Brainball – using brain activity for cool competition

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1. INTRODUCTION

This paper describes Brainball, a game and a research project on methods of human-machine interaction using brain activity. It also describes the results of an evaluation with users. In Brainball Beta and Alpha waves in the electrical activity of the brain are measured by EEG (Electro-Encephalography) sensors to allow interaction between two people playing the game. The players control a ball on the table through their state of relaxation, the object of the game being to score a goal by moving the ball into the opponent's goalmouth.

Using biosensors for human-machine interaction is an interesting new field for research and development. For medical purposes, EEG machines have been used since the 70s to trace brain activity and deficit brain-function. In clinical psychology, biofeedback using EEG machines has been used to treat neuroses, panic disorders and attention disorders (ADHD and ADD) with good results. Some children with mild attention disorders can attain good results with as few as five to ten sessions (Padgitt 2000-08-15). Research has also been carried out using EEG as input device for computers (Picard 1997) and for physically disabled people (Lusted & Knapp 1996). Leapfrog Technology uses a combination of EEG and EMG, tiny muscular movements on the forehead, to control a mouse cursor on the screen.

1.1 Research question

Our main interest relates to how Brainball is perceived and if it can be used as a tool for relaxation. Since one compete in relaxation, Brainball questions normal game design and relaxation techniques. How does this effect the results?

- Does Brainball decrease stress?
- Can Brainball be used as a method for biofeedback when learning to control stress?

1.2 Biosensors and EEG

Biosensors are sensors that measure biological signals such as ECG, EEG, pulse, conductivity etc. Biofeedback is the concept of measuring a signal and presenting it to the individual for example through sound. We may then be able to for example lower the pulse intentionally (Davis 1995). In our project we have limited the game idea to EEG sensors only. The signals are measured through electrodes positioned on the skin of the head and are typically in the range of microvolts. Different waves are categorised by the frequency of their emanation and can be seen to correspond to certain types of brain activity. The Beta waves lie typically in the range of 14-30 Hz and are associated with an alert state of mind. They can reach frequencies of up to 50 Hz during stress or intense mental activity. Alpha waves, in the frequency between 8 and 13 Hz are usually quite strong in a relaxed state, they diminish in amplitude when a person is stimulated by light or attempts mental efforts.

1.3 Set-up

Three electrodes are mounted right on the forehead with a headband. The EEG signals are picked up by the ProComp box, a multimodal 8-channel device for monitoring EEG, EMG, temperature, pulse and skin-conductance. ProComp interprets the data and sends it to a standard Pentium PC where a program called Biograph computes a ratio between the Beta and Alpha waves. Biograph transmits midi-messages, and is set to send one channel for each player. Using Java we interpret the midi-messages as two opposed forces and send it to the game table by serial communication. A steel ball is controlled via magnetic force , by a magnet mounted to the arm of the X/Y-table. The EEG-signals and the Beta/Alpha ratio are also projected onto a screen, to provide the players with feedback on their state of relaxation.

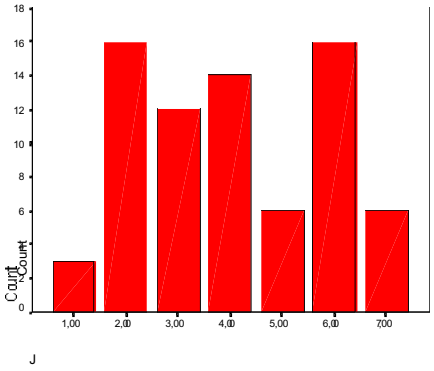
2. EVALUATION WITH USERS

The aim of the test was to study the use of Brainball, subjective and objective time during games (will not be presented here), stress levels and how the subjects perceived the game. During the test, stress was measured by using a GSR (Galvanic Skin Response) sensor.

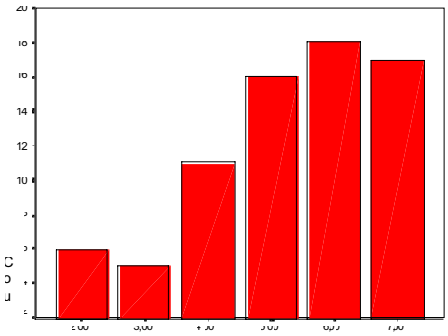
The test was divided into two parts: 1) Competition: Three games are played where the goal is to be the most relaxed and score on the opponent's side. 2) Co-operation: One game is played where the players have to co-operate in moving the ball from one side of the table to the other by alternating stress and relaxation, and finally placing it in the middle. Finally a form is filled in answering questions about gender, age, perceived time of the game and attitudes to the game. The questions were assessed on a Lickert scale between 1-7.

1.4 Results

Playing Brainball did make users more relaxed. Both the GSR values and the evaluations showed great significance in the result.



Before the test: Stressed/Relaxed



After the test: Stressed/Relaxed

General attitudes towards BB were very positive, BB was considered very interesting, and very exciting and over 90% of the subjects wanted to try BB again. This has a bias to gender. Women were significantly more enthusiastic about BB than men. Women also state that they are more stressed then the men but the GSR result and the competition result show no differences between the sexes. The GSR shows that stress levels were lower during competition than during co-operation. Co-operation was also considered slightly easier and more fun than competition, and this has a slight bias to gender. Women did in fact find competition more fun and men liked co-operation better. The results suggest that the male preference for competition is neither biological nor normative. *How* you compete and in *what* plays a significant role. If the quantitative results questioned traditional gender thinking, then the qualitative results supported them. Here females are happy, uncritical, self-blaming and talkative, while males are creative, sceptic and scientific. This is also interesting and might support the concept of gender as something cultural, transmitted and cultivated within a social group.

3. DISCUSSION

Brainball measures brain activity and puts the player in a position where he/she has to compete in relaxation. This is a contradiction in terms and thought provoking. Can we compete and relax at the same time? According to the user test the answer to this question is yes.

The main issue Brainball raises is connected to stress and relief. Stress is becoming a widespread problem, a "mal de temps", a typical disorder of the late twentieth century. Burnout was adopted as a clinical description in 1998 in Sweden, since then the number of people suffering from this syndrome has increased dramatically. This is a probable cause for the interest in Brainball and suggests a course for further development. User tests show that subjects relate to Brainball as an interesting way of practising control over brain activity and of learning how to relax. The tests also show that motivation to keep on playing Brainball is very high. This attempt to combine relaxation with a game is an interesting aspect for future development. The high level of interest shown in Brainball by users and the media suggests that it may have widespread future possibilities in various applications related to stress and relaxation.

4. REFERENCES

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