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IMPACT OF COGNITIVE AND PERSONALITY PROFILES ON MENTAL-IMAGERY BASED BRAIN-COMPUTER INTERFACES CONTROLLING PERFORMANCE

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INTRODUCTION

- Mental-Imagery based Brain Computer Interfaces (MI-BCIs) are **very promising to improve living standards** of patients with motor disabilities...



- ...However, they remain **barely used** outside laboratories [1].

WHY?

- Controlling a MI-BCI-based system requires the acquisition of specific skills: generate stable and distinct brain activity patterns when performing the mental tasks.
- Some people seem unable to acquire these skills using standard training protocols** [2].

LONG TERM OBJECTIVE

- Propose MI-BCI training **protocols adapted to users' profiles** in order to increase MI-BCI reliability.

RESULTS & DISCUSSION

- This model, generated by a Stepwise Linear Regression, allows to predict MI-BCI users' performance (i.e. the rate of good classification of the MI tasks) with **80.9% accuracy**:

$$\text{PREDICTED_PERFORMANCE} = \alpha_0 - \alpha_1 * \text{TENSION} + \alpha_2 * \text{IMAGINATION} + \alpha_3 * \text{ACTIVE_LEARNER} + \alpha_4 * \text{AUTONOMY}$$

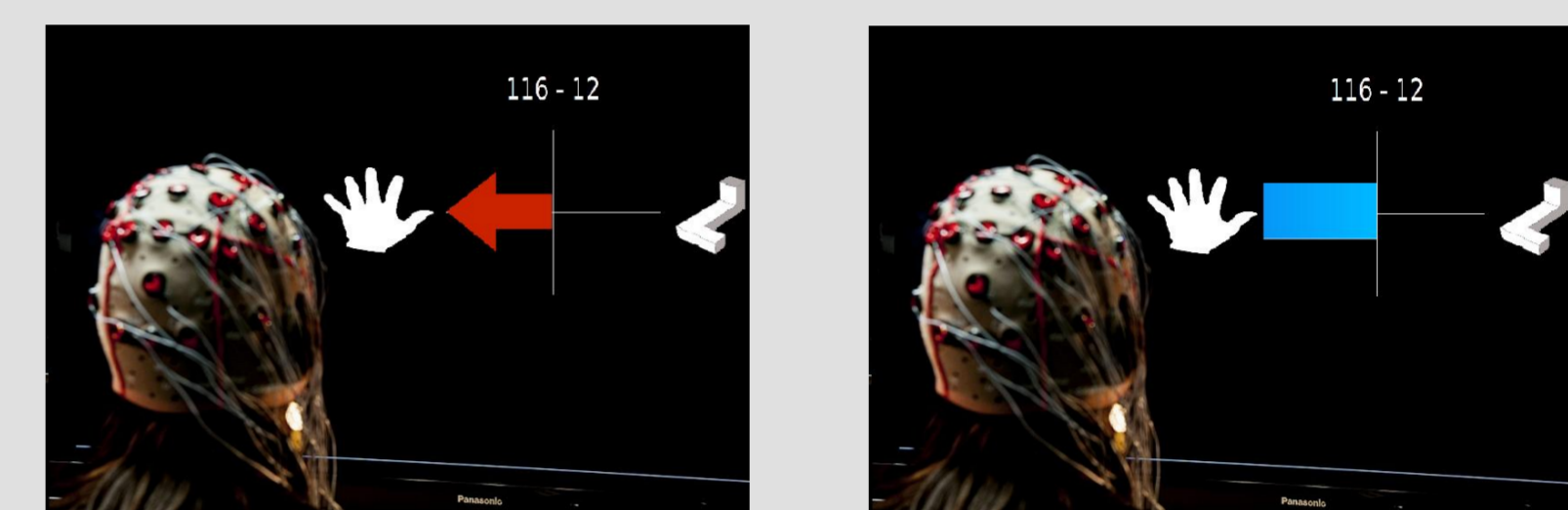
- With:
 - Tension, Imagination & Autonomy*: 3 dimensions assessed by the 16 PF-5 test [4].
 - Active Learner* (by opposition to Reflective Learner): one dimension measured by the Learning Style Inventory test [5].
- These results are very interesting because the 4 dimensions are:
 - independent** from the performed **mental tasks**.
 - consistent** with psychology and instructional design **literature**.

CONTRIBUTION

- Proposing a model allowing to **PREDICT MI-BCI USERS' PERFORMANCE** according to their personality and cognitive profile.

METHODS

- 18 participants (9 women, aged 21.5 ± 1.2)
- 6 two-hour long sessions per participant
- PART 1 - Learn to perform 3 Mental-Imagery (MI) tasks** [3]
 - Left hand motor imagery
 - Mental subtraction
 - Mental rotation



- PART 2 - Complete questionnaires assessing:**
 - Personality*: locus of control, anxiety, autonomy, imagination, self-confidence, sensibility, etc.
 - Cognitive profile*: learning style, working memory, visual retention, etc.
 - The ability to perform the MI tasks*: motricity, arithmetic and mental rotation tests.

CONCLUSION

- This model predicts MI-BCI performance with 80.9% accuracy and informs about cognitive and personality aspects that influence this performance.

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FUTURE WORK

- Designing new MI-BCI training approaches adapted to the users' profiles.
- Include these protocols in an **Intelligent Tutorial System** which also allows to adapt the protocol during the training according to users' state, and make this training more pleasant and efficient.

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To know more about our work: <https://team.inria.fr/potioc/>