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Brain Painting V2: long-term evaluation by an end-user at home – an update

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Introduction: Brain Painting (BP) is a brain-computer interface (BCI) application that allows for creative expression using P300 event related potentials [1]. BP has been adapted for home use and benefited to two users (JT and HP) with amyotrophic lateral sclerosis (ALS) and was reported to increase their quality of life [2]. The new version BP2, providing features and the possibility to draw lines, was created following a user-centered design (UCD) approach [3]. It was installed at the home of JT and was evaluated across a period of 3.5 months [4]. We present here new evaluation results of JT from another 3 months.

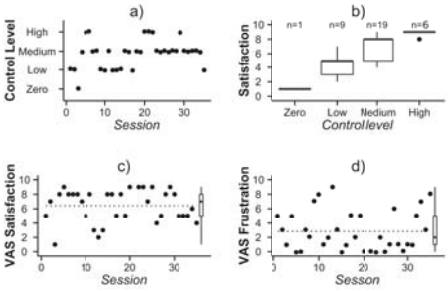

Figure 1. *Control level (a), VAS for Satisfaction (c), VAS for Frustration (d) as a function of sessions. Boxplot (c,d) represent quartiles and dotted line the mean. (b) Boxplots show Satisfaction depending on control level.*

Methods: End-user JT, male, 74, diagnosed with ALS in 2006, in the locked in state, retired architect and professional painter regularly using BP for more than 2 years. EEG was measured with 8 channel and digitized by a g.USBAmp amplifier (g.Tec). BCI was calibrated prior to the evaluated period [4]. All sessions were initiated by caregivers, in complete autonomy. After each session, JT evaluated the session following the UCD framework [3] ("Effectiveness", "Efficiency", NASA TLX, "Satisfaction", QUEST 2.0 for BCI. NASA-TLX and QUEST were answered after the evaluated period.

Results: n=35 sessions occurred within 3 months, painting duration was M=40.8min (SD=21.5), 17 Brain Paintings were produced. "Effectiveness": Level of control (see fig.1.b). "Efficiency": exhaustion was low n=28, medium n=7, high n=0. Workload was 70 (out of 100), with subscales mental demand 25.3, physical demand 18, temporal demand 12, performance 8.3, effort 6 and frustration 0. Selection/min: 2.47. "Satisfaction": (means in fig.1.c-d) no significant variation in satisfaction (M=6.4), enjoyment (M=6.0) and frustration (M=2.8) was found over time. Subjective level of control predicted satisfaction (R^2=.52, F(3,30)= 13,1 p<.001). The QUEST 2.0: high satisfaction M=4.7 (out of 5) and M=5 for BCI related questions.

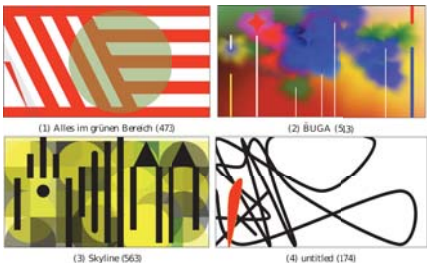

Figure 2. *JT's creations made using BP2, demonstrating the use of lines. Number of selections under parenthesis.*

Discussion: JT painted often and showed good overall satisfaction, although it was inferior to the previous 3.5 months of use [4]. Once again, satisfaction was highly dependent on the BCI performance. The home setup remained functional, until JT complained about blur vision due to cataract. After visual inspection of every painting session, the subjective control level appears negatively biased, as the control is sufficient for JT to paint and cancel wrong selections. Thus, low control may also refer to general dissatisfaction with the painting. Workload did not differ from former use of BP. Still, selections per minute and performance were inferior to what most ALS patients expect from BCI technology [5]. Nevertheless, the high results in the QUEST and the high involvement of JT show that following the UCD leads to applications that match users' needs.

Significance: If a BCI and its application is tailored to individual needs following the UCD, it is used in daily life independent of experts being present and despite shortcomings such as perceived low control. The metric to implement the UCD suggested by [3] can be implemented in a long-term independent home setting.

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