



HAL
open science

Using computational modelling to better understand and predict Mental-Imagery based BCI (MI-BCI) users' performance

Camille Benaroch, Camille Jeunet, Fabien Lotte

► To cite this version:

Camille Benaroch, Camille Jeunet, Fabien Lotte. Using computational modelling to better understand and predict Mental-Imagery based BCI (MI-BCI) users' performance. Journées CORTICO 2018 - Collectif pour la Recherche Transdisciplinaire sur les Interfaces Cerveau-Ordinateur, Apr 2018, Toulouse, France. hal-01847280

HAL Id: hal-01847280

<https://inria.hal.science/hal-01847280>

Submitted on 23 Jul 2018

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Using computational modelling to better understand and predict Mental-Imagery based BCI (MI-BCI) users' performance

Camille Benaroch

Inria, Talence, France

Camille Jeunet

CNBI, EPFL, Geneva, Switzerland / Univ. Rennes, Inria, IRISA, CNRS, Rennes, France

Fabien Lotte

Inria, LaBRI (Univ. Bordeaux, CNRS, Bordeaux-INP), Talence, France

Mental-Imagery based Brain-Computer Interfaces (MI-BCIs) use signals produced during mental imagery tasks to control the system. Using an MI-BCI requires a dedicated user-training. The more users practice, the better they should become. In other words, their mental commands will most likely be more often correctly recognized by the system. Current MI-BCIs are rather unreliable, which is due at least in part to the use of inappropriate user-training procedures. Understanding the processes underlying user-training by modelling it computationally could enable us to improve MI-BCI training protocols and adapt the latter to the profile of each user. Our objective is to create a statistical/probabilistic model of training that could explain, if not predict, the learning rate and the performances of a BCI user over training time using user's personality, skills, state and timing of the experiment.

In order to build such a model, we are currently using data obtained from three different studies [1, 2, 3], which are based on the same protocol. In total, 42 participants were instructed to learn to control an MI-BCI by performing three MI-tasks (i.e., left-hand motor imagery, mental rotation and mental subtraction) across different training sessions (3 to 6 depending on the experiment). Data are divided into four categories: the user's traits (e.g., mental rotation, tension), the user's state (e.g., level of fatigue and difficulty), the timing of the experiment (e.g., hour, lapse between two sessions) and the user performances (e.g., online classification accuracy -CA-, offline cross validation CA).

Preliminary analyses revealed positive correlations between MI-BCI performances and mental rotation scores among two of the three studies, suggesting that spatial abilities play a major role in MI-BCI users' abilities to learn to perform MI tasks, which is consistent with the literature [4].

1. Jeunet, C., N'Kaoua, B., Subramanian, S., Hachet, M., & Lotte, F. (2015). Predicting mental imagery-based BCI performance from personality, cognitive profile and neurophysiological patterns. *PloS one*, 10(12), e0143962.
2. Pillette, L., Jeunet, C., Mansencal, B., N'Kambou, R., N'Kaoua, B., & Lotte, F. (2017, September). PEANUT: Personalised Emotional Agent for Neurotechnology User-Training. In *7th International BCI Conference*.
3. Teillet, S., Lotte, F., N'Kaoua, B., & Jeunet, C. (2016, October). Towards a spatial ability training to improve Mental Imagery based Brain-Computer Interface (MI-BCI) performance: A Pilot study. In *Systems, Man, and Cybernetics (SMC), 2016 IEEE International Conference on* (pp. 003664-003669). IEEE.
4. Jeunet, C. (2016). *Understanding & Improving Mental-Imagery Based Brain-Computer Interface (Mi-Bci) User-Training: towards A New Generation Of Reliable, Efficient & Accessible Brain-Computer Interfaces* (Doctoral dissertation, Université de Bordeaux).