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# **RESPONSE ACTIONS TO DIFFICULTIES IN USING EVERYDAY TECHNOLOGY AFTER ACQUIRED BRAIN INJURY**

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## **ABSTRACT**

*Purpose:* People with acquired brain injury (ABI) have difficulties using everyday technology (ET) in daily tasks at home and in the society. To support them managing the demands imposed by using ET, knowledge is needed about their response actions to the difficulties that occur during task performance, their conditions and efficiency. The aim of this study was to explore and describe what characterizes response actions to difficulties using ET, their conditions and how they influence the experiences of tasks in daily life among people with ABI.

*Methods:* Interviews and observations were undertaken with thirteen men and women with an ABI. Data were analyzed qualitatively using the constant comparative method.

*Results:* The participants' response actions were categorized as (i) deliberately and organized planning, (ii) random and inflexible repeating (iii), re-evaluating tasks, (iv) explaining difficulties related to others, and (iv) proving and protecting capability. Certain conditions were decisive for the different response actions to be applied and also for their effectiveness in enabling engagement in tasks in daily life. Each participant used several type of response actions and the same action could be applied in several situations.

*Conclusion:* To support people with an ABI to manage the demands imposed by using ET, it is important to identify the uniqueness of each client and his or her response actions to difficulties using ET and thereafter adjust the interventions accordingly.

## **KEY WORDS**

activities of daily living; assistive technology; brain injury; occupational therapy; rehabilitation; adaptation, psychological

## **INTRODUCTION**

Everyday technology (ET) comprises a variety of technical, electronic and mechanical products and services, ranging from well-known devices to more recently developed ones (1). Using ET is a necessity for most individuals' tasks in their home and in today's society (2). ET is also considered to have the potential to facilitate daily life for people with disabilities, such as acquired brain injury (ABI) (2-4). However, a recent study (5) found that a majority of individuals with ABI had difficulties using various ET, such as automated telephone services, computer programmes, alarms and cash dispenser. Thus, using ET can be both a demanding and a complicating environmental aspect during the performance of tasks in daily life for people with a cognitive disability. Various difficulties, combined in different ways and in different situations, have been identified among individuals with ABI (6). Difficulties finding technological functions, following required sequences, managing codes, starting and finishing a device at an appropriate point of time, were commonly described, and these difficulties negatively influenced the individuals' task performance, personal identification and participation in society.

As the difficulties using ET varies, e.g., sometimes people with ABI can continue to perform tasks independently but at other times have to stop (6), the response actions they use to compensate to overcome these difficulties are important to consider. According to Wilson (7) and others (8, 9), compensatory response actions can take place when there is a decrease in a given skill resulting in a mismatch between the individual's accessible skills and environmental demands. In addition, an individual needs to be aware of this mismatch and, also, chose appropriate response actions. Even if a mismatch exists, a high degree of environmental support can prevent the response actions of the individual with ABI from being initiated. This implies that several requirements need to be fulfilled before a response action can be initiated and considered as compensatory.

The compensatory response actions aimed at counterbalancing the mismatch between a persons' skills and the demand of the environment can be categorised into three groups (8, 9): (i) increase the time and effort used to complete tasks, (ii) use a substitute skill or use an alternative mean, such as an external memory aid, and (iii) adjust expectations and choose new tasks. These three groups can be used by anyone experiencing a mismatch, but compensatory response actions used by people with cognitive impairments are mostly the same as those used by non-disabled people. Yet, people with cognitive impairments use them more frequently and the outcome is crucial for their independence (7-9). This also implies that

many compensatory response actions can be self-generated, even if they are commonly developed during brain injury rehabilitation (10).

Cognitive impairments, such as impaired memory, awareness and executive functioning (11-14), together with limited process skills (15) are of great importance for the performance of tasks in daily life after ABI. They influence the need to develop compensatory responses actions (7, 16-18) and, also, the ability to initiate and develop them effectively. Compensatory response actions of individuals with ABI are heterogeneous, primary due to the cognitive functions being affected and the severity of the impairments (7, 9). For example, those with mild or severe impairments are less likely to compensate than those with moderate impairments, but people with pronounced amnesia but no other cognitive impairments are more likely to compensate than those with less pronounced amnesia and additional cognitive impairments (9). Awareness of deficits (16, 19, 20) and perceived self-efficacy (21) are also important for peoples' compensatory response actions. In addition, age, length of time post-injury and rehabilitation are likely to influence whether the compensatory response actions are successful or not (7, 9).

In brain injury rehabilitation, the term compensatory strategies are used to describe the compensatory response actions that clients develop to achieve matches between their skill and the environmental demands. Compensatory strategies are adopted when remediation or recovery of impaired functions are not possible (7) and they are selected by professionals depending on the clients' needs, impairments and residual skills. Several reviews (14, 22-24) have shown that compensatory strategies applied in brain injury rehabilitation, such as repetition, verbalising, visualising, using notebooks and assistive technology (AT), can improve targeted cognitive functions. As most studies have been carried out in contrived situations, clients' use of response actions in real-life situations is not known in detail. Studies of daily activities after ABI (25-28) have focused on the response actions that are used on a more general level, e.g., adopting new ways of thinking, doing tasks differently or using the environment rather than specific situational actions. Very little is, however, known about actions undertaken in response to the difficulties using ET, and which actions that support continued performance. Knowledge is also lacking about the conditions and processes influencing the use of response actions as well as the consequences of the actions in terms of their efficacy in enabling task performance.

Rehabilitation following ABI have gradually come to use approaches that allow the intervention to be target to an individual's needs and goals during tasks in daily life (29-31), instead of specific isolated skills or functions (32, 33). In line with the International

Classification of Functioning, Disability and Health (ICF) (34), these approaches emphasize the interaction between the individual and the environment. To support individuals with ABI to manage environmental demands, knowledge about their response actions to difficulties in tasks in daily life is essential. Moreover, rehabilitation programmes that build on the response actions that the clients themselves have found useful are more likely to succeed. Therefore, an increased knowledge in this area may also lead to more targeted interventions.

The aim of this study was to explore and describe what characterizes response actions to difficulties using ET, their conditions and how they influence the experiences of tasks in daily life among people with ABI.

## **METHODS**

### **Study design and participants**

The study had a qualitative design (35) and the participants were selected from a cohort of 36 people with ABI, who had attended a rehabilitation medicine department of a university hospital in southern Sweden. In a previous study (5), the perceptions of difficulties using ET had been described for this group, which was used to select participants in the present study.

The inclusion criteria in the previous study (5) were that they: (a) had an ABI caused by a trauma or disease, (b) had received rehabilitation between 1998 and 2004, (c) had been discharged from the brain injury unit at least one year, (d) were between 18 and 60 years of age, and (e) lived in their own home in the community. Participants were excluded if they at discharge from rehabilitation had 15 or lower on Functional Independence Measure (FIM) social/cognitive scale, indicating moderate assistance, need of help 25-49 % of the time, or had a severe motor impairment and/or a severe visual impairment and therefore unable to use ET by themselves. To be eligible, potential participants had to perceive difficulties in many areas of ET use, based on the assessment with the Everyday Technology Use Questionnaire (ETUQ) (36). In the previous study, the ETUQ was used as a standardized interview and not as a instrument to measure a construct (37).

A purposeful sampling strategy (38) was applied to obtain sufficiently rich data with a diversity of response actions. Heterogeneity in ET and related tasks and in the difficulties in their use was sought. In addition, participants of both sexes and different ages were selected. Participants were informed both in written and verbally about the study and informed consent was obtained from each participant. Data collection ended when 13 persons had been included in the study (Table 1), as their data were considered to have enough variety to ensure the quality of the study.

## **Data collection**

A combination of interviews and observations, conducted in the participants homes, was considered to bridge possible threats to the quality of the data (e.g., due to memory impairments) (39). The qualitative research interviews (40) were based on an interview guide that comprised questions with an open-ended format and focussed on the participants' experiences of difficulties using ET after the ABI, how they responded to these difficulties and the influence on their engagement in tasks in daily life. The interviewer (second author) used different techniques, suggested to increase the quality of interview data collected from people with ABI (41), to follow-up on what was said, e.g., by asking concrete questions and repeating the question when necessary.

The interviewer and the participants agreed on which difficulties and related response actions using ET that would be the focus of the observations. For each participant, two to three ET in one to five tasks, for each ET, were identified. After the interview, the observations were prepared and the participants agreed about the specific tasks that were going to be observed. The participants were then informed, and agreed, that the observer (second author) would have a passive and observing role during the observation, and how the observer should act if the need of assistance would arise. During the observations, the participants were asked to describe how they reasoned when using ET and how they responded to difficulties during the observations. Field notes (38) describing the observed situations were obtained immediately after each observation.

All interviews were tape recorded and all observations filmed. The second author transcribed verbatim the recorded interviews and the field notes, and also transformed the observations into text by detailed descriptions. The data collection with each participant varied between 1.5 and 2 hours.

## **Analysis of data**

The data were analyzed with the constant comparative method of grounded theory (35). The analysis was chosen as it inductively uncovers the patterns of actions, processes and the meanings present in experiences of interactions such as when people use (and interact with their) ET. By the constant comparison of experiences, the conditions that give rise to or apply to different response actions can be explored and, also, consequences related to these actions. Thereby, the forms and patterns of interactions that are taken to manage events or difficulties can be explored and described. Initially, all interviews, field notes and the descriptions of the observations were read several times to gain an understanding of the content. A line-by-line

analysis followed, where text related to the response actions to the difficulties were identified and coded. The codes were named as close as possible to the informants' expressions or what happened during the observations. The analysis then moved to a comparison of the codes, in which each participant was considered separately. The codes reflecting similar experiences of response actions to difficulties in using ET were grouped together into preliminary categories. The preliminary categories from the different participants were then compared with each other, which enabled the identification of the categories' content and characteristics. Thereby, preliminary sub-categories and their properties were identified. During this step in the analysis, it was seen that the preliminary sub-categories including their properties reflected either conditions of the participants' response actions or their consequences. Similarly, the relationship between sub-categories was identified, and certain response actions were found to be related to certain conditions and certain response action had, in turn, certain consequences. In the end, this comparison formed five final categories. The analysis continued by refining the categories, their sub-categories and properties by comparing their labels and the raw data until they were clearly described and agreements were reached between the authors. The constant comparison aimed to ensure that the results were grounded in the data and, also, the completeness of the analysis. The first and second author carried out the main analysis and the third author was later involved when the preliminary categories had evolved, as a way to increase the trustworthiness of analysis. The preliminary findings were also reviewed by an occupational therapist experienced in working with ET in people with ABI who found them reasonable.

## **RESULTS**

The analysis of the participants' experiences and exhibitions showed that their response actions formed five categories: "Deliberately and organized planning"; "Random and inflexible repeating"; "Re-evaluating tasks"; "Explaining difficulties related others"; and "Proving and protecting capability". Each category included two sub-categories reflecting the main conditions that influenced the response actions and the consequences of the response actions for their tasks in daily life (Table 2). Several categories of response actions were used by each participant but in most cases one to three were represented (Table 2). Each category included 2 to 11 different response actions. The participants described between 3 and 10 ET that they had difficulties using (Table 3) and the number of response actions used by each participant varied between 4 and 12. Their descriptions showed that the same type of response actions could be used with different ET and, also, that different response actions could be

used to overcome difficulties when they were doing a specific task with ET. The situations when the participants had difficulties using ET varied due to, e.g., fatigue and the presence of other people. Therefore, they said that the response actions used also varied from one situation to another and that different response actions were used depending on the situation.

### **Deliberately and organized planning**

The participants' experiences and exhibitions showed that they used a set of response actions that was deliberately planned and organized in established purposeful routines. One common action was to take one step at a time when the ET was used, e.g., by taking time to stop, reflecting and recheck. This is illustrated by a description given by a participant while being observed:

*“If I shall boil water, I take the kettle and then begin to think [stops and reflect] about how I should be able to choose the right knob...I put the kettle on the...then I confirmed for myself that it is the right hot plate [reflecting] I will use...by feeling with the hand if the hot plate gets hot [rechecking]... when I feel it gets warm, then I get the confirmation that it is the right hot plate [reflecting].”*

This stepwise response was mostly used to overcome difficulties in doing basic adjustments, recognizing steps, following sequences, finding and using different functions, such as when they used the microwave oven, the telephone book in the mobile phone, did internet banking and were fault-tracing when they used the computer.

Some participants had written their own notes or used manuals when they used their ET. This included both reminders about when they needed to do tasks, such as vacuum-cleaning, and instructions how to do tasks, such as putting on the washing machine. Some described that they were seeking guidance and supportive confirmation from others with sequences that they found too difficult to manage, such as using computer programs, internet, ticket machines, digital alarm clocks and electric appliances. The participants described that minimizing disturbances in the environment and making peace and quiet during their task performance were common types of response actions. By avoiding crowds, stress was reduced so that credit cards could be used with less difficulty. Avoiding using ET, such as computers, when they knew that others could interrupt them and minimizing the use of ET when noise was present, were other examples. Informing others, e.g., staff at the cash desk where they regularly shopped, was an effective response action, according to some participants.

Another response action, described during the interviews, was a more frequent use of existing ET, e.g., using the microwave oven instead of the kitchen range (as it could be adjusted for safety) and standing bank transfers (instead of having to remember to pay every month). Using new functions in the mobile phone to overcome difficulties with starting and finishing the use of different ET, was also described, as illustrated by the following quotation:

*“I put on the reminder function in the mobile phone when I start the washing machine so that I know when I need to go down [to the laundry room] and empty the washing machine.”*

Some participants had also purchased new ET to be able to use another ET. For example, a GPS and a digital camera were used to find the way to public transports and an Mp-3 player was used as a voice recorder and notebook.

The participants frequently described how they trusted their habitual positions and movement patterns of hand and fingers when they used ET that required a PIN code or a ticket machine. One participant also described how the same code was used for different ET and she had limited the time and number of ET used. Some participants also described and showed how they used AT that they had received from health care. The AT was mostly related to the use of ET, such as a timer (AT) to the stove (ET). Keeping reminders and notes in a hand-held computer and using a voice synthesis to write e-mails were other examples.

*Ability to anticipate difficulties.* Some conditions influenced the deliberately and organised planning, as reflected in the interviews and observations. Here, the participants were attentive to their difficulties using ET and had identified errors in their acts. The participants wanted and needed to perform the tasks related to the specific ET, and, thereby, prioritized to overcome the difficulties. This was also described as important and sometimes meant that they had made far-reaching efforts over time to find effective response actions.

*Retain engagement.* According to the participants, the consequences of these response actions were that they could retain or recapture their engagement in tasks in daily life. By this, they could continue using their ET even if the engagement in the tasks were experienced as more demanding than before the injury.

### **Random and inflexible repeating**

Another category that emerged from the participants' descriptions and observations was the use of response actions that were random and inflexible. These responses were usually

repetitive and ineffective as the participants tried to overcome the difficulty by continuing to apply the same action over and over again, without adjusting it or choosing another response.

One such response action that they described and exhibited was their haphazard acting to required sequences. This can be illustrated by one participant who, during an observation, told what he thought and did when he was trying to download music by using computer software:

*“...No, it was here I should press and then here [observation: taking a chance to find the right keys], I do not know if the sound is up here [observation: try once again with another key and fails] where do I press... now then I press this...[observation: taking a chance on another key and fails again] I do not know, I might have to open this [try another key] or I do not know, I do not remember how to do download this.”*

In situations where the participants had recognized that they needed to adjust to their difficulties using ET, they wrote notes that they, however, seldom could use or brought with them, could not find or were not aware of that they had. They also tried to use manuals but they could not act in accordance with them. Instructions could be too brief to support them, such as following the sequences required to use computer programs, the DVD and the washing machine.

Another response action, described during one interview, was the use of unreliable and complex memorizing when using ET that included the management of serial numbers or letters. This participant used different memorizing system and related numbers to luck and bad-luck, country codes or dialling codes, and letters to brand names on clothes companies. The participant's description also showed that the use of a system for a specific ET was mixed up with that for another ET.

The participants also responded by extending their use of an existing ET, but only used it sporadically. One participant described that he had saved PIN codes for credit cards in his mobile phone but rarely used them. Other participants who had started to use timers and alarm clocks to remind themselves of tasks they needed to do, e.g., taking out the laundry, said that they often were unsure of what to do when they heard the alarm. Often, they started guessing and checking possible alternatives. Some also said that they did not always notice when the alarm went off.

Some participants used and trusted deceitful habitual experiences when they had difficulties to manage PIN codes. They often needed to enter the PIN codes several times without knowing which figures they had failed to enter; this is illustrated by this participant:

*“I have learnt the pattern of the keys [to the bank card], I roughly know the numbers and their places but not the order of them... .“*

They also used habitual experiences without adjusting to the current situation, because of the difficulties with basic adjustment of ET. For example, one participant expressed that she always chose the same washing program regardless of the type of clothes, even if she knew that there were other and more appropriate programs.

*Limited ability to prevent difficulties.* One condition influenced the use of random and inflexible repeating, as shown by their exhibitions and descriptions. The participants were attentive to their difficulties but had limited ability to identify errors that were present in their actions. Deep-rooted habits were another condition that influenced their response actions and some participants described that they preferred to hold on to previous performance preferences, as illustrated by this comment:

*“I think it is cheating, [using strategies] I want somehow to try by myself...I am reluctant, I have always...I can by myself and I am still like that... I think it has worked out quite well, with no strategies, so to speak.”*

As the participants more or less wanted and needed to be able to carry out these tasks by themselves, this also became the condition that influenced their persistence to respond, despite their inefficiency.

*Hindered engagement.* The participants experienced that their engagement in tasks in daily life was hindered as a consequence of these response actions to their difficulties in using ET. They continued to use their ET but their engagement was described as demanding and time-consuming. The participants said that their inefficiency in responding to their difficulties in the use of ET made them feel insecure, both before and during the performance of the tasks. One participant said:

*“I am trying and taking a chance, that’s that, sometimes it works, other times I fail.”*

After failing to respond effectively they sometimes had to ask other people for help.

## **Re-evaluating tasks**

This category relates to the participants' descriptions of how they re-evaluated which task they found worthwhile to continue to do, despite their difficulties in using ET. After re-evaluation, the participants described that they acted simply by not doing the task that included ET, e.g., watching a movie on the DVD, or left the tasks which included using ET to others, e.g., managing economy and buying travel tickets. One participant said:

*"I have my... [close person] to do everything that relates to the computer."*

*Acknowledge the limited potential to overcome difficulties.* A condition that influenced this response action was that the participants, as reflected in their descriptions, were attentive to difficulties using ET that still existed, despite their strong efforts to overcome them, and thereby acknowledged their limited potential to overcome the difficulties using ET. Another condition that the participants told of was that they did not continue to struggle to overcome their difficulties using specific ET.

*Abandon engagement.* The participants described that they had chosen to abandon their engagement in these tasks including ending the use of ET as a consequence of their re-evaluation, even if they sometimes hoped to regain them in the future.

## **Explaining difficulties related to others**

This category was formed by response actions identified during both the interviews and the observations, and meant that some participants defused their own difficulties by relating them to other persons. A way to respond to the difficulties using ET, identified in the interviews, was to make excuses, e.g., by explaining that difficulties were shared with other people. This meant that efforts to overcome the difficulties were not initiated or were described as something others also did, which is illustrated by the following quotation:

*"I have a tendency to forget the coffee machine [on] but my husband also has that [problem], we forget it both... I check if the coffee machine is on as everybody else."*

Another response action, identified in some of the participants' descriptions and observations, was that they expected other people to respond to their difficulties. They more

or less consciously demanded others to use the ET in their place in order to complete related tasks, or to do or guide them through certain sequences in the ET that they used, instead of trying to overcome the difficulties by themselves. If others did not respond to their request or responded to late, they were instead seen as the problem. One participant said:

*“She forgets to remind me... I get so annoyed at her, I told her that she has to remind me [how to use the programs in the computer].”*

*Limited interest to overcome difficulties.* The participants’ descriptions reflected that they could identify difficulties using ET, but also that they were not attentive to them. Therefore, they were not always interested in or able to identify errors in their actions. These experiences were reflected as a condition influencing their choice of explaining and relating difficulties using ET to others shortcomings. It was also evident from the interviews that the tasks in which the ET was used were not prioritized at the time of the study. However, it remained unclear if these tasks had been more prioritized before the injury or if the prioritization had changed afterwards.

*Restricted engagement with minimal concern.* The consequences of this response category, was that the participants with minimal concern experienced a restricted engagement in the tasks concerned and that they frequently needed support from others when they used ET. One participant said:

*“I forget the laundry in the washing machine, but I don’t know why it is so important, I will see it the next time I go down to the basement [where the washing machine was placed]”.*

Instead, they expressed an overall frustration over their life situation.

### **Proving and protecting capability**

One participant told that he tried to prove that he had the capability by demonstrating his performance of tasks and ways to respond to the difficulties that aroused. When demonstrating, this participant reported that he had problems overcoming the difficulties, e.g., he turned on the wrong knob on the stove several times. Another response action was to avoid getting rebukes related to the reduced capability, as illustrated in this quotation:

*"Sometimes when my partner watches me [when using the stove] and says: do it this way instead, but when... that is to say, I do not care about it [cooking food]."*

*Other persons' concerns.* Acts, negative attitudes and concerns by other persons were conditions that according to one participant limited the possibilities to respond and develop effective response actions. Instead he described how he had to focus on response actions that protected and proved his capability. According to the participant, other persons' worries about personal safety when using ET meant that these persons took over tasks that the participant still wanted to carry out. This participant also felt that others did not trust that he was able to solve the difficulties that arose; in fact, observations showed that he was not fully able to identify errors in his actions.

*Prevented engagement.* As this participant described that he was not allowed to continue using certain ET without the presence of others, he said that he lost his interest to engage in these tasks.

## **DISCUSSION**

In this study we have explored and described the response actions that 13 people with ABI have developed to manage difficulties in using ET, the main conditions that give rise to these actions and how these actions influenced their experiences of engaging in tasks in daily life. The main results were that: (i) each one of them used several response actions which exceeded the number of ET that was difficult to use; (ii) the same type of response actions could be used to manage different ET; (iii) the choice of response actions to a specific task could vary depending on the situations where ET was used; (iv) the response actions applied were influenced by interactions between different conditions related to the person and his/her prioritisation of the task and, also, other persons actions; (v) the efficiency of the response actions varied; and (vi) pre-existing or new ET was used, with varying efficiency, to overcome difficulties in using other ET.

Interestingly, all participants described that they used a number of response actions. This is in contrast to research (10) showing that many people with ABI could not generate compensatory response actions. This research also showed that they used fewer strategies than healthy people, even if healthy people have less need to compensate and fewer strategies (17). However, as this research focused on completion of cognitive tasks outside the context of daily life, further studies are needed to determine if people with ABI respond differently to difficulties using ET than healthy people.

The results showed that the participants applied the same type of response actions to overcome difficulties using different ET. This implies that they have been able to transfer their response actions to different situations. Thus, the contextualised training approach, focusing only on specific situations in which response actions are used, is highly inefficient when a particular difficulty occurs in many other contexts (32). In line with this, interventions applying information processing strategies across a range of tasks and settings have found to be significantly more effective in improving task performance than current intervention approaches (29).

The fact that the participants needed to change their response actions due to differences in situations when using ET was expected (6). This suggests that people with ABI need to practice not only how to transfer a certain response action to a new or different situation, but also prepare them to use another kind of response action when the situation deserves it. Looking at the response actions from the perspective of each participant, it is obvious that all of them had developed efficient responses and, also, that they mostly used a variety of response actions that were more or less efficient. This indicates that they might have the potential to overcome their more ineffective response actions if they get support to transfer or generate more efficient ones. By supporting people with ABI to identify errors in their actions during task performance, they could be able to prevent known difficulties and learn to plan when a compensatory response action is needed and choose the most efficient one (32, 42, 43).

Of the five categories of response actions identified, four can be clearly seen as compensatory (cf. Deliberate and organised planning, Random and inflexible repeating, Re-evaluating tasks and Proving and protecting capability). To compensate (8), the individuals need to experience a mismatch between their skills and the demands of the environment – in this case the ET. However, this was not evident from the category “Explaining difficulties related to others”. On the other hand, the results showed that people with ABI can also face situations where other people limit their possibilities to compensate or even make it impossible. (cf. “Proving and protecting capability”). The three groups of compensatory response actions, described in the literature as reducing the mismatch between the skills of the individual and the demand of the environment (7-9), were all evident in the results. Two of the groups of compensation, an increase of time and effort as well as the use of an alternative means were both reflected in the categories “Deliberate and organised planning” and “Random and inflexible repeating”. The third group of compensation, adjustment of expectations, were seen in the category re-evaluating tasks. Some of the participants’ response actions

(cf. “Deliberately and organised planning” and “Re-evaluating tasks”) reduced the mismatch between their skills and the demands of the environment (7-9), whereas others (cf. “Random and inflexible repeating”) were maladaptive and failed to reduce the mismatch. Given that maladaptive response actions overall can be seen as a prominent cause of persisting disability following ABI, it is important to understand the origin and process of response actions, regardless of whether they can be considered as compensation or not. Such a complete picture of response actions is necessary for rehabilitation professionals to be able to design interventions specific to the clients’ needs.

The interaction between certain conditions related to the person and the environment appeared to be very important for the different categories of response actions and their efficiency. Interestingly, the participants’ level of prioritisation related to the task influenced their efforts in finding efficient response actions. As a prioritised task increased their efforts, it is suggested, in line with Fischer (31), that it is important to understand each client’s motivations, priorities and inner drives to task performance when designing interventions specific to his or her needs. Whether they were attentive to their difficulties and able to identify errors in their actions also appeared to be conditions of great importance for many of the response actions. Dirette and others (16, 44) have also emphasized that the ability of people with ABI to accurately recognize problems caused by the brain injury is linked to their ability to compensate. In addition, Ekstam et al.(45) found that awareness of disabilities in people with stroke is related to their efficiency in the performance of tasks in daily life. Other research (16, 19, 20) has also emphasized the importance of awareness of deficits for the outcome of rehabilitation. The need to evaluate if a discrepancy exists between observed task limitations and clients experiences of task limitations in the design of interventions is thereby evident. Even though it was beyond the scope of this study to interpret the influence of such specific cognitive impairments on their response actions, it was obvious. This implies that professionals need to evaluate how cognitive functions interfere with the response actions. However, it was not possible to determine whether the participants’ response actions were self-generated or a result of rehabilitation. Thus, future research also needs to focus on the role of rehabilitation as a way to generate compensatory response actions to difficulties using ET in people with ABI. As the compensatory response actions found in our study are similar to those in another group of people with cognitive impairments (46), comparisons of different groups in future research will enrich our understanding of compensation in different task in daily life.

Overall, the participants' response actions were to a larger extent related to their environment than to their cognition. Response actions, such as seeking guidance from others, avoiding certain environments and using ET in new ways, were commonly used by the participants. This implies that the environment had an important role in overcoming difficulties related to ET. Some of the response actions identified are often used effectively as compensatory strategies in cognitive rehabilitation (22-24). Somewhat unexpectedly, many extended the use of their existing ET or had purchased new ones to respond to their difficulties using other ET. Thereby, their use of pre-existing or commonly available ET can be seen as an AT. However, some participants chose to use ET with too low technology, e.g., timers for reminders of tasks they did not remember when an alarm went off, which lead to new problems. Hence, it is important that occupational therapists and other professionals support their clients to choose an appropriate ET by matching them to the demands imposed by the technology (47). Many of the other random and inflexible response actions, such as non-usable notes, could potentially have been avoided with ET, such as the reminder function in the mobile phone or hand-held computer. As indicated in the results, these are products that today often already exist in peoples' life. The use of AT in the rehabilitation of people with ABI has increased and is effective in reducing problems in daily life (33). Based on the conclusion that ET has a potential to compensate following ABI, more research is needed to increase our knowledge about how commonly available ET can be effectively used as AT.

The generalisation of the results is restricted to the 13 participants and it is possible that other characteristics of response actions would be found in other studies with a similar design. With regard to the concept of transferability (48), it is, however, reasonable to assume that the responses to difficulties using ET are not unique and that similar responses could be obtained in other people with moderate or severe ABI. The choice to combine interviews and observations (39), as well as certain techniques to facilitate the interviews (41), proved to ensure the validity, as the participants had difficulties remembering and describing their responses. However, a limitation is that the data collection took place at one occasion; it is possible that repeated data collection could have yielded more information (for further discussion see (6)). The counting of the participants' response actions was a way to enhance the understanding, by discovering and confirming patterns in the data and also make them more evident (49). Therefore, the numbers should not be interpreted in a statistical way. This is also not possible due to the non-randomised selection of participants and the openness and unstructured way to collect data.

In conclusion, the results indicate that people with ABI can generate various response actions with diverse efficiency to overcome difficulties using ET, and that their actions can be transferred and used across several ET. Furthermore, the choice of response actions varied across participants and situations, and, was also influenced by conditions related to the interaction between the person, the task and the environment. To improve daily life for people with ABI and reduce their difficulties using ET, it is important that rehabilitation professionals, such as occupational therapists, identify the uniqueness of each client and their responses to difficulties using ET, and adjust interventions accordingly.

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Table 1. The characteristics of the 13 participants with acquired brain injury (ABI).

Number	Age	Sex	Marital status	Type of ABI	Year since injury/disease onset	Support	Vocational situation
1	33	Female	Cohabiting	Trauma	5	Close person	Working
2	43	Male	Single	Trauma	5	Close person	Permanent disability pension
3	55	Female	Married	Anoxia	5	Close person	Temporary disability pension
4	43	Male	Cohabiting	Trauma	6	Close person	Temporary disability pension
5	33	Male	Single	Encephalitis	9	Close person and home help	Permanent disability pension
6	47	Male	Single	Haemorrhage	3	No assistance	Vocational training
7	59	Female	Married	Ischemia	7	Close person	Permanent disability pension
8	44	Male	Married	Tumour	3	Close person	Vocational training
9	41	Male	Married	Trauma	4	Close person	Temporary disability pension
10	26	Female	Single	Trauma	10	No assistance	Studying
11	45	Female	Married	Trauma	6	Close person and home help	Permanent disability pension
12	39	Female	Single	Ischemia	3	No assistance	Temporary disability pension
13	34	Male	Single	Trauma	10	Close person and home help	Permanent disability pension

Table 2. An overview of the five categories of responses to difficulties in the use of everyday technology (ET) in the 13 participants with acquired brain injury (ABI).

<i>Categories:</i>	<i>Sub-categories:</i>	
Response actions to difficulties using ET	Main conditions influencing the response actions	Consequences of the response actions in tasks in daily life
<b>Deliberately and organized planning</b> Taking one step at a time (1,3,4,6,7,8,10,11,12,13) Acting according to own notes and/or manuals (10,11)  Seeking guidance from others (1,2,5,7,9,11,12,13) Avoiding disturbing incidents in the environment (all) Informing others (1,2,10)  Extending the use of existing ET (1,2,4,6,8,10,11,12,13) Starting to use new ET (5,6,13) Using trustworthy habitual physical experience (1,3,5,6,8) Using the same codes to different ET (10) Limiting the number of ET used and time used (10) Using Assistive Technology (2,8,12,13)	<b>Ability to anticipate difficulties</b> Attentive to difficulties Identify potential errors in acts Often highly prioritized tasks	<b>Retained engagement</b> Continue to use ET Demanding
<b>Random and inflexible repeating</b> Acting haphazard to sequences (2,3,9) Writing notes that one seldom can make use of and/or try to use manuals (1,2,3,4,5,8,9) Using untrustworthy complex memorising (1)  Extending the use of a existing ET but use it sporadic or being unsure on expected acting (2,3,4,5,9) Using deceitful habitual physical experiences (1,3) Using habitual experiences without adjusting (1,3)	<b>Limited ability to prevent difficulties</b> Attentive to difficulties Do not identify errors in acts Deep-rooted habits Previous performance preferences More or less prioritized tasks	<b>Hindered engagement</b> Continue to use ET Demanding and time-consuming Uncertainty
<b>Re- evaluating tasks</b> Let go of tasks (5,10,12)	<b>Acknowledge the limited potential to overcome difficulties</b>	<b>Abandon engagement</b> End the use of ET

Pass over tasks (1,7,8,9,11)

Inability to overcome difficulties  
Continued actions to overcome  
difficulties not prioritized

**Explaining difficulties related to others**

Making excuses (3)  
Expecting others to respond (1,9)

**Limited interest to overcome difficulties**

Not consider difficulties as such  
Identify potential errors in acts sometimes  
Low prioritized tasks

**Restricted engagement with  
minimal concern**

Use ET by the support of  
others

**Proving and protecting capability**

Demonstrating task performance (8)  
Avoid rebukes related to reduced capability (8)

**Other persons concerns**

Others acts and negative attitudes  
Do not identify potential errors in acts  
Prioritized tasks

**Prevented engagement**

Use ET only during others  
supervision  
Loss of interest

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Table 3. Number of everyday technology (ET) identified as difficult to use and the number of response actions used to overcome the difficulties in the 13 participants with acquired brain injury (ABI).

Participant	Number of ET that was difficult to use*	Number of response actions used**
1	10	12
2	6	8
3	4	9
4	5	5
5	5	7
6	4	5
7	3	4
8	5	9
9	5	5
10	9	8
11	3	6
12	5	6
13	3	6

\* the ET often involved the use of several functions that could be difficult to use and the characteristics of the difficulties varied (6).

\*\*see Table 2 for information on the types of response actions