Longitudinal Intervention of VR-based BCI Training: A Case Study of Chronic Stroke Patients

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Introduction: There is increasing evidence of the impact of Motor-imagery (MI) Brain-Computer Interfaces (BCI's) in stroke rehabilitation [1][2]. MI practice can be augmented through embodied feedback delivered by virtual reality (VR). Nonetheless, detailed information concerning the impact of VR-BCI training in clinical outcome is still largely missing. This abstract illustrates the long-term effect of VR-BCI training in sensorimotor patterns and clinical scales of stroke patients.

Material, Methods and Results: Seven chronic stroke patients underwent a 3-week VR-BCI intervention. Fugl-Meyer Assessment (FMA) was conducted pre-, post- intervention, and a follow-up, one-month later. The VR-BCI training consisted of a bimanual rowing task (NeuRow) involving MI and motor observation [3]. From the EEG, the Event-related Desynchronization (ERD) was extracted from the Mu band (8-12 Hz). All patients showed significantly increased Mu ERD compared to baseline, however, the affected side showed reduced ERD during the contralateral MI. Significant ERD differences originating from both the lesioned and the healthy hemisphere were found when comparing post- with pre- intervention in all patients, and decreasing ERD was found for patients with no clinical improvement. Patients with decreased lateralization of ERD had no improvement of the FMA score (fig.1).

Conclusion: Stroke patients in the chronic phase can modulate their brain activity patterns using MI in a VR-BCI task, with observable patient-specific differences between brain activity and clinical outcome. Nonetheless, only patients with increased ERD lateralization showed clinical improvement.

Significance: These results add further evidence concerning the relationship of ERD features with clinical outcome in terms of FMA in an VR-BCI training paradigm in chronic stroke patients.
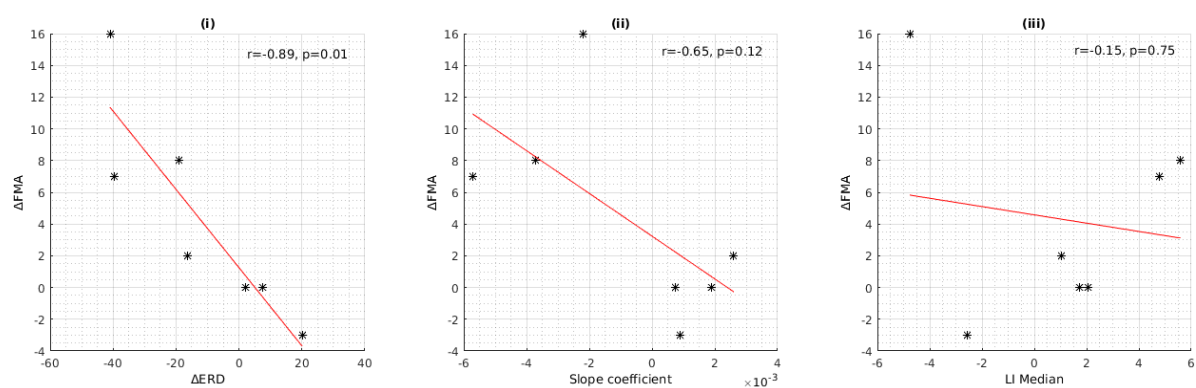

Figure 1. *Relationship of ΔFMA score between (i) pre-post- ΔERD; (ii) ERD steepness of the paretic side, (iii) LI of ERD.*

References

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