# Impact of Cognitive And Personality Profiles On Motor-Imagery Based Brain-Computer Interface-Controlling Performance

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# Impact Of Cognitive And Personality Profiles On Mental-Imagery Based Brain-Computer Interfaces Controlling Performance

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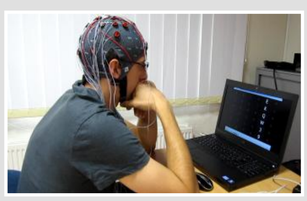
## Introduction

- 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

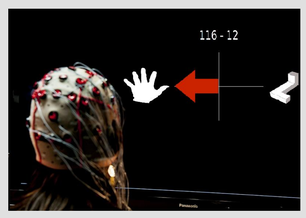
- Propose MI-BCI training protocols adapted to users' profiles in order to increase MI-BCI reliability.

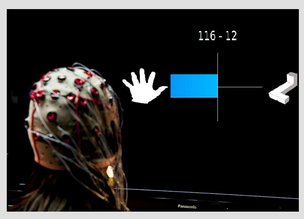
## Contribution

- 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.

## 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.

| R | $R^2$ | $R^2$ adjusted | Standard Error |
|---|---|---|---|
| 0.925 | 0.857 | **0.809** | 1.919 |

| | Non Stand. coefficients | | Stand. Coefficients | t | Sign. |
|---|---|---|---|---|---|
| | A | Standard Error | β | | |
| (Constant) | $\alpha_0$ = 46.783 | 2.472 | | 18.928 | .000 |
| Tension | $\alpha_1$ = -1.320 | .227 | -.733 | -5.816 | .000 |
| Imagination | $\alpha_2$ = .863 | .227 | .458 | 3.806 | .003 |
| Active learner | $\alpha_3$ = .723 | .175 | .527 | 4.172 | .001 |
| Autonomy | $\alpha_4$ = .853 | .340 | .330 | 2.250 | .027 |

## Conclusion

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

## 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/

## References

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