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Towards congruent BCI feedback

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We explored possibilities to increase motor imagery (MI) BCI performance by implementing Flow theory. According to this theory, by adapting the task difficulty to one's skills and making engaging content, one can reach a state of flow, i.e., to be fully immersed in a task, forgetting about the self and the environment, and thus reaching higher performance rates [1]. In this experiment, to evoke the state of flow, music was played in the background, the BCI task was playful (a video game), and the difficulty was adapted in real-time according to user performance (classifier output). Subjects reported to have been perturbed by the rhythm of the music which did not follow their imagined movement [2]. This inspired us to explore the benefits of a task-related (congruent) and synchronised audio feedback which would comply with the user's imagined movements.

Congruent visual environment in MI BCI has been researched in virtual reality, giving a sense of body ownership illusion, and showed to be more robust and improve performance [3]. On the other hand, the effects of a congruent audio environment, have not yet been explicitly explored in BCI. We investigate the potential of an audio congruent to the task, tackling the sensori illusion of presence by providing realistic audio feedback using a synthesizer from [4]. We present preliminary results to show the benefits of a congruent, audio MI feedback of feet as opposed to no congruent feedback using abstract sound. We found a significant difference ($p < 0.05$) in classification accuracy when a binary classifier was trained offline separately on the "congruent" and "non-congruent" runs (respectively 66.1%, SD: 7.45 and 63.9% SD: 7.8, 10-fold cross-validation) [5].

This study encourages further research on congruent BCI tasks, which can both induce flow and assist users to achieve more stable MI.

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