

BCI-controlled Brain Painting at home: years of use

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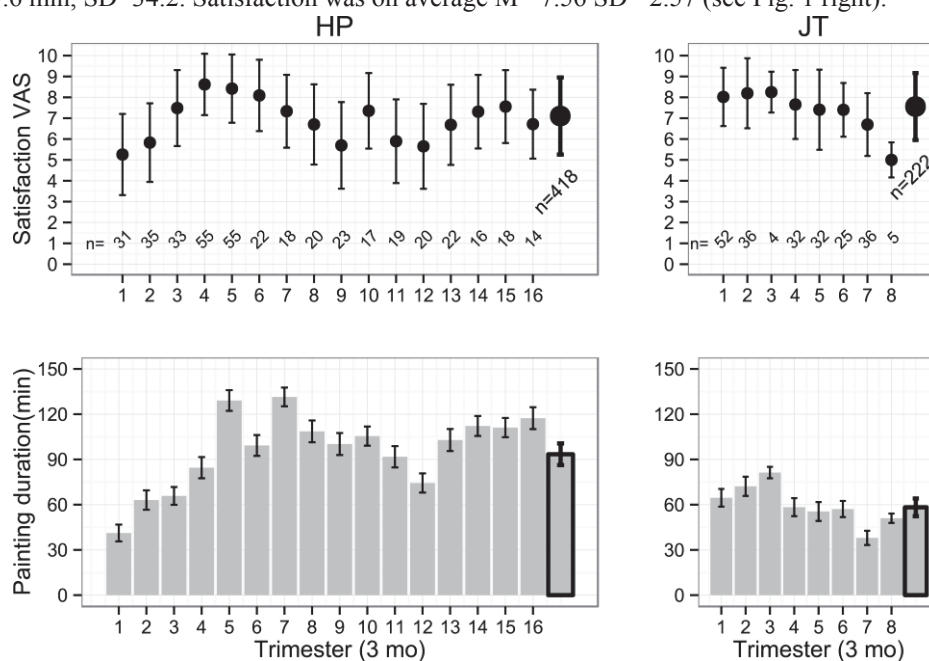
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Introduction: Brain Painting (BP) is a P300-BCI controlled application that allows for creating pictures [1]. BP has been adapted for home use following the user-centred design (UCD) approach [2] and was installed at two patients' home (JT and HP). Both patients were diagnosed with amyotrophic lateral sclerosis (ALS) in the locked-in state. Since January 2012 (HP) and September 2013 both end-users have been painting at home independently of experts being present. Caregivers and family members were trained to set-up the system. After every session end-users are asked to rate their satisfaction, frustration, and joy. Here we report painting duration and satisfaction across the entire time of enrollment.

Material, Methods and Results: End-user HP: female, 76, diagnosed with ALS in 2007, locked-in state, retired teacher, impressionist lay painter, communication with eye movements possible. BP installed at home 26th January 2012; Einstein face stimulation [3] was added October 19, 2012 after 96 sessions. End-user JT: male, 74, diagnosed with ALS in 2006, locked in state, retired architect and professional painter, communication with eye movements possible. BP installed at home 16th September 2013, after 158 BP Version 2 was installed December 10, 2014. At the end of each session satisfaction is rated on a visual analogue scale (range 1-10; 1 = not at all satisfied, 10 = absolutely satisfied). All results are stored on the local PC and automatically transferred to a remote server owned by UNI WUE. LB and EH provide remote supervision and technical support if necessary. Until December 10, 2015 HP has been painting for N=418 sessions with an average duration of 93.7 min SD=51.4. Satisfaction was on average M=7.11, SD=3.42 (see Fig. 1 left). JT has been painting for N=222 with an average duration of 59.6 min, SD=34.2. Satisfaction was on average M= 7.56 SD= 2.57 (see Fig. 1 right).

Figure 1. Satisfaction (top) and painting duration (bottom) for HP (left) and JT (right). Due to the high number of sessions, single sessions were summarized in 3-months periods. Most right data of each plot show the average across the entire painting years.



Discussion: BP has been used for 4 (HP) and 2 (JT) years. Fluctuations in satisfaction did not lead to abandoning of BP. P300-BCI use requires attention and concentration and has been used between 1 and 2 hours, which may be indicative for the maximum duration of BCI use per session.

Significance: BCI-controlled applications can be long-term used at home independent of experts being present. If the application matches end-users needs, they keep using the BCI despite known shortcomings (EEG cap, fluctuations in performance). Simple metrics to monitor satisfaction with the device are tolerated by the end-users and can be applied after each session.

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References

- [1] Münßinger JI, Halder S, Kleih SC, Furdea A, Raco V, Höhle A, Kübler A. Brain Painting: First Evaluation of a New Brain-Computer Interface Application with ALS-Patients and Healthy Volunteers. *Front Neurosci.* 2010 Nov 22;4:182.
- [2] Kübler A, Holz EM, Riccio A, Zickler C, Kaufmann T, Kleih SC, Staiger-Sälzer P, Desideri L, Hoogerwerf EJ, Mattia D. The user-centered design as novel perspective for evaluating the usability of BCI-controlled applications. *PLoS One.* 2014 Dec 3;9(12):e112392
- [3] Kaufmann T, Schulz SM, Köblitz A, Renner G, Wessig C, Kübler A. Face stimuli effectively prevent brain-computer interface inefficiency in patients with neurodegenerative disease. *Clin Neurophysiol.* 2013 May;124(5):893-900