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

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Background

People suffering from severe motor disabilities are victims of social isolation and they lack autonomy. Thus, developing tools such as Brain-Computer Interfaces (BCIs) appears very promising for improving their living standards.
BCIs are control and communication tools allowing users to interact with their environment, using only their brain-activity (Wolpaw 2002). More particularly, Mental-Imagery-based- BCIs (MI-BCI) allow users to control a device (i.e. a wheelchair) by doing different mental tasks, which are then translated into commands. MI-BCIs, although very promising, remain barely used outside laboratories because they are not reliable enough. Indeed, around 20% of people cannot control a MI-BCI at all (so-called "BCI-illiteracy"), while most of the remaining 80% achieve relatively modest performances (Allison & Neuper 2010).
Two main reasons for this have been identified. The first one, extensively investigated, concerns brain signal processing, with current classification algorithms being still imperfect (Alison & Neuper 2010); while the second one, much less investigated, concerns both the mental tasks used and the user's characteristics (cognitive and personality profiles).
In this context, the aims of our study are 1) to determine if some mental tasks are more efficient than others to optimise performance and 2) to determine a relationship between users' cognitive and personality profiles and their ability to perform different mental tasks.

Method

18 participants (9 males and 9 females, aged 21.5±1.2) have been trained to perform three mental tasks, using an existing MI-BCI training protocol including 3 mental tasks (Friedrich et al. 2013): "imagination of a left-hand movement", "mental-subtraction" and "mental-rotation". Participants were also asked to complete psycho-technical tests to determine their cognitive and personality profiles.

Results & Discussion

Preliminary results suggest that some mental tasks are better performed by the participants, and that these performances seem to be related to some aspects of the participants' cognitive and personality profiles such as locus of control, learning style or anxiety.
These results suggest that performance at MI-BCI control does not only depend on classification algorithms efficiency, but also on the user's cognitive and personality profiles.

Conclusion

In line with our preliminary results, we will develop training protocols that will be adapted to different cognitive and personality profiles to optimise users' performance at MI-BCI control. Another promising approach we are interested in is to make these training protocols adaptable in real-time to the cognitive, motivational and emotional states of the user in order to make BCI training faster, easier and more pleasant.

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