

28th ECSS Anniversary Congress, Paris/France, 4-7 July 2023

The effects of Neurofeedback training and Psychological skills training on putting performance in expert golfers

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INTRODUCTION: In recent studies, the effectiveness of neurofeedback training (NFT) and psychological skills training (PST) have been evaluated not only in the clinical population, but also for their enhancement of performance in general. The mechanism for the effect may differ based on different effective attention control derived from both trainings. Previous research suggests that Frontal Midline Theta (Fm) is an indicator of top-down sustained attention and Fm can be used to distinguish an individual's best and worst golf putting performances during the pre-putt period. Thus, this study investigated the effect of NFT and PST on golf putting performance and hypothesized that expert golfers would exhibit enhanced putting performance after both trainings.

METHODS: Twenty-eight expert golfers were recruited and assigned into the NFT group (N = 9), PST group (N = 8), or control group (N = 11). Participants were asked to perform golf putting while electroencephalogram (EEG) was recorded, both before and after intervention. The NFT group participated in eight 1.5-hr sessions of Fm NFT in a lab setting. During the Fm neurofeedback training, participants had to develop their own strategies for controlling Fm amplitude based on the visual or audio feedback in real-life putting. The PST group participated in eight 1.5-hr sessions of Mindfulness-Acceptance-Commitment (MAC) in a lab setting. During this time, the control group did not receive any type of intervention.

RESULTS: The one-way ANOVA showed a significant effect on putting accuracy ($F(2, 27) = 9.648, p = .001$). The post hoc analysis showed that the NFT group had better performance than control group ($p = .003$) and PST group ($p = .004$). Fm and attention-related cortical indicators did not differ between the three groups.

CONCLUSION: Despite its limitations, this study found that 8-session Fm NFT significantly improved putting performance in expert golfers while mindfulness based intervention did not. To the best of our knowledge, this is the first long-term interventional Fm NFT study on putting performance and EEG activity. The null finding in the PST group could be attributed to promotion of control over automation in acceptance-based mindfulness training, which may not match the attentional style of these participants. From a practical standpoint, although Fm NFT was ineffective in changing EEG-related cortical activities during putting, it is effective in improving putting performance. The mechanism of performance enhancement via NFT and PST still remains a question. Future research could focus on clarifying the underlying mechanism of the effect through NFT and PST.

Topic: Psychology

Presentation: Oral

European Database of Sport Science (EDSS)

Supported by SporTools GmbH



19088