Bridging the gap between BCI technology design and severely disabled end-users: experience from a photo browser validation


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Aim

Photo browser software controlled by an ERP-based (Event-Related Potential) Brain Computer Interface (BCI) was tested with a severely disabled end-user. The photo browser allowed the end-user to share photos with one friend and two family members. The results show the end-user’s high satisfaction with the application, and an increasing level of self-assurance in its use is indicated by a decrease in the level of reported “incompetence fear” and “effort”.

The BCI-controlled photo browser described here is a social application developed for severely disabled end-users. It aims to consider their specific needs and focus attention on the social environment as an important factor toward achieving a better quality of life. The evaluation of the application considers the end-user characteristics and their psychological/cognitive factors associated with the system. One severely disabled end-user (FA), her friend (C), brother (F) and niece (A) were involved in the study. Each participant was provided with a tablet PC to serve as a digital photo frame. A collection of shared folders using the Dropbox file synchronization service (www.dropbox.com) allowed F, C and A to share photos with FA individually. While FA was able to share photos to all three people. Images shared with FA could either be viewed on her photo frame or when she was using the photo browser. FA controlled the photo browser by means of a BCI exploiting visual ERPs elicited by an oddball paradigm.

Concept

- 47-year old woman
- brainstem ischemic stroke
- tetraplegia with severe dysarthria
- Communication of primary needs only possible with the support of her caregivers

Before the event FA was a very active and social person, working in the graphic art field and playing drums in a band.

Methods

- Visual analogue scale (VAS) scored from 0 (not motivated) to 10 (very motivated).
- Questionnaire for Current Motivation in BCI (QCM BCI) - mastery confidence, incompetence fear, interest, challenge.

Focus group

- The study was a positive experience for everybody
- The system was simple and intuitive both for the end-users both for the friends
- All the participants desire to continue the study

Conclusions of focus group

- The photo-browser application allowed FA to communicate with friends through photos.
- The slide-show in the photo-frame was a good company for FA during boring moments
- FA rediscovered the pleasure to do some activities that she didn’t do anymore

Activity, participation and environmental factors

Free phase: FA showed a big enthusiasm in using the device. She enjoyed interaction: she often laughed viewing some shared photos and greatly appreciated the pictures. During a post study questionnaire the end-user declared that: It was very nice for her to use the photo browser; she enjoyed a lot having the photo frame at home, sharing pictures with friends and relatives increased her contacts with them; she would like to continue to use the P500 photo browser at home in order to send pictures and communicate her mood whenever she wants. She would like to continue to use the photo-frame at home because it is very simple to use and it is a “window on the world”.

Friends and relatives were enthusiastic about the system and frequently shared photos throughout the study. Shared photos were about everyday situations, people, old familiar photos (the end-user and brothers when they were young), animals, drawings, existing photos imported, photos of written messages.

Conclusion

The results demonstrated that FA’s level of satisfaction with the BCI photo browser system was high, that she was highly engaged with the application and that her motivation increased over time. This could be due to the fact that FA gradually gained confidence with the system while simultaneously developing a greater understanding of its social significance. Also, this confidence may have led to lower perception of “effort” as evidenced by FA’s gradually decreasing levels of self-reported “incompetence fear” and “effort”. “Mental demand” was significantly negatively correlated to FA’s mood, as though mood influences the perception of mental resources to be invested in the task.

In conclusion, FA as well as her friend and family members were and are very enthusiastic about the photo browser application as it has allowed FA to interact with her previously inaccessible social environment.

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References
