

Which factors drive successful BCI skill learning?

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Introduction

Brain-Computer Interfaces (BCI), although very promising, suffer from a poor reliability [1]. Rather than improving brain signal processing alone, an interesting research direction is to guide users to learn BCI control mastery. Thus, we present here a set of motivational and cognitive factors which could influence the learning process, and which should be considered to improve the global performance of BCI users.

Methods

We based our study on Keller's integrative theory of motivation, volition, and performance, which combines motivational (affective) *and* cognitive factors, to explain what makes human users learn and perform efficiently, irrespectively of the task [2]. These factors can guide the creation of learning environments, such as BCI training protocols.

According to the theory, the optimization of *motivational factors* - **Attention** (triggering a person's curiosity), **Relevance** (the compliance with a person's motives or values), **Confidence** (the expectancy for success), and **Satisfaction** (by intrinsic and extrinsic rewards) - leads to more user efforts and thereby a better performance.

Additionally, considering the *cognitive factors* - the **limited user working memory** (requiring to minimize the amount of skill-unrelated information), **the way information is actively processed** by him/her (requiring to make relevant information salient) and the **existing knowledge in his/her long-term memory** (requiring to relate the to-be-learned skill to existing knowledge) - leads to a more efficient skill acquisition.

Most factors are usually not considered for BCI design. Optimizing the motivational factors while respecting the cognitive constraints may lead to improved user BCI control.

Discussion

This poster identified factors possibly influencing BCI skill learning. However, their relevance and the interplay between them for BCI needs further addressing. We conclude, that shifting the focus from machine learning-centered to user-centered training may encourage user involvement and hence may enable a more efficient use of human brain resources.

References

- [1] Wolpaw, J., & Wolpaw, E. W. (Eds.). (2012). *Brain-computer interfaces: principles and practice*. Oxford University Press.
- [2] Keller, J. (2008). An Integrative Theory of Motivation, Volition, and Performance. *Technology, Instruction, Cognition & Learning*, 6(2).