An Assessment of Alpha Music on Brain – Computer Interface Performance

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Introduction

"BCI illiteracy" is a term used to describe individuals performing asynchronous BCI with poor performance despite a long training process. Scientists have estimated that 15 – 30% of BCI learners are listed as BCI illiteracy.

ALPHA MUSIC

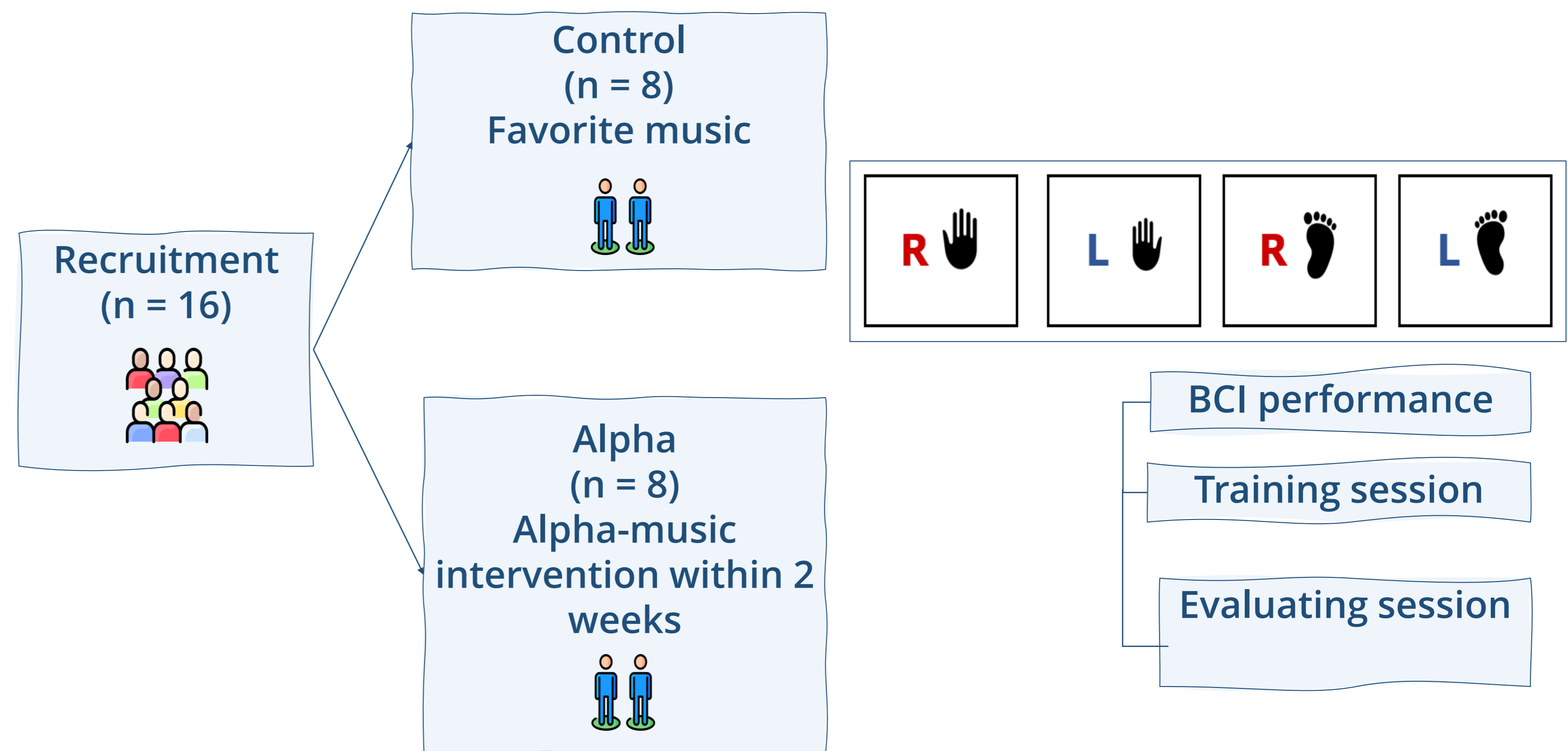- brings a state of tranquility effectively;
- can inspire the brain to produce alpha waves through certain rhythmic patterns;
- has not been researched, but its potential to improve BCI illiteracy holds a great promise.

This study aimed to assess two groups of naive BCI users following their performance and alpha power.

Methods

Recruitment (n = 16)
→ Control (n = 8) Favorite music
→ Alpha (n = 8) Alpha-music intervention within 2 weeks

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- BCI performance
- Training session
- Evaluating session
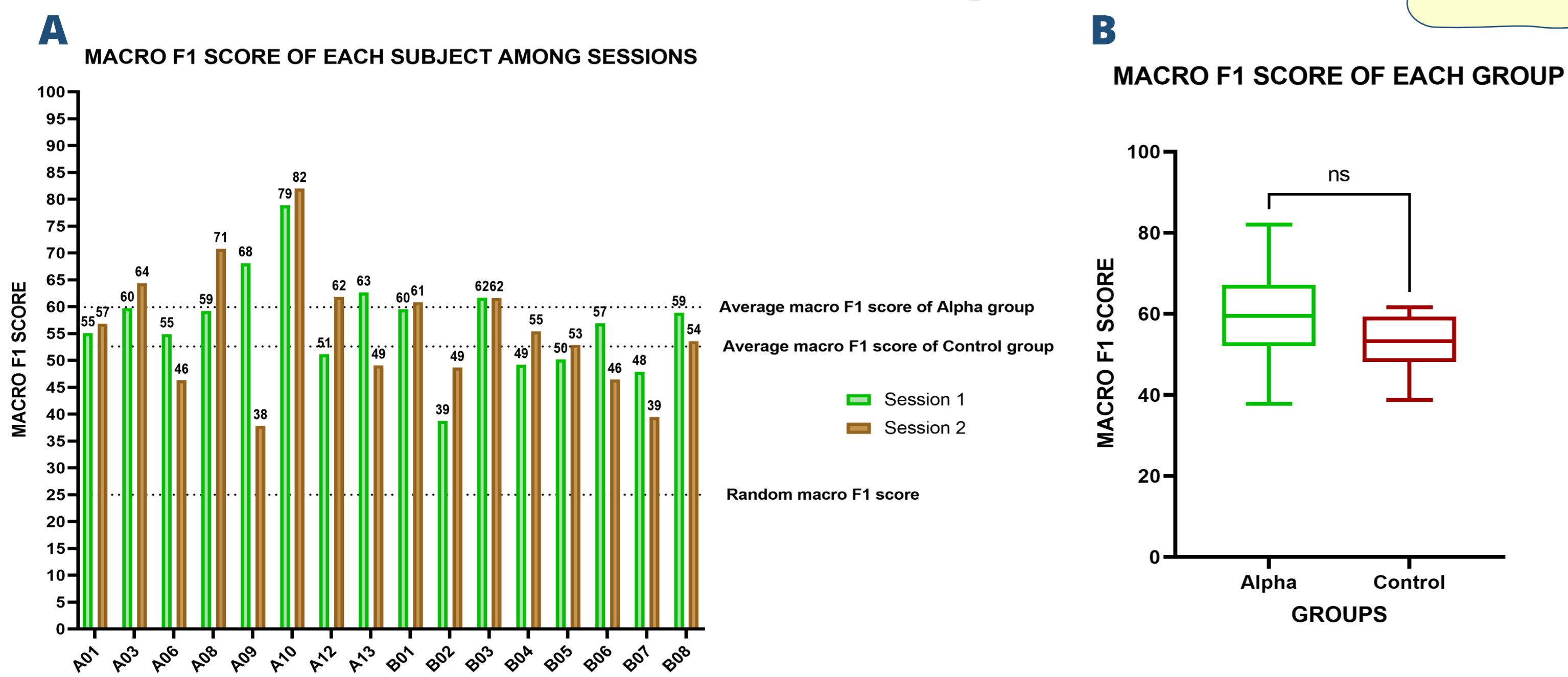
Results

BCI PERFORMANCE

Figure 1. The Macro F1 Scores generated from subject-specific models (Support Vector Machine) for four classes under 10-fold Cross Validation through Filter Bank Common Spatial Pattern features: **(A)** Macro F1 Scores across subjects and sessions. **(B)** A comparison of Macro F1 Scores among two groups.

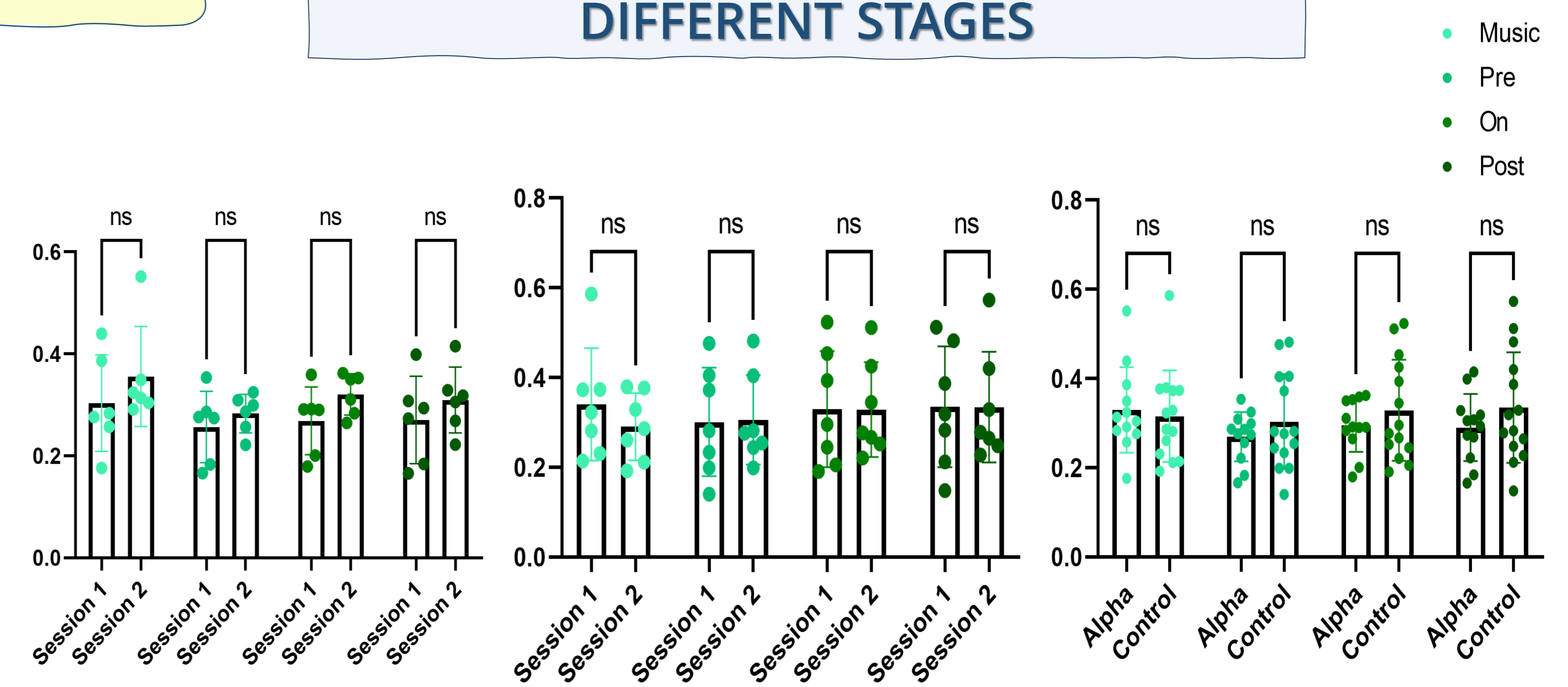### ALPHA RELATIVE POWER ACROSS DIFFERENT STAGES

Figure 2. Relative Power of Alpha band (7 – 13 Hz) in two sessions according to different stages among: **(A)** Alpha group. **(B)** Control group. **(C)** two groups.

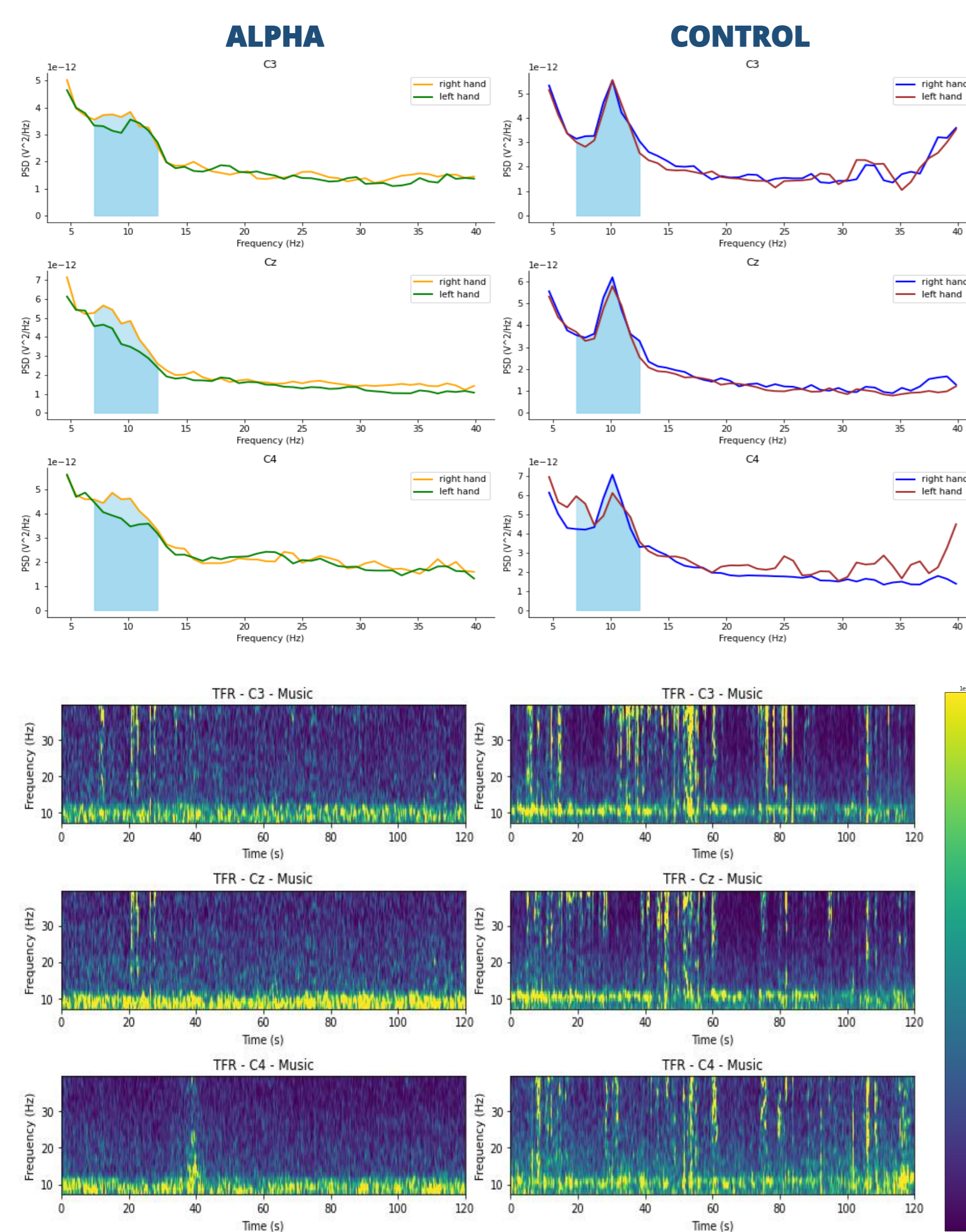### ALPHA-POWER ACTIVITIES ACROSS MOTOR – IMAGERY TASKS

Figure 3. Alpha distribution over the motor cortex (across C3, Cz, and C4 channels) between Alpha and Control groups at the evaluating session: **(A)** Power Spectral Density in Motor-Imagery tasks (left-hand and right-hand tasks). **(B)** Spectrograms at the Music stage.
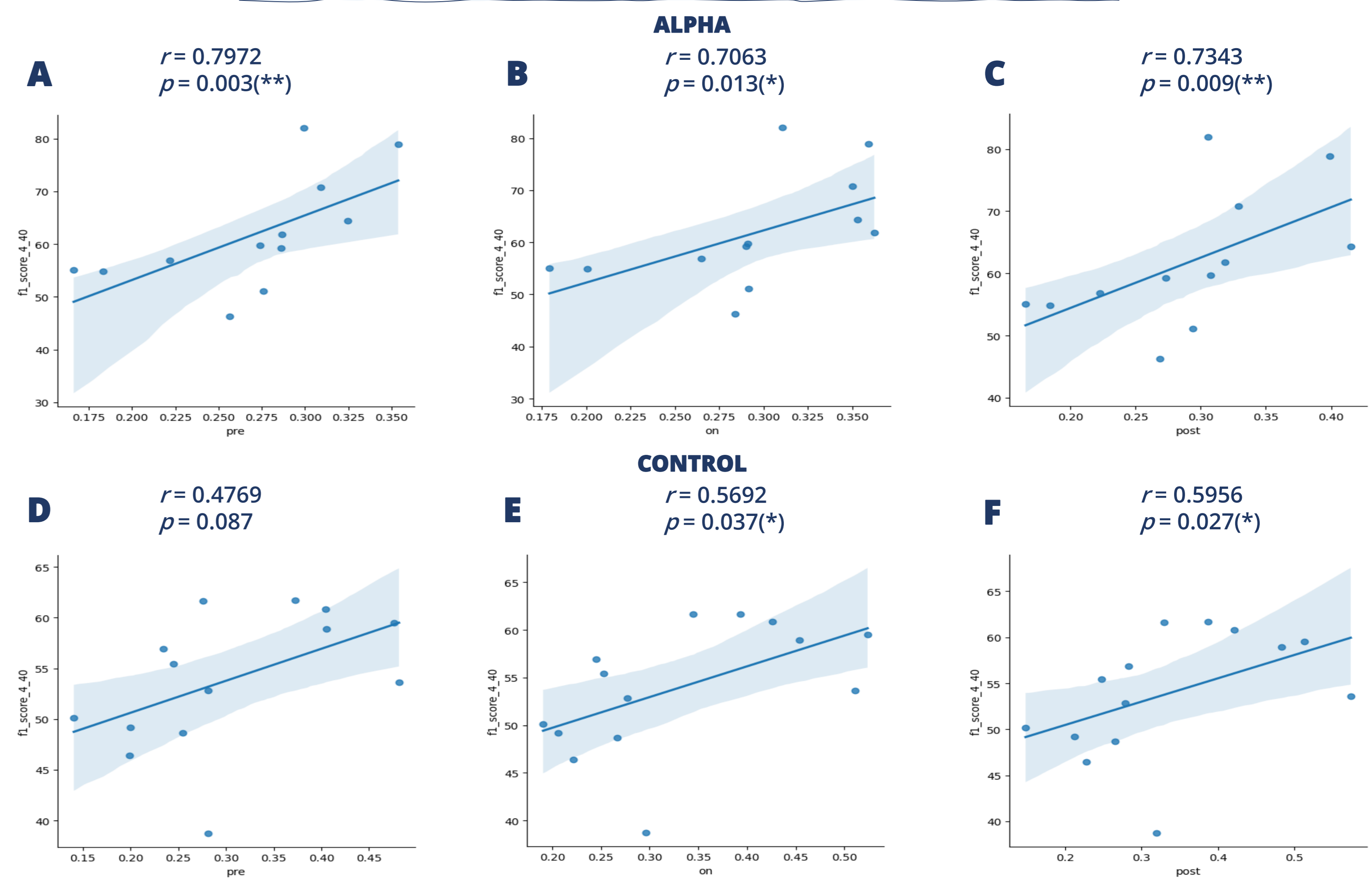
THE CORRELATION OF BCI PERFORMANCE AND ALPHA POWER

ALPHA
A: r = 0.7972, p = 0.003(**)
B: r = 0.7063, p = 0.013(*)
C: r = 0.7343, p = 0.009(**)

CONTROL
D: r = 0.4769, p = 0.087
E: r = 0.5692, p = 0.037(*)
F: r = 0.5956, p = 0.027(*)

Figure 4. Spearman-Rank Correlation of Macro F1 Scores and Relative Power at Motor-Imagery stages between two groups.

Conclusion

- The Apha group **outperformed** the Control group (59.91% and 52.61% accordingly).
- The Alpha group had **a clear discrimination PSDs** between right-hand and left-hand tasks while the Control group showed an overlapping pattern.
- The Alpha group's performance **was positively correlated** with Relative Power at 3 MI stages (Pre, On, and Post) while there was no significant statistics observed in the Control group.
→ Alpha-music intervention **has a moderate effects** on BCI performance, which can be extended in a longer period of training (1 month or 2 months).