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# Freedom! Making a case for more options for users during training in BCI

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**Introduction:** Mental Task-based Brain Computer Interfaces (MT-BCI) are still highly unreliable [1], in part due to suboptimal user training [2,3]. It has been suggested that one possible improvement could be to include more self-paced sequences into MT-BCI user training protocols [1] i.e., allowing the user to train on their own terms, thus adapting the mental exercise to their own needs and preferences. Like many user-centered approaches, providing choice is not a widespread practice on BCI research [3]. This is sometimes done by letting learners choose to train with some MT out of different motor and cognitive possible task options [4] and has been experimented on to some extent, in a long-time self-paced training of a patient [5]. However, a large body of evidence leans towards its beneficial effects in BCI user training procedures.

**Material and method:** As it is not common practice, experimental evidence is lacking as to how, when or why introducing user choices in BCI training would be effective with experienced or novice users. In the wake of a future experiment, we conducted a literature review to investigate the possible influences of user choice in different research fields - adult education, cognitive science and instructional design. We also classified the possible choices by subcategory: self-paced, self-guided, self-configured.

**Results:** In the reviewed literature, many learning principles rely on offering options to the learner, e.g. flow/zone of proximal development [6], goal-oriented learning [7], deliberate practice [8], self-paced training [9], autonomy [10], inductive reasoning [11], self-directed learning [12]. Accordingly, suitable learning-related user states in BCI, like intrinsic motivation and sense of agency amongst others, could be induced by offering choices to the user throughout the training protocol. An overview of possible user choices and their influence on training is shown in Fig. 1. For example, users could be provided with the possibility to train the mental task they want either at their own pace or during window-of-opportunity self-paced trials [13]. At a larger level, users might be provided with the possibility to co-design an exercise (e.g. the feedback or the skill trained) with the option to skip a task or to redo a task.

**Discussion:** Including more leeway in training protocols might induce suitable learning-related states to ultimately improve performances. Future work will formally test some of the presented aspects.

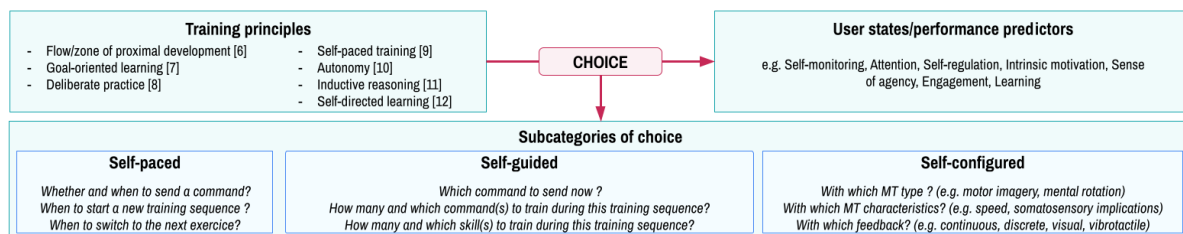


Figure 1: As showcased in the boxes on top, training principles based on learning literature provide a framework in which the user state can be leveraged to improve training outcomes through making choices for themselves. As depicted on the bottom boxes, future research should evaluate the effect of the presence/quantity/frequency of these different subcategories in the outcomes of BCI training programs.

## References:

- [1] Chavarriaga, R., et al. (2017). Heading for new shores! Overcoming pitfalls in BCI design. *Brain-Computer Interfaces*, 4(1–2), 60–73
- [2] Jeunet, C., et al. (2014). How Well Can We Learn With Standard BCI Training Approaches? A Pilot Study. *6th Int. BCI Conf., Sepy*, 1–5
- [3] Roc, A., et al. (2020). A review of user training methods in brain computer interfaces based on mental tasks. *J. of Neural Engineering*, 18(1), 011002
- [4] Millán, J. D. R., et al. (2004). Brain-actuated interaction. *Artificial Intelligence*, 159(1-2), 241-259
- [5] Neuper, C., et al. (2003). Clinical application of an EEG-based brain-computer interface: a case study in a patient with severe motor impairment. *Clin. Neurophysiol.* 114, 399–409
- [6] Mladenović, J., et al. (2017). The impact of flow in an EEG-based brain computer interface. 7th Int. Conf (Graz, Austria)
- [7] Song, H. D., & Grabowski, B. L. (2006). Stimulating intrinsic motivation for problem solving using goal-oriented contexts and peer group composition. *Educational Technology Research and Development*, 54(5), 445-466
- [8] Miller, S. D., et al. (2020). To be or not to be (an expert)? Revisiting the role of deliberate practice in improving performance. *High Ability Studies*, 31(1), 5–15
- [9] Tullis, J. G., & Benjamin, A. S. (2011). On the effectiveness of self-paced learning. *J. of Memory and Lang.*, 64(2), 109–118
- [10] Murayama, K., et al. (2016). Your choice motivates you in the brain: The emergence of autonomy neuroscience. *Advances in Motivation and Achievement*, 19, 95–125
- [11] Klauer, K. J., & Phye, G. D. (2008). Inductive reasoning: A training approach. *Review of Educ. Research*, 78(1), 85–123
- [12] Gureckis, T. M., & Markant, D. B. (2012). Self-Directed Learning: A Cognitive and Computational Perspective. *Perspectives on Psychological Science*, 7(5), 464–481
- [13] Mason, S., et al. (2006). Evaluating the performance of self-paced brain-computer interface technology. *Neil Squire Soc., Vancouver, BC, Canada, Tech.Rep*