Effects of Acquired Brain Injury and the use of external aids

Summary of research studies

OVERVIEW

Acquired Brain Injury (ABI) causes a wide range of cognitive and physical impairments, which can affect the person's ability to perform everyday tasks, and reduce their independence. The use of external aids (both paper-based and technological tools) can improve everyday functioning and facilitate the rehabilitation process, however research shows the existence of several barriers that can prevent their uptake and efficient use.

A set of requirements capturing studies were conducted to identify the situations where there is a need for technological aids and what would their intended purpose be, and to further examine the common cognitive effects of ABI and how how these affect the usability of existing external aids. These studies include an **online survey for people with ABI** (n=99), gathering general information about the experience of brain injury and the use of technological aids, and a **group interview with neuropsychologists** to acquire additional details about the effects of ABI, current neuropsychological rehabilitation methods, and to gather expert feedback on the design of assistive technologies.

Study 1 (Online Survey)

99 brain injury survivors from different English speaking countries participated in the survey. The questionnaire consisted of six sections covering the following topics: 1) demographic information; 2) Memory performance; 3) Executive function; 4) Motivation and activeness; 5) Rehabilitation, and 6) Use of external aids (paper-based tools, electronic devices with a screen, and Voice Assistants). 5-point Likert scales were used to indicate the frequency of everyday issues resulting from the effects of brain injury, the frequency of use of the different types of external aids and the participants' subjective evaluation of their effectiveness. Non-parametric statistical tests were used to investigate the correlation between answers to different questions of the survey, and to examine the difference between subgroups within the sample.

Issues related to poor prospective memory, and problems with organisation, scheduling and decision making were the most common among participants. High frequency of occurrence of such issues was associated with how mentally demanding participants found external aids. More information is needed, however, to determine specifically how cognitive impairments can impact usability. Although the majority of participants reported using at least one type of aid frequently, many reported having to rely on other people to carry out everyday tasks, indicating room for improved design of external aids. Nevertheless, the large number of participants reporting being satisfied from external aids and regular use of technology showed a positive predisposition towards assistive technologies and confirms their beneficial impact. The use of Voice Assistants was not common among participants of the survey compared to the other two types of cognitive aids.

- ## Study 2 (Group Interview with neuropsychologists)

The participants were 7 neuropsychologists who had been working for at least 6 years at a rehabilitation centre for brain injury survivors. The interview was conducted in a semi-structured way, with questions evolving around the effects of ABI, methods of neuropsychological rehabilitation, and the design of assistive technologies. Inductive thematic analysis was used to analyse the recorded data, producing the following themes: 1) The need for prompting; 2) Family involvement; 3) Social participation, and 4) Personalisation and adaptivity.

Through the analysis of the results from the above studies, a set of use cases and a set of design characteristics for Assistive Technologies for people with Acquired Brain Injury,were created:

Use Cases of Assistive Technologies for People with ABI

1. Support impaired cognitive functions such as memory, organisation, initiation and motivation through timely cues to prompt action.

2. Increase awareness of inappropriate behaviour through regular prompting.

3. Facilitate communication between family members/carers and people with ABI to improve support and reduce conflicts.

4. Facilitate collaboration between family members/carers and therapists to improve mon- itoring, assessment and support.

5. Support engagement to the rehabilitation process by increasing motivation through goal completion.

6. Increase activeness and participation in social activities.

7. Facilitate task completion through suitable guidance, and by supporting concentration and attention.

Design Characteristics of Assistive Technologies for People with ABI

- **Personalisable**: Offer customisation to support users with different levels of impairment, cognitive capabilities and rehabilitation goals.

- **Adaptive**: Automatically adjust the content of prompting based on the context and the user's behaviour.

- **Trustworthy**: Provide support in a friendly and intimate manner that appeals to the individual and inspires trust.

- **Discrete**: Provide efficient prompting in a discrete manner that avoids unwanted attention and social embarrassment.

- **Rewarding**: Provide a goal-oriented sense of achievement and positive reinforcement to increase motivation.

- **Simple**: Use concise and straightforward interaction to support users with lim- ited cognitive capacity.

- **Autonomous**: Provide timely support without relying on the user's input and initiative.

The above results can be used by designers aiming to create assistive technologies for the rehabilitation of people with cognitive impairments due to ABI, or by rehabilitation professionals/clinicians who are looking for ways to integrate technology into their practice.