Extraction and Classification of Difficulties Faced by Patients with Brain Injury Living at Home While Using Everyday Technology

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博 士 論 文

Extraction and Classification of Difficulties Faced by Patients with Brain Injury Living at Home While Using Everyday Technology

（在宅生活をおくる脳損傷者が日常生活機器使用時に直面する困難さの抽出と分類）

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ORIGINAL ARTICLES

Extraction and Classification of Difficulties Faced by Patients with Brain Injury Living at Home While Using Everyday Technology

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Abstract

The aim of this study is to identify the characteristics of difficulties with using everyday technology (ET) faced by the patients with acquired brain injury (ABI) in daily life by creating a table classifying the extracted difficulties. Twenty-five persons (19 men and 6 women aged from 20 to 62 years old with a mean age of 43.2 ± 13.7 years) with ABI were interviewed, using the Everyday Technology Use Questionnaire (ETUQ), about their perceived difficulties using ET. Data were analyzed qualitatively with a constant comparative method. Difficulties were classified into 49 primary categories according to their similarities. The primary categories were then classified into the 9 secondary categories according to cognitive dysfunctions. Daily difficulties in 25 control participants were analyzed in the same way. A classification table was obtained from these difficulties in ABI and control groups. Most of the difficulties including the category "wrong judgments" that was related to frontal lobe damage was specific to ABI group. This classification table might enable the dysfunction to be clarified.

Key words: Acquired brain injury, classifying table, daily life, everyday technology

INTRODUCTION

Cognitive impairments such as memory disorder, attention disorder and executive dysfunction occur frequently after acquired brain injury (ABI) [1,2]. Such cognitive disorders have been reported in many patients with ABI [3], and it is well known that these impairments affect the daily lives [4]. Wilson et al. have reported the difficulties of these patients include forgetting where they have placed objects or parked their cars and being unable to manage money [1]. Many young post-ABI patients live at home [5]. In addition to the inconveniences faced by the patients themselves, a burden is also placed on the caregivers [6,7]. Cognitive impairments also lower the chance of a return to work and makes it harder to interact in society, making the patient reliant on other people in their lives [8].

Everyday technology (ET) mainly comprises electric, technological and mechanical devices, and includes both recently developed devices and well-known technology and services [9]. ET is vital in society and life at home and has the potential to make daily life more convenient [10,11]. Regarding the life experiences of patients with ABI, Erikson et al. clarified that these patients faced various difficulties in their home life [12]. Many difficulties while using ET in daily life caused by post-ABI cognitive impairment have also been reported [11,13]. A range of skills is required to use ET and even people without any cognitive dysfunction may face difficulties when using ET [9]. Therefore, the

benefits that can be gained from ET by ABI patients with various types of cognitive impairment are even more limited [10,14]. It has been reported that in order to enhance rehabilitation services for ABI patients, we need to know not only which ET patients with ABI have difficulties in using but also the characteristics of the difficulties in using ET that these people experience[13]. Lund et al. also emphasized the need for occupational therapists to evaluate the extent to which difficulties are faced during ET use as a result of cognitive impairment [15].

Basic intervention strategies for ABI patients with cognitive impairment trying to live in the community include learning external compensation methods and adjusting to environments as well as functional recovery [4]. During these interventions, it is important to reveal the difficulties faced during ET use [12,13], and to know their response actions to the difficulties [15]. However, while various technologies have been used, it has been pointed out that there is a lack of research regarding extensive ET used by ABI patients with cognitive impairment [11]. Therefore, this study was designed to investigate what kind of difficulties ABI patients faced with various types of ET in their daily lives. The revealed difficulties were then categorized according to their reasons why they have difficulties with using ET. The obtained classification table was used to understand everyday difficulties faced by ABI patients living at home in conjunction with cognitive function. By making this classification table compatible with intervention strategies for existing cognitive disorders, it should be possible to improve patients' home lives. This study may also offer a better understanding of what characteristics of daily difficulties in ABI patients with cognitive dysfunction by creating a table classifying the extracted difficulties.

PARTICIPANTS

Inclusion criteria for the participants in this study were: (i) those diagnosed with cognitive disorders caused by brain injury, (ii) those living at home and (iii) those with a score of less than 100 in the Wechsler Memory Scale-Revised (WMS-R). Exclusion criteria were: (i) cognitive dysfunction with no clear cause, (ii) those who had not been diagnosed by a physician and (iii) those lacking the communicative ability to undergo an interview. Upon starting the study, we sent requests to general hospitals, clinics, regional workshops specializing in cognitive disorders and patient–family associations in the central part of Japan. Twenty-five participants who met the criteria were enrolled. Participants comprised 19 male and 6 female aged from 20 to 62 years old with a mean age of 43.2 ± 13.7 years. Causes of injury were head trauma (n=16), cerebrovascular disease (n=6) and cerebral hypoxia (n=3). Participants lived in the middle part of Japan.

Three participants lived alone and 22 participants lived with family. Three participants were in regular employment, 9 participants were in assisted employment in the welfare facilities and 13 participants were not employed (including retirees, homemakers and students). The 25 controls have no history of head trauma nor cerebrovascular disease and they lived in the middle part of Japan (male: 19, female: 6, 23–72 year-old, mean age: 42.1 ± 13.6 years; Table1). Informed consent was obtained from all participants. This study proposal was approved by the Ethical Committee of Kobe University Graduate school of Health Sciences.

METHODS

We conducted interviews at each participant's home. Participants were asked about their daily lives in semi-structured interviews. Through the interviews, the participants were not only asked about what is the ET they could not use or use with difficulty, but also why they couldn't use that ET so as to elucidate the causes.

The difficulties of ET use were investigated using the Japanese version of the Everyday Technology Use Questionnaire (ETUQ-Japan). The original ETUQ is a questionnaire that has been developed to investigate the difficulties of ET use in elderly individuals with cognitive problem living at home [9,18] and is also used for intellectually disabled [19] and ABI patients [11,14,16]. The original ETUQ is composed of 93 items in 8 domains. These domains are household activities (microwave, vacuum cleaner, etc.), activities in the home (TV, DVD, etc.), personal care (thermometer, hair dryer, etc.), power tools (lawnmower, electric screwdriver, etc.), accessibility (elevator, intercom, etc.), data and telecommunications (push-button telephone, computer, etc.), economy and shopping (credit card, internet banking, etc.), and transportation (automatic turnstile, automatic ticket machine, etc.). The ETUQ-Japan was translated by Tanemura and her colleagues of Graduate School of Kobe University with the consent and cooperation of the developers of the original questionnaire. The ETUQ-Japan was revised to be composed of 101 items in 8 domains, excluding types of ET not used often in Japan (13 items), such as soda maker and teletext, and adding types of ET peculiar to Japan (21 items), such as rice cooker and" kotatsu" (table with heater) [20,21].The ETUQ-Japan is sensitive tool to evaluate perceived ability in ET use analyzed by a Rush measurement model[22].

The classifications were made based on the causes of the difficulties. This study was designed as a descriptive interview study. For data analysis, we used the principles of the constant comparative method [23]. The analysis in this study was comprised of a number of steps. In the first step, we have revealed the reasons of the difficulties with

using ET. For example, the reoccurring tendencies to forget taking out the heated food from the microwave oven were as follows: This category included comments such as, “While heating my food in the microwave oven, the sound from the TV distracted my attention and I started watching it. Therefore I didn’t recognize when my food was ready.”(No.18 loosing concentration when being stimulated by something).

In the second step, the difficulties have been categorized into several groups according to cognitive dysfunctions which were causes of their difficulties with using ET. When performing this task, we discussed and all instances of unclear context were confirmed by contacting the relevant participant. For example, a participant comments, “I bought the IC recorder to help me remember things, but I haven’t had many opportunities to use it. So now, I can’t remember how to use it.”.

In the third step, each primary category was then classified according to cognitive dysfunctions to create secondary categories.

Every step was carried out being supervised by the second author (RT) who was mastering qualitative research. The constant comparison have done several times through data reading, coding, and emerging categories to achieve the saturation.

RESULTS

There were 397 difficulties reported by the ABI group. Difficulties were classified into categories according to similarities (No. 1 of primary categories “unable to memorize numbers” – No. 49 “unable to be waiting” , Table 2). The primary categories were then classified according to cognitive dysfunctions to create the 9 secondary categories (A. forgetfulness – I. unable to be waiting). The 25 participants in the control group encountered 270 types of difficulty. Classification was done in the same way as for the participants with cognitive impairment, resulting in the extraction of 20 primary categories. The primary categories were then classified according to similarities to create 7 secondary categories. All of these categories were common with the ABI group (Table3).

A. **forgetfulness**: This category comprised 14 primary categories. For example, this category included comments such as, “I am unable to memorize where the thermometer is kept, so I always ask my family where it is.” (No.3 unable to memorize where things are kept) and “I sometimes worry about whether I have locked the house and go back to check.” (No.12 unable to recall having done something before).

B. **unable to get used to things**: This category comprised 1 primary category. For example, this category included comments such as, “I cannot get used to using a mobile phone. I cannot answer it properly and sometimes accidentally end the call.”, “No

matter how many times I try, I have difficulty bringing up the address book on my mobile phone, so I often type in the phone number directly.".

C. **errors due to distractions**: This category comprised 3 primary categories. For example, this category included comments such as, " I sometimes put the chain lock on the door and lock my family out." (No. 16 reacting to the objects unconsciously). "When I was looking at the price board to buy the train ticket, I ended up asking the station staff because I couldn't find it." (No. 17 unable to find what I need among multiple items).

D. **difficulties when trying to do multiple things at once**: This category comprised 1 primary category: For example, this category included comments such as, "I often call the wrong number even though looking at the phone number when I try to use a push-button telephone." and "I try to select the washing time and type of wash while looking at a memo, but it does not work well.".

E. **making mistakes in operation**: This category comprised 4 primary categories. For example, this category included comments such as, "I placed a mail-order over the phone, but I must have input the wrong number, because a different item arrived." (No. 21 difficulties when trying to operate a device while thinking of how to operate it) and "I try recording a TV program by pressing various buttons on the remote, but I fail recording it." (No. 22 trial and error to operate devices but it does not work well).

F. **behaving the same way as before**: This category comprised 4 primary categories. For example, this category included comments such as, "I sometimes wash the dishes after eating so that I may dry them in the dishwasher, but being unaware of that, I rewash them in the dishwasher as usual." (No. 25 trying to act the same as usual even though there is a change of plan) and "I bought a new refrigerator and the vegetable compartment is on the top, but I forget and put the vegetables in the bottom compartment." (No. 26 trying to act the same as before).

G. **mistaking carelessly**: This category comprised 2 primary categories. For example, this category included comments such as, "After cleaning the bathtub, I use the automatic hot-water supply system and intend to fill the bath tub, but I forget to plug the drain and keep the water run." (No. 28 forgetting to do something carelessly) and "The television and video cassette recorder remote controls are very similar, so I often get confused." (No. 29 accidentally selecting wrong item among similar items).

H. **wrong judgments**: This category comprised 19 primary categories. For example, this category included comments such as, "I am irresponsible for answering the phone when I am at home, because my parents always do." (No. 37 thinking unnecessary for me to do some things) and "I do not adjust the air conditioner because I do not mind of

temperature." (No. 48 behaving appropriately without much thought).

I. **unable to be waiting**: This category comprised 1 primary category: For example, this category included comments such as, "When toasting some bread, I take them out before it is cooked because I want to eat it immediately." and "When water in bath tub is tepid, I set the temperature of the automatic hot-water supply system too high, and it becomes too hot.".

DISCUSSION

The results showed that patients with ABI had many kind of difficulties with using ET. Engström pointed out that individuals with ABI experienced and exhibited a variety of difficulties in using everyday technology [14]; this is consistent with our results. Inserting the difficulties encountered during ET use into this classification table can help therapists understand why ABI patients experience difficulties. This classification table might enable the dysfunction to be clarified. The comparison of categories to ABI and control groups is discussed below.

Category A, "forgetfulness," appeared to be related to memory impairment, and many primary categories was involved only in ABI group. Memory impairment is one of the most commonly observed dysfunctions of ABI patients [24]. It is well known that memory impairment affect the daily lives of people with ABI [4]. Prospective memory disorder in the form of "No.7 unable to remember on time" was also observed only in ABI classification table. Prospective memory is remembering to do things one had intended to do, and refers to remembering to do something at an appropriate time [25]. Some participants forgot to switch on the coffee maker although they prepared it to have a fresh coffee at breakfast. Memory of exercises and skills falls under procedural memory and most people with memory problems show normal or relatively normal procedural learning [26,27]. For example, "I am always clumsy when using a computer keyboard." refers to not being able to get used to doing some things no matter how many times one repeats it. This is likely due to procedural memory impairment. Our results suggested that attention should be paid to the presence of individuals with impaired procedural memory.

Most of the primary categories including category H "wrong judgments" was specific to ABI group. ABI patients are known to exhibit impaired thinking and reasoning [24]. These dysfunctions are thought be caused by damage to the prefrontal cortex [28,29]. Many head trauma patients suffer damage to the frontal lobe [4]. It is conceivable that many individuals who suffer frontal lobe damage would complain of difficulties while using ET that fall into this category. Although our classification table included a wide

range of primary categories, many participants complained of difficulties in this category. Thus, developing countermeasures for this category of difficulties is important when trying to reduce the difficulties experienced by ABI patients while using ET. There were several primary categories related to assistance from others in this category. (e.g. No34 checking with my caregiver to determine whether right or wrong). Lindén et al revealed that using ET can place people with ABI at risk of dependence on others [11]. According to our classification table, that may cause by "wrong judgments".

Category I, "unable to be waiting" appeared to be related to impaired self-restraint, and this category was involved only in ABI group. This is often observed in individuals who have suffered injury to the frontal lobe and in terms of ET may result in difficulties such as, "When operating the DVD, pressing the buttons one after another without checking and waiting for the next step.". They have tendencies to rush doing necessary operations when using devices.

These categories peculiar to ABI patients clearly demonstrate the difficulties in using ET that arise when an individual suffers from brain injury.

Categories shared by both groups were subtle, such as No. 11, "forgetting where I put things" or No. 48, "behaving appropriately without much thought". Most categories related to attention disorders or action slips were common in both groups. Action slip is the error that occurs when a person does an action that is not intended [29]. According to Reason, action slips often occur at "decision points" of a task sequence [30]. There are several decision points at the time of using ET, and it is thought there is a high possibility for the action slip to occur. This demonstrates that regardless of the presence or absence of some kind of impairments, difficulties related to attentional function and action slip occur during daily life when using ET. Action slip often occurs in interactions between humans and objects. This is studied linked to human errors [30]. Norman's study of "The psychology of everyday things" also reports that the design of various devices and tools (such as large number of buttons on video cassette recorders, door knobs those are difficult to operate and open, etc.) cause action slips [31]. Investigating the design of ET should reduce mistakes not only in healthy individuals, but also in ABI patients.

Study limitations

The result of this study has achieved to saturation, but it is important to continue to investigate this issue, as other participants may have other difficulties not described here. It might be hard to capture the full range of difficulties associated with using ET in people with ABI from 25 participants.

When applying these results to other populations, it is important to consider that most of the participants in this study had moderate or severe brain damage. In addition, as the participants were asked to recall specific situations when using ETs, there may be inaccuracies due to memory impairment mainly. Some participants underwent the interview with the help of a caregiver. In these cases, the caregivers sometime had different views than the patients.

CONCLUSIONS

ABI patients' difficulties using ET in daily life were extracted using the ETUQ-Japan. We obtained saturated classification table about the difficulties using ET.

The relationship between the difficulties and cognitive impairment was investigated. Comparisons with a control group revealed that ABI patients faced many kind of difficulties with using ET. This classification table can be used to link difficulties experienced by ABI patients in using ET with cognitive impairment. This classification table could also serve as a means of selecting which existing strategy to make use of intervention in such clients.

Specialists such as occupational therapists who are involved in the home life of ABI patients should focus on the mutual relationship between the reasons why individual clients cannot use ET and their impairments of brain functions. Therefore these specialists have to analyze how these difficulties restrict the lives of the clients and their caregivers and offer the appropriate support.

Declaration of interest

The authors indicated no potential conflicts of interest.

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Table1. Characteristics of the ABI and control.

	ABI group(n)		Control group(n)	
Age	Male	Female	Male	Female
20～29	5	1	5	
30～39	4	1	5	1
40～49	2	1	3	3
50～59	7	2	5	1
60～69	1	1		1
70～			1	
total	25(male19,female6)		25(male19,female6)	
Average-Age	43.2±13.7		42.1±13.6	

Table2. The categories of difficulties using ET

No	Primary categories	Secondary categories
1	unable to memorize numbers	A. forgetfulness
2	always referring to instruction manual	
3	unable to memorize where things are kept	
4	unable to remember some procedures due to memory problems	
5	operate things in an easier way due to forgetting how to do in a former way	
6	unable to recall information how hard I try	
7	unable to remember on time	
8	always operating devices inefficiently	
9	unable to remember too many procedures	
10	unable to memorize how to use rarely-used devices	
11	forgetting where I put things	
12	unable to recall having done something before	
13	going ahead with an action forgetting what was done previously	
14	forgetting when doing multiple tasks at once	
15	unable to get used to things	B.unable to get used to things
16	reacting to the objects unconsciously	C.errors due to distractions
17	unable to find what I need among multiple items	
18	loosing concentration when being stimulated by something	
19	difficulties when trying to do multiple things at once	D. difficulties when trying to do multiple things at once
20	getting confused when miss operating devices	E. making mistakes in operation
21	difficulties when trying to operate a device while thinking of how to operate it	
22	trial and error to operate devices but it does not work well	
23	making mistakes when there are many procedures	
24	difficulty of changing one's behavior according to devices	F.behaving the same way as before
25	trying to act the same as usual even though there is a change of plan	
26	trying to act the same as before	
27	operating devices the same way as before	
28	forgetting to do something carelessly	G. mistaking carelessly
29	accidentally selecting wrong item among similar items	
30	unable to put the thoughts together well	H. wrong judgments
31	do not do things unless told to	
32	unable to determine an appropriate amount of time	
33	unable to switch between actions in response to inappropriate stimuli	
34	checking with my caregiver to determine whether right or wrong	
35	give up operating a device for not remembering how to use it	
36	do not feel like operating devices by oneself	
37	thinking unnecessary to do some things	
38	checking with someone else when anxious	
39	unable to determine appropriate amounts	
40	unable to understand the meaning of the operation of devices	
41	unable to understand the procedure due to intellectual problems	
42	not using devices for saving money	
43	operating devices with caregiver for being anxious to do by oneself	
44	do not use devices by oneself when it is thought there is a risk	
45	do not feel necessity of using devices	
46	thinking more lazily than before	
47	asking someone else to do things so that I can relax	
48	behaving appropriately without much thought	
49	unable to be waiting	I. unable to be waiting

Note: Darker colored primary categories are specific to ABI patients. White colored primary categories are the common between ABI group and control group.

Table3. Comparison of the number of categories between ABI and control

	ABI group(n)	control group(n)
perceived difficulties	397	270
primary categories	49	20
secondary categories	9	7

Note: Twenty primary categories and 7 secondary categories were classified in the control group. All of these categories were common with the ABI group.