BCI APPLICATIONS: DEFINING USER NEEDS AND REQUIREMENTS

C Zickler[1], V Di Donna[2], V Kaiser[3], A Al-Khodairy[4], SC Kleih[1], A Kübler[51], D Mattia[2], S Mongardi[6], C Neuper[3], M Rohm[7], R Rupp[7], P Staiger-Sälzer[8], EJ Hoogerwerf[6]

[1] University of Tübingen, Germany; [2] NEILab, FSL, Rome, Italy; [3] Graz University of Technology, Austria; [4] Clinique romande de réadaptation, SuvaCare, Switzerland; [5] University of Würzburg, Germany; [6] AIAS Bologna onlus/Ausilioteca, Italy; [7] Orthopaedic University Hospital Heidelberg, Germany; [8] Consultation Center AAC, Bad Kreuznach, Germany

Introduction

The EU-project "Tools for Brain-Computer Interaction" (TOBI) aims at developing practical technology for brain-computer interaction, i.e., non-invasive brain-computer interfaces combined with other assistive technologies (AT) that will improve the quality of life of disabled people. Brain-computer interfaces (BCI) circumvent the human motor system and allow the user communication, environmental control, and the control of neuroprosthesis. An important concern of the project is the integration of people with disabilities from the very beginning.

Aim of the Study

To define

1. the needs (a person's wants and necessities with respect to different aspects of independence)
2. the requirements (instrumental needs demanding specific functions/characteristics from the product or solution)

of potential users with regard to assistive applications based on BCI.

Material

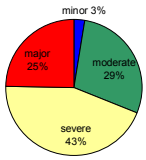
The TOBI members developed a questionnaire to assess the

1. overall satisfaction with current AT solutions (1=not at all satisfied, 10=absolutely satisfied).
2. satisfaction with current solutions with regard to aids for manipulation, communication, computer access, environmental control (1=not at all satisfied, 4=very satisfied,).
3. three most important areas where participants wanted to improve their independence.
4. possibility of independent access to devices for communication and entertainment and if AT is used for this purpose as well as the desire to gain independent access and to use AT.
5. importance of various aspects of AT (1=not at all important, 4= very important).

Participants

Participants (N=77, 23 female; mean age 43.3 ± 13.6, range 19-71 years) were from Austria (12%), Italy (41%), and Germany (47%) and diagnosed with neurological/neuromuscular diseases (47%), spinal cord injury (37%), or cerebrovascular disorders (16%). Diagnoses dated back on average 16 years (SD±14.9, range 1-53).

Categories of Impairment



Minor	slightly impaired limbs
Moderate	severely impaired lower limbs *or* no verbal language
Severe	almost tetraplegic, able to use verbal language and able to handle special input device
Major	tetraplegic with nearly no control of muscles but able to use verbal language (device input channel) *or* almost tetraplegic, able to handle special input device (input channel), no verbal language

User Requirements

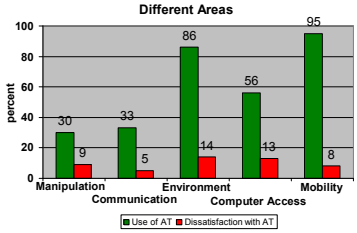
Aspects of AT	M	SD
Functionality	3.74	±0.44
Possibility of independent use	3.67	±0.58
Easiness of use	3.60	±0.59
Aesthetic design	2.09	±0.96

Considering the adoption of a new AT solution, participants rated "functionality" as the most important aspect followed by "possibility of independent use" and "easiness of use". "Aesthetic design" was rated as the least important aspect.

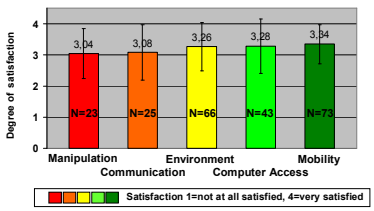
User Satisfaction

Between 30% (manipulation) and 95% (mobility) of the participants used AT in the different areas of independence. Overall satisfaction (M=7.1, SD±1.9) and satisfaction in the different areas of independence was rather high. However, 16% (communication) to 30% (manipulation) were dissatisfied with their current solutions. Lowest dissatisfaction ratings were found in the area of mobility (8%). Main reasons for dissatisfaction were "functionality" (N=12) and "easiness of use" (N=8).

Use of AT and Dissatisfaction with Current AT Solutions in Different Areas



Satisfaction with Current AT Solutions in Different Areas



User Needs

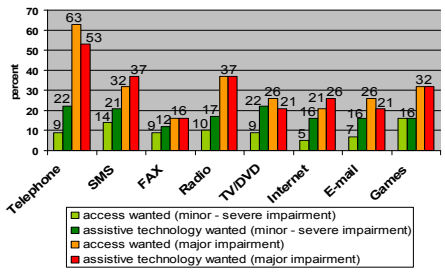
Devices for Communication and Entertainment

The majority of the participants had independent access to different devices for communication and entertainment. However, depending on the device 10%-22% would have liked to have access to different devices for communication and entertainment and even more (13%-30%) would have liked to use AT for this purpose.

Participants with Major Impairment

Participants with major impairment (n=19) were in a worse situation. Depending on the device 16%-63% of these participants had no independent access and wished to use AT to get access to the different devices for communication and entertainment. For the less impaired participants (n=58) only 5%-16% did not have and would have liked to have access.

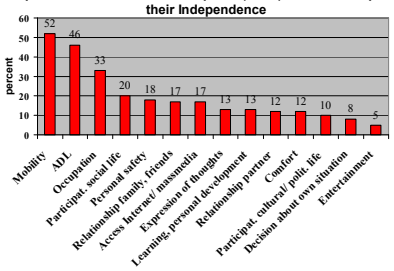
Desire for Independent Access to Devices for Communication and Entertainment. Less Impaired and Major Impaired Participants



Desire for Improved Independence

"Mobility" (52%) was the aspect of life in which the majority of the participants wanted to improve their independence followed by "activities of daily living (ADL)" (46%) and "occupation/employment" (33%). Participants who used communication aids had needs, which where in parts different from those of the rest of the participants (see table).

Aspects of Life in which Participants (N=77) Wanted to Improve their Independence



Aspects of Life in which Participants with and without Communication Aids Wanted to Improve their Independence

Improvement wanted in the area of	Participants without communication aids (n=52)	Participants using communication aids (n=25)
Mobility	56%	44%
ADL	48%	40%
Relationship to family	10%	32%*
Decision about own situation	2%	20%*
Expression of thoughts	8%	24%[a]

* significant $p=.05$; [a] trend $p=.07$

Discussion and Conclusion

The herein investigated group of AT-users was very heterogeneous in age and diagnosis and showed a high degree of impairment, that is participants represented potential BCI-users.

Between 30% to 95% of the participants used AT in the different areas, that means participants had a high degree of experience with AT. Sixteen percent to 30% were not satisfied with their current AT solutions in the areas of manipulation, environmental control, communication, and computer access, i.e., there is a need for better or/and alternative AT solutions in the areas where BCI can contribute. Main reason for dissatisfaction was functionality.

With regard to the adoption of a new AT participants rated functionality, easiness of use and possibility of independent use as most important.

The main conclusions for TOBI are: (1) To develop simple (easiness of use) and effective (functional/ robust) BCI applications. (2) If communication aids are needed, to provide devices which enable people to communicate their thoughts and wishes and support their interaction with significant others. (3) To provide AT solutions with which users are as independent as possible from the support of others.

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