A large-scale study on the general public to assess and model the acceptability of BCIs dedicated to motor rehabilitation after stroke

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Introduction. While several meta-analyses have demonstrated the relevance of BCIs for improving motor recovery after stroke [1], these technologies are still barely used in clinical practice. We hypothesise that optimising the acceptability of BCIs could be used as a lever to increase the efficacy of BCI-based motor rehabilitation procedures, and thereby their clinical use. Indeed, a better acceptability will enable a reduction of anxiety levels and an enhancement of motivation and engagement in the procedure [2]. Both will in turn allow for more cognitive resources to be allocated to the task, thus favouring learning and, ultimately, motor recovery. To the best of our knowledge, so far only one study [3] has assessed the relevance of a BCI-based stroke rehabilitation procedure using acceptability measures among their primary criteria of efficacy. Most often, acceptability is only considered as an attribute of user satisfaction, itself being a dimension of user experience [4,5]. Yet, given its potential impact on BCI use, it seems important to study acceptability as an integral component. Thus, our objective is to rely on validated models depicted in other literature in order to design a first thorough model of acceptability specifically dedicated to BCI-based procedures for motor rehabilitation after stroke.

Material, Methods and Results: We designed a model of BCI acceptability (Fig.1A) based on the technology acceptance model 3 (TAM3) [6] and on the unified theory of acceptance and use of technology 2 (UTAUT2) [7] that assess acceptability in terms of perceived usefulness (PU), perceived ease of use (PEOU) and behavioural intention (BI). Then, we created a questionnaire based on our model in order to estimate its validity and to quantify the influence that each factor had on BCI acceptability. We collected a data sample of 753 respondents representative of the general public in France. We targeted the general public for two main reasons. (i) Due to the high prevalence of stroke, many of us are concerned, more or less directly, by stroke. (ii) Patients' acceptability is likely to be influenced by the opinions and attitudes of their close relatives (who are part of the general public) [8]. **Descriptive analyses:** Our results suggest that BCIs are associated with high levels of acceptability: PU (8.28/10 ±1.57), PEOU (7.17/10 ±1.57), BI (8.23/10 ±1.69). **Validity analyses:** Cronbach's α coefficient analyses revealed a satisfactory internal consistency of our questionnaire, i.e., the items used to measure each factor are mostly consistent and not too redundant (12/17 factors in [0.72;0.95], 4/17 in [0.50;0.62] and 1 = 0.97). Furthermore, a confirmatory factor analysis showed that the structure of the model is adequate. **Quantification analyses:** Regression analyses based on random forest algorithm revealed that BI is mainly driven by the PU of the system and by the perceived *benefits on risk ratio* associated with the technology. PU itself is mainly determined by the *scientific relevance* of BCIs and by PEOU. The main determinants of PEOU are *ease of learning* and *playfulness*. These results are depicted in Fig.1B.

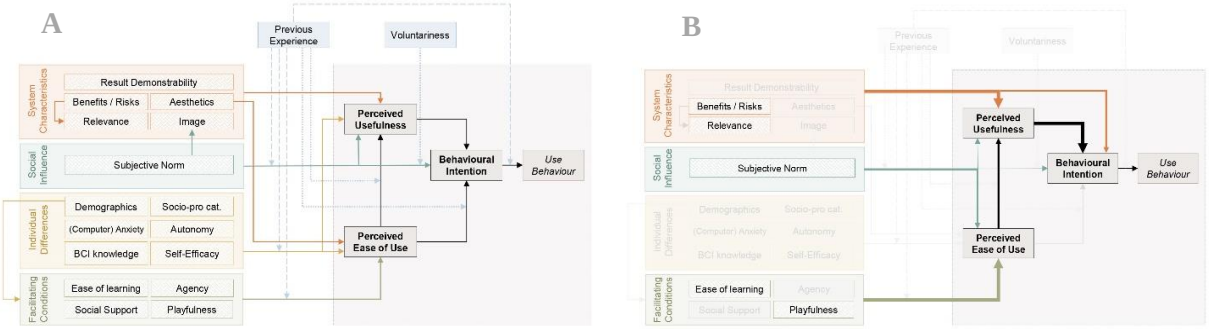

Figure: (A) Initial theoretical model of acceptability for BCIs dedicated to motor rehabilitation after stroke. (B) Final model highlighting the most influential factors based on our results (N=753 respondents from the general public)

Discussion: Our results suggest that beyond the *subjective norm* (i.e., perceived opinions of our close ones), several factors impact significantly BCI acceptability. Given the weight of the *scientific relevance* and *benefits/risk ratio*, it is of utmost importance to clearly inform the population. In addition, the impact of *playfulness* and *ease of learning* should encourage us to adapt the rehabilitation procedures to each patient. In order to refine this model, additional data should be collected, in particular with i) patients and caregivers; ii) persons from different cultures; and iii) in different contexts, i.e. for other use cases.

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