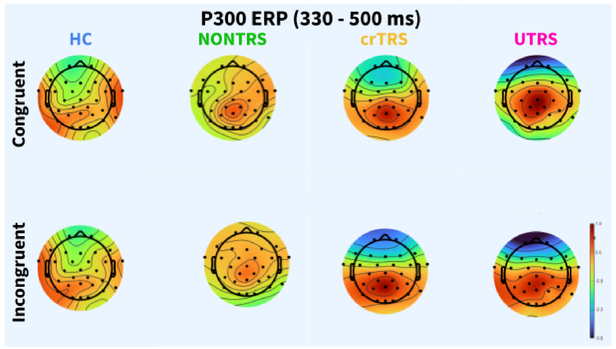


Figure 3
Event-Related Potential (ERP, μV) topographic distribution of the P300 stimulus processing phase.

Centro-parietal and temporal activity increase with disease severity. Cr-TRS and UTRS also demonstrate increasingly negative frontal activity.

Functional Connectivity Resting and Task-Based Analysis

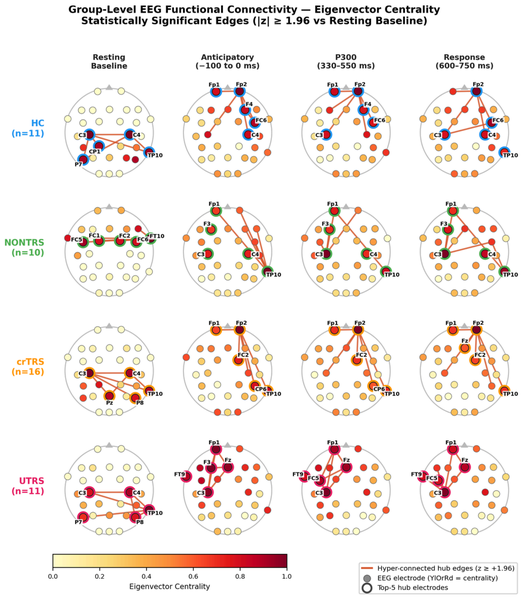


Figure 4
Group-level EEG functional connectivity and eigen vector centrality across task phases (|z| ≥ 1.96 vs resting baseline).

- Healthy controls and NONTRS : More distributed and balanced hub organization across the network.
- crTRS and UTRS : Hubs are more clustered rather than distributed, indicating increased network centralization.

Conclusions

- ↑ Delta/theta → **cortical slowing with increasing severity**
- ↑ Gamma in UTRS → suggests **local circuit dysfunction**
- ERP changes → **impaired cognitive processing and conflict processing**
- Connectivity → **rigid and less adaptable brain networks**
- Together: evidence of **progressive global + local brain dysfunction in Treatment Resistant Schizophrenia subgroups.**

Take Aways

- EEG reveals **distinct patterns across schizophrenia subtypes.**
- Treatment resistance groups shows more **rigid, less flexible brain networks.**
- EEG features may serve as **objective biomarkers** of severity and treatment resistance.

IMPACT

- Earlier detection of treatment resistance
- More targeted treatment decisions
- Step toward **precision psychiatry**

Future Work

- **Expand cohort size**: improve statistical power and generalizability across schizophrenia subtypes
- Identify which brain **regions** driving **connectivity differences**
- Develop **predictive models** using EEG features
- **Longitudinal EEG data** collection prior to treatment initiation to identify early biomarkers of treatment resistance
- Integration of **multimodal data** (clinical, cognitive, imaging) to improve classification of TRS subgroups