fMRI Signal Complexity on the Effect of Repetitive Transcranial Magnetic Stimulation for Negative Symptoms in Schizophrenia

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INTRODUCTION

- A consistent challenge in the management **of schizophrenia** (SZ) is the treatment of **negative symptoms**. These symptoms have a lower responsiveness to antipsychotic, leading to decline in functional outcome[1].

- **Repetitive Transcranial Magnetic Stimulation (rTMS)** has been explored as a promising treatment method in SZ, but it is unclear if the negative symptom can be ameliorated with rTMS[2].

- The human brain exhibits **time-series signal variability** overtime. The signal alteration in Resting-state Functional Magnetic Imaging (r-fMRI) have been shown to provide insight into SZ's neural dysregulation[3].

- No studies have explored the activity pattern of these time-series signal in response to rTMS treatment in SZ.

> **We aimed to** (1) investigate whether rTMS can alleviate the persistent negative symptom that current therapeutic approaches do not resolve; and (2) explore the r-fMRI time-series signal complexity in response to rTMS treatment effectiveness in SZ.

Scan to know more about Schizophrenia!

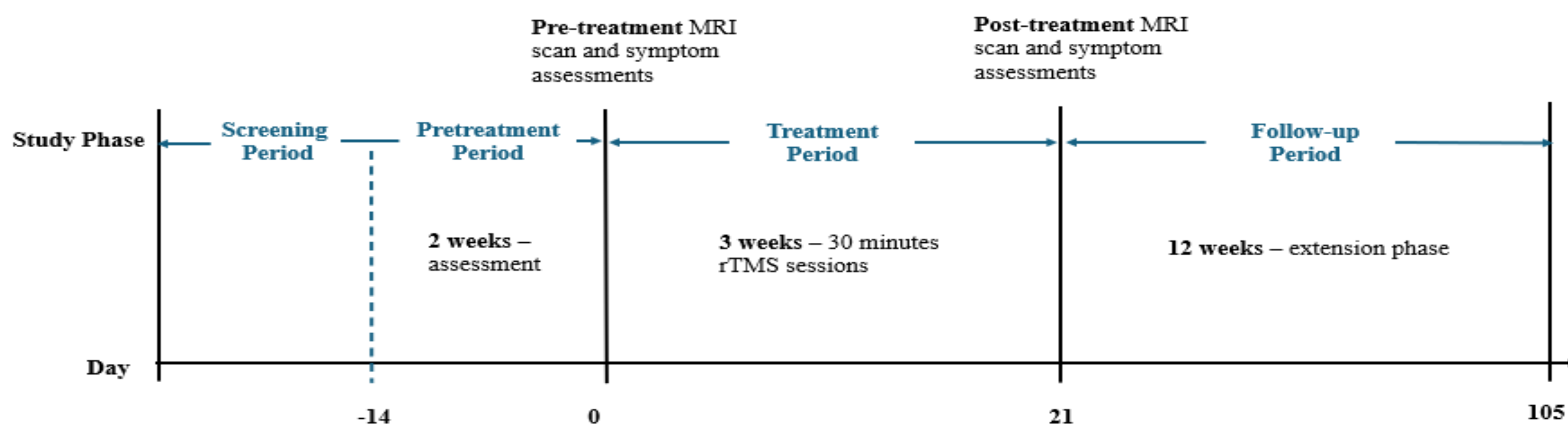**Or..**

to connect!

METHODS

Figure 1. Timeline of the study

Processing Workflow

- Participants entered rTMS intervention that targets the left **Dorsolateral Prefrontal Cortex (DLPFC)**. Pre- and post-treatment (PANSS scores and MRIs) were conducted.

- **Region of interest (ROI) analysis** was preformed to extract the time-series variables, including Shannon entropy **(SE),** Hurst exponent **(HE),** and standard deviation **(SD).**

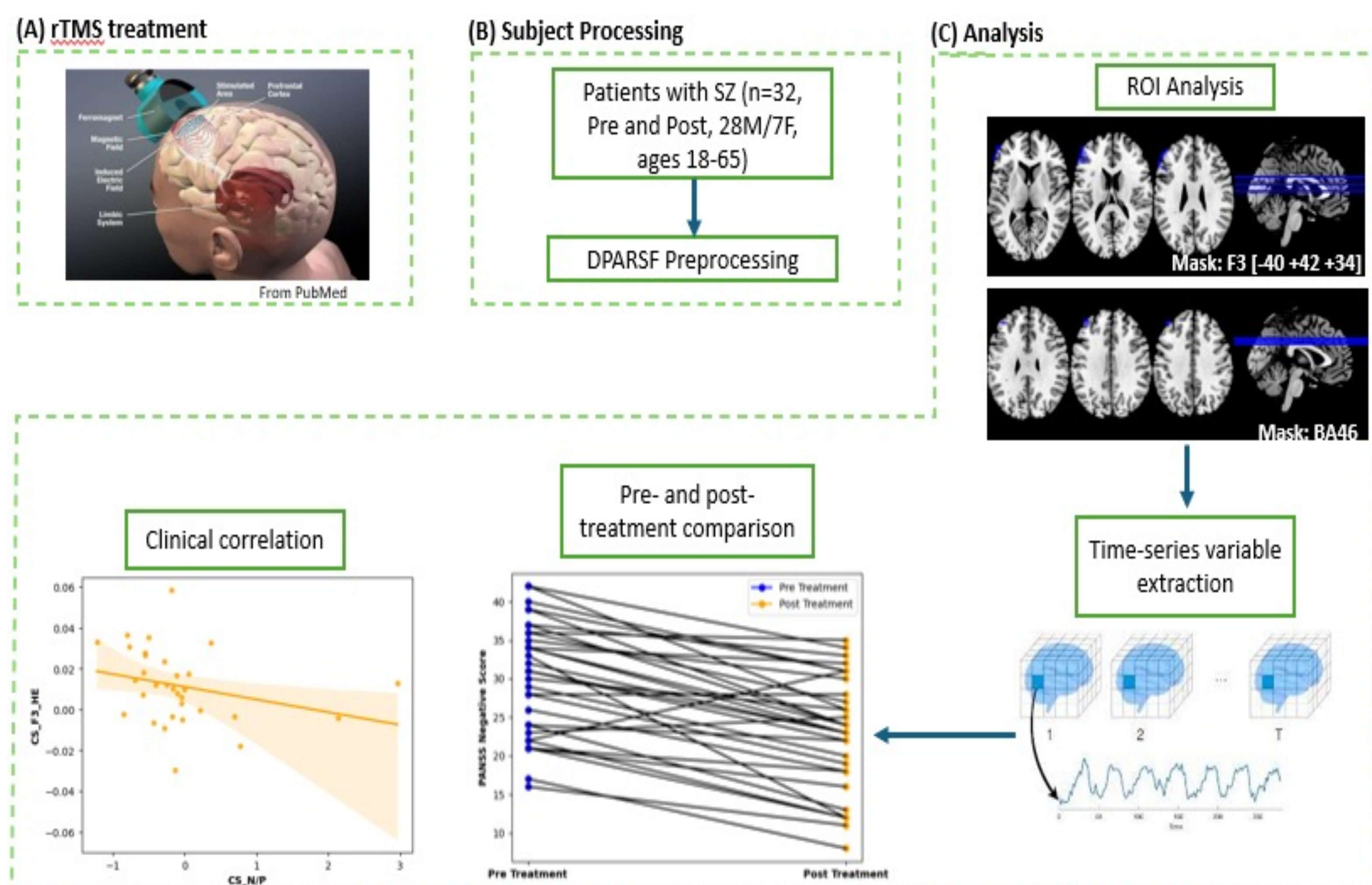- Correlation analysis compared pre- and post-treatment data.

Figure 2. An overview of the processing and analysis workflow performed for this study.

RESULTS
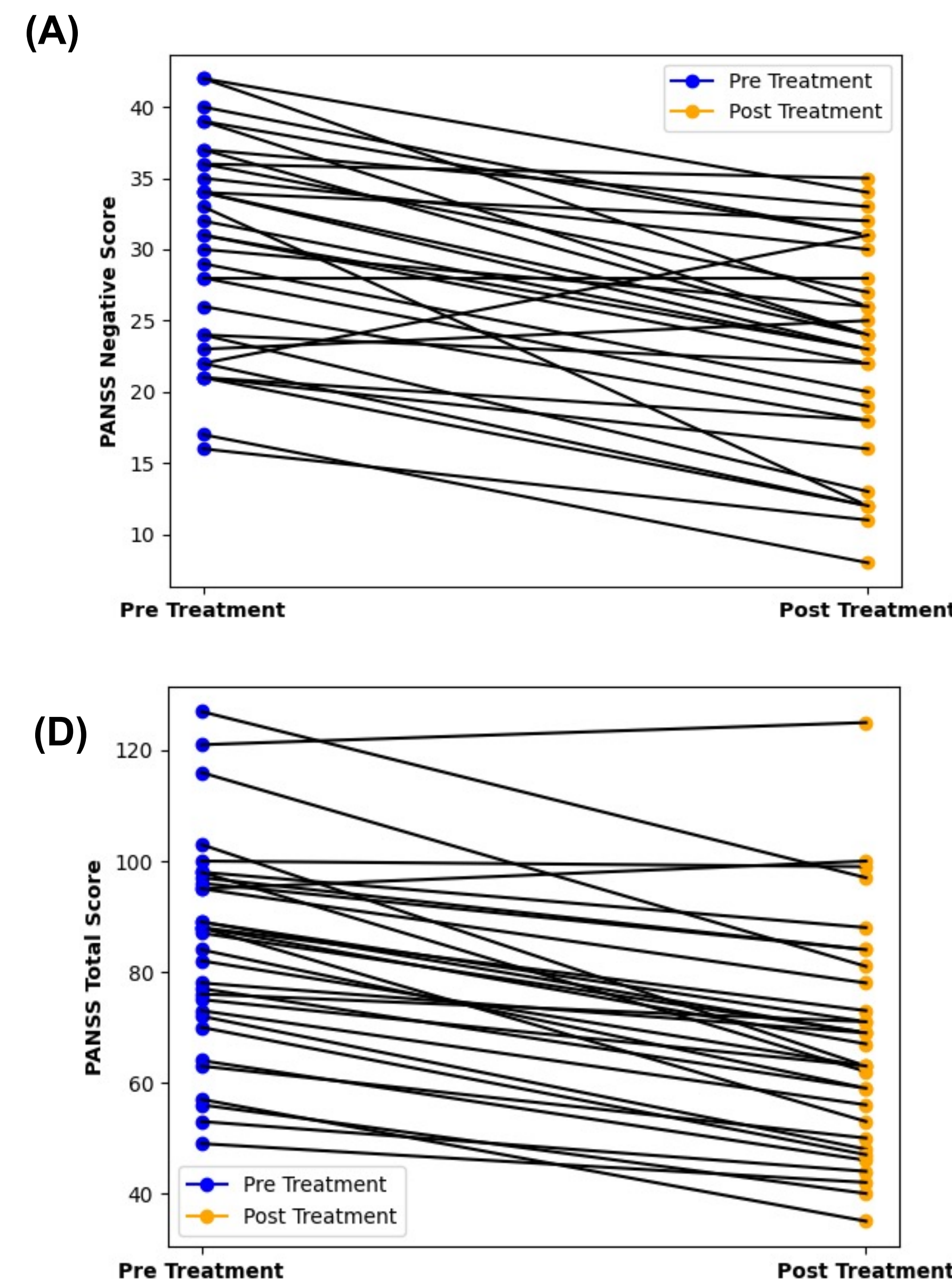
Clinical Symptoms Comparison

Figure 3. Examples of pre-and post treatment comparison of PANSS (A) Negative score (B) Total score.

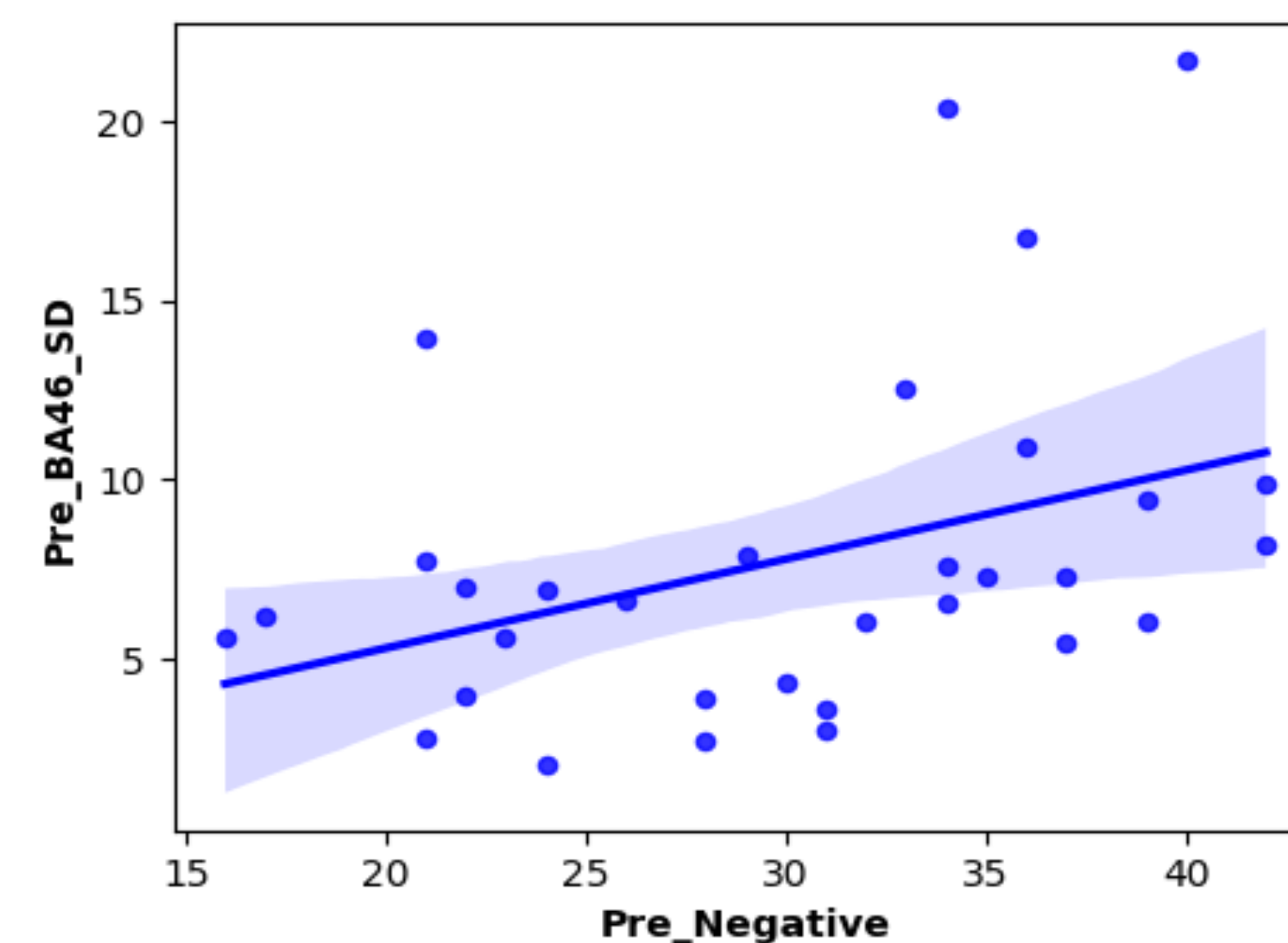### Pre-Treatment Clinical Correlation

Figure 4. Significant positive correlation ($p = 0.012$) between SD of the time-series and the PANSS negative scores at baseline using color blue for BA46 masks.

Change Score Clinical Correlation
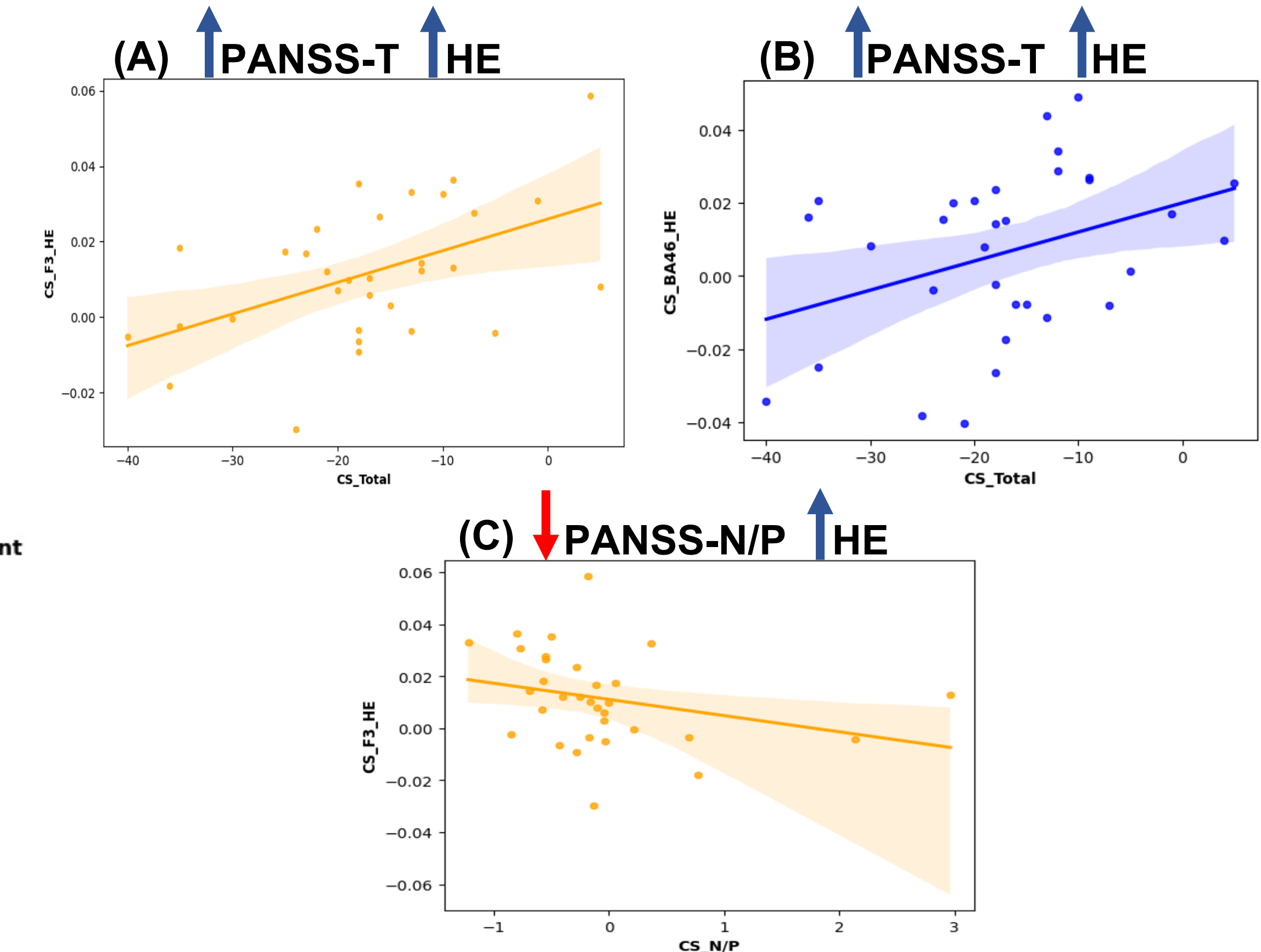
Hurst Exponent & PANSS Score

Figure 5. Examples of significant correlation ($p<0.05$) between change scores of Hurst Exponent and PANSS scores using color yellow for F3 masks and blue for BA46 masks
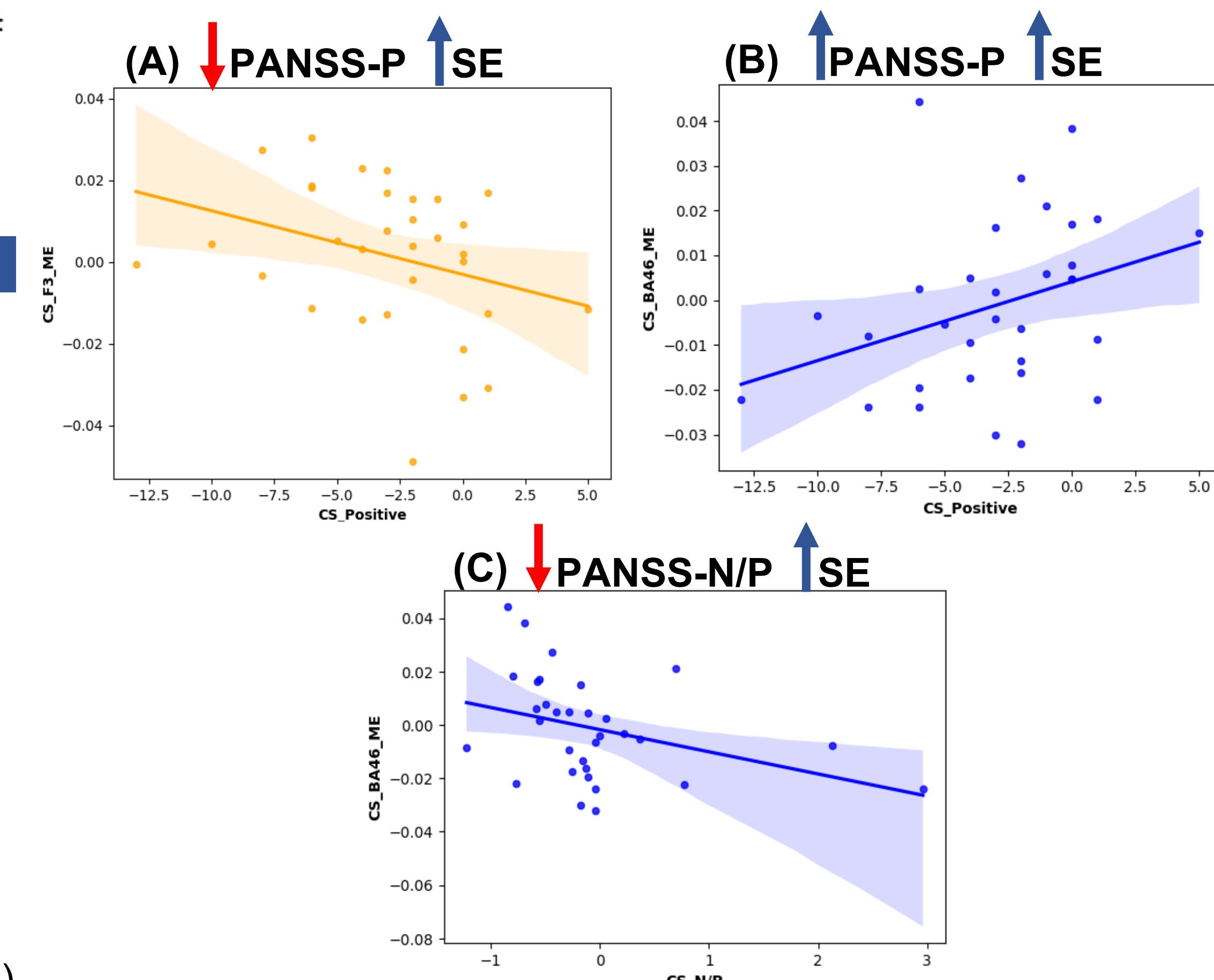
Shannon Entropy & PANSS Score

Figure 6. Examples of significant correlation ($p<0.05$) between change scores of Hurst Exponent and PANSS scores using color yellow for F3 masks and blue for BA46 masks

DISCUSSION

- Our results suggest that rTMS can effectively alleviate the clinical symptoms of schizophrenia. (Figure 3)

- Baseline correlation between the time-series variables and the PANSS negative scores e suggests that patients with greater fluctuation in the fMRI timeseries tend to exhibit more pronounced negative symptoms. (figure 4)

- Time-series complexity variations correspond to changes in PANSS positive, total scores, and the N/P ratio. Rising PANSS total scores are positively related to HE across all masks, while the relationship between PANSS positive scores and ME varies by mask. (figure 5, figure 6)

REFERENCES

[1] Aleman, A., Lincoln, T. M., Bruggeman, R., Melle, I., Arends, J., Arango, C., & Knegtering, H. (2017). https://doi.org/10.1016/j.schres.2016.05.015 [2] Pan, Z., Xiong, D., Xiao, H., Li, J., Huang, Y., Zhou, J., Chen, J., Li, X., Ning, Y., Wu, F., & Wu, K. (2021). https://doi.org/10.1016/j.psychres.2021.113866. [3] Graham, J. W. C., Jeon, P., Théberge, J., & Palaniyappan, L. (2023). https://doi.org/10.1016/j.pscychresns.2023.111640

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