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Reviewing open challenges in Mental Tasks (MT-)based BCI user training

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Abstract

Traditional MI-BCI training programs could be further improved [1]. This can be done through guidelines [2]; user-centered design [3] and adaptive systems [4]. We conducted a literature review on several aspects of MI-BCI user-training, e.g. environment, cognitive support, exercises. Here, we highlight the elements that we identified as not sufficiently explored or formalized yet.

Concerning the training environment, these challenges include:

- a) balancing between a relevant control task [5], a motivating environment, and the associated risk of imposing cognitive overload [6, 7, 8];
- b) studying social aspects of training, e.g. feedback content [9].

Concerning instructions and cognitive support, it includes:

- a) introducing the BCI to foster users' understanding and engagement;
- b) evaluating the learnability/memorability of the MI-BCI skills and instructions [10];
- c) assessing users' strategies [11];
- d) selecting user-centered task(s) [12];
- e) providing guidance based on user-only metrics instead of classification accuracy [13].

Current challenges for MI-BCI exercise design include:

- a) implementing varied exercises instead of the only same one [1];
- b) studying indirect/incidental MI-BCI training tasks, e.g. mindfulness meditation [14], physical preparation [15];
- c) assessing online learners' states [16] and progress to provide adapted/adaptive environment (e.g. manipulating timing [17]);
- d) exploring the suitable parameters of trials (e.g. order, duration, number [18]) and their influences on users' states and performances.

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