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Stability of person ability measures in people with acquired brain injury in the use of everyday technology : the test-retest reliability of the Management of Everyday Technology Assessment (META)

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ABSTRACT

Aim: This study aimed to evaluate the test-retest reliability of the person ability measures to manage everyday technology generated from the observation-based instrument Management of Everyday Technology Assessment (META) in a sample of participants with acquired brain injury (ABI).

Method: The META was administered twice within a two-week timeframe in 25 people with ABI. A Rasch measurement model was used to convert the META ordinal raw scores into equal-interval linear measures of each participant's ability to manage everyday technology (ET). Test-retest reliability of the stability of the person ability measures in the META was examined by a standardized difference Z-test and an intra-class correlations analysis (ICC 1).

Result: The result showed that 22 of the 25 participants' ability measures generated from the META were stable over the test-retest period of time. The ICC 1 of 0.63 indicates a good overall reliability.

Conclusion: The META demonstrated acceptable test-retest reliability in the sample of ABI. The results indicate the importance of using sufficiently challenging ETs in relation to a person's abilities when assessing people with META in order to generate stable measures over time.

Keywords: Test-retest reliability, assessment, technology, occupational therapy, brain injury

Over the last few decades, everyday technologies (ETs) such as computers, cell phones, and remote controls [1] have become increasingly used at home, at work, and in the society [2, 3]. This has changed the performance of several activities; the access and ability to manage ET can, therefore, be seen as prerequisites for participation in daily activities [3]. ET is often described as a support product to facilitate people's performance of activities [2, 4]. However, studies have found that persons with an acquired brain injury (ABI) may have difficulties in the management of ET [5-7]. Therefore, people with an ABI run the risk of being excluded from the performance of activities at home, at work, and in society [7, 8]. This calls for reliable assessments to be used by health care professionals, such as occupational therapists (OTs), to be able to measure the ability to manage ET to gain information of how to plan and design interventions to support the use of ET. Furthermore, there is also a need for reliable assessments to evaluate the effectiveness of interventions and to measure changes in ability over time [9].

In selecting assessments for specific samples and purposes, considering psychometric properties [10], such as reliability and validity, is important. Reliability refers to the consistency of an assessment. In evaluation of an assessment, one of these issues is whether a measure is stable in any given period [11] with respect to a target sample [12]. It is important that evaluation outcomes detect potential improvements that may occur as a result of the intervention, as opposed to the shortcomings of the instrument [10, 11, 13]. Therefore, it is essential that sufficient evidence is gathered to establish the test-retest reliability of measures before using an instrument in clinical practice.

The Management of Everyday Technology Assessment (META) [14] is a recently developed observational instrument assessing the ability to manage ET. The META was originally developed to assess older adults, in general and specifically, those with mild cognitive impairment or dementia [14]. The psychometric properties of META have been examined and have demonstrated that the META generates valid assessments of ability to manage ET among older adults with and without cognitive impairment [15]. Furthermore, the results of a recent study indicate that META can be a useful instrument for assessing the ability of people with ABI, as well [8]. However, the stability of the person ability measures in META has not yet been examined over time in any study. A common way to investigate the stability of measures over time is to examine the test-retest reliability [10, 11, 16]. An examination of test-retest reliability [12] of the person ability measures in the META could add more knowledge about its psychometric properties. Such knowledge might also be valuable when using the META to assess the ability to manage ET and to evaluate interventions aimed to improve the ability.

To summarize, before META can be used in clinical practice to evaluate interventions, health care professionals, such as OTs, need to know that person ability measures generated by the assessment remain stable over time when no change is expected. Therefore, this study was designed to evaluate the test-retest reliability of measures of a person's ability to manage ET generated by the META in a sample of persons with ABI.

Methods

Participants

The potential participants in this study were recruited from the participants in a previous study [8], which included 81 persons with ABI. The inclusion criteria to the pervious study were that participants: i) had ABI due to stroke or trauma; ii) had been injured at least 18 months prior to the study; iii) lived in one of two municipalities in North Sweden; iv) were between the ages of 18-65 years; v) did not have any other diseases which could affect the results and vi) were able to express themselves verbally. Further information of the recruitment and selection of participants are described elsewhere [8]. The planned number of 25 participants [17] in this study was reached using the pool of 81 participants from the previous study. The final sample included 15 (60%) men and ten (40%) women with ABI in between the ages of 25-64 years (mean 52.4, SD 10.4). The time since injury varied between 2-30 years (mean 7.4, SD 8.2). In terms of cause of injury, 22 (88%) had a stroke and three (12%) had a traumatic brain injury. According to the Extended Glasgow Functional Outcome Scale (GOSE) [18], seven participants had a severe disability (SD) (28%) 12 (48%) had a moderate disability (MD) and six (24%) had a good recovery (GR) after the ABI (Table I). The study was approved by the Ethical committee in Umeå (Dnr. 2010-235-31).

Insert Table I about here

Instrument

The participants' observed ability to manage ET was evaluated with the META [14]. The META consists of ten items of observable performance skills items, e.g., identify and separate objects, coordinate different parts of technology, and manage a series of numbers (Table II). According to the manual [14], each performance skill item is scored on a threecategory rating scale: 3) no difficulty, 2) minor difficulty, 1) major difficulty. In a previous study the META demonstrated acceptable values both in terms of rating scale function, person response validity, technology goodness-of-fit, intra-rater reliability, person separation and reliability among older adults with cognitive impairments [15]. In addition, an initial analysis of META in the same sample of persons with ABI demonstrated acceptable internal scale validity, person response validity, intra-rater reliability, and everyday technology goodness- of-fit [8].

Insert Table II about here

Data collection

The assessments were carried out by three clinically experienced OTs. The data collection and the education of data-collectors in using the META is described in detail elsewhere [8]. The participants were observed while using three of their own ETs which they perceived as relevant and challenging [14], and were used at two different sessions within two weeks +/- one day. The three ETs were chosen by the participants and could be either the same or different ETs between the sessions. The test-retest period of two weeks was considered as a sufficient interval on the basis of previous test-retest studies [11, 12].

Data analysis

A computer application of a many-faceted Rasch measurement model, Facets [19], was used to convert the raw scores from META-observations into equal interval linear person ability measures, expressed in logits. The many-faceted Rasch model makes it possible to compare persons with each other even when they are (i) observed while managing different ETs of various degrees of challenge, (ii) observed while managing performance skills of various difficulties, and (iii) scored by different raters. Person ability measures and associated individual standard errors (SE) were generated for all the 25 participants for session one and two respectively.

The Statistical Package for Social Sciences (SPSS) [20] was applied for descriptive statistics and analysis of the test-retest stability of the person ability measures over time. The stability of each participant's META measure between the two sessions was examined using a standardized difference Z-comparison. The Z score was calculated using [Session 1-Session 2 measures]/[SE1+SE2] (Table III). The determination was based on the criterion that the differences between the two assessments should be less than Z (±1.96) [21]. The agreement average of the person ability measures in the two sessions was calculated by use of a one way random effect model in the Intraclass Correlation Coefficient model (ICC) [22]. The criterion for the associations between the assessments was 0.75-1.0 perfect reliability, 0.4-0.75 fair to good reliability and less than 0.4 indicated a poor reliability [23].

Result

The mean values of person ability measures from the two sessions showed that the mean value for participants' ability measures in the first session was 1.5 logits (SD 1.36) and ranged from -.79 to 5.05 logits. During the second time, the mean score was 1.6 logits (SD 1.43) and ranged from .00 to 4.97 (Table III). The analysis using the standardized difference Z showed that 22 of 25 participants' ability measures generated from META were within the acceptable range (±1.96) [21]. In addition, the ICC of 0.63 indicates a fair to good reliability according to the set criteria.

Insert Table III about here

Discussion

The results provide preliminary evidence of acceptable test-retest reliability of the person ability measures generated from the META in a sample of persons with ABI. The META person ability measure for 22 (87.5%) of the 25 participants was considered to be stable over two weeks' according to the comparisons of the standardized difference Z-scores (Table III). In addition, the ICC was also found to be good, which further supports the test-retest reliability of the META in people with ABI. These results indicate that the META can generate stable person measures of the ability to manage ET for most persons with ABI when no changes in ability have occurred, which is required of an assessment in order to demonstrate potential to detect real changes in abilities in relation to time or intervention. However, more research is needed about the METAs sensitivity to change, i.e., the efficiency of the measures to detect actual changes when they have occurred, before it can be determined if META can evaluate effectiveness of interventions.

The analyses did, however, reveal a larger than acceptable variation over time for three of the participants (12.5%) (Table III). There are several potential reasons why these three participants' ability measures could vary more than expected. One reason might be found in overall high or low META raw scores in one of the three technologies observed (ceiling effect), which then could result in unexpectedly high/low person ability measures in either of the sessions, which then could influence the magnitude of difference between assessments. However, a more in-depth analysis of the specific measures showed no floor or ceiling effects in the raw data that could explain the unexpected variation over time among the three participants (Table III). Another reason to the variation in the person ability measures between the sessions might be that the participants' abilities varied due to variations related to their medical conditions such as fatigue in relation to any of the sessions [24, 25]. However, no clear indicators for the reason to the variations could be found in relation to the participants' demographics.

Although, the result indicates good test-retest reliability of the person ability measures generated from the META, there is still a variation across measures between the two assessment sessions for some individuals among those twenty-two with statistically stable person ability measures (Table III). An in-depth analysis indicates that the variations were caused by an insufficiently challenging ET during one session and a challenging ET at another session. This discrepancy calls for assessments that include sufficiently challenging ETs in relation to a person's abilities.

The data from the assessments were analyzed using a many-faceted Rasch measurement model, Facets [19]; the use of this model made it possible to do the analysis even if the participants did not use the same ET during both assessment sessions. Additionally, from a client-oriented perspective, it is important to evaluate functional outcomes in an ecologically relevant context. This is one of the advantages of using META in combination with a Rasch model. Other instruments, e.g., the Assessment of Motor and Process Skills [26-28], ETUQ [29, 30] and Assessment of Awareness of Disability [11, 31], at earlier points have successfully implemented such facets in order to adjust the individual ability measures in relation to variations in tasks performed.

There are some methodological considerations that will be further discussed. This study was limited to 25 persons with ABI of working age. The results in this study cannot be considered to be representative for the entire population of persons with ABI or other diagnoses. Nevertheless, men and women of different ages representing all levels of severity of disability (Table I) were included in the study, which will contribute to some generalization of the findings. Consequently, development of an assessment is an on-going process and more research is required to evaluate if the META can generate stable person measures of the ability to manage ET for persons with ABI as well as for other groups of clients having difficulties in managing ET. In such studies larger samples of participants would be favourable. Furthermore, in this study the participants were assessed in the use of three ETs in each of the two assessment sessions. However, using an even higher number of additional ET assessments in each session might generate more precise person ability measures [32]. Hence, a suggestion for further studies of the META is to include additional ETs in each assessment for the participant. However, this is a balancing act as assessments takes time and effort, especially among groups of disabled people and the elderly, who are more prone to fatigue.

To conclude, the results indicate that the META has acceptable test-retest reliability for a majority of the sample with ABI. A slightly higher than expected, proportion of people did demonstrate larger variations than expected and no clear indicators were found in relation to clients' demographics. But the results indicate the importance of using a higher number of sufficiently challenging ETs in relation to a person's abilities when carrying out the assessment in clinical practice.

Implications for rehabilitation

As ET is essential when performing everyday activities and participating in society it is vital that heath care professional such as OT are prepared to assess and support peoples ability to manage ET. Additionally it is of importance that researchers and clinical practitioners' in the field of technology use to support healthcare professionals how this could be done for people with ABI. The findings of this study revealed the META is a reliable tool which can be useful when it comes to assess peoples in their abilities. In additions', META can also be a useful to evaluation instrument for evaluate improvements' of abilities following interventions aiming to improve abilities to use ET. Finally, the META where showed to have potential to be a useful instrument used in clinical work to assess and evaluate the ability to manage ET among people with ABI and possibly also among other groups of people with disabilities.

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Table I
Description of the participants

Participant	Age (years)	Sex	Cause of injury	Years since injury	GOSE*
1.	60	Male	Stroke	24	SD
2.	54	Female	Stroke	2	GR
3.	45	Male	Stroke	2	MD
4.	41	Female	Stroke	8	GR
5.	42	Male	Stroke	2	GR
6.	45	Female	Stroke	9	SD
7.	62	Male	Stroke	6	SD
8.	64	Male	Stroke	5	MD
9.	50	Female	Stroke	5	GR
10.	25	Female	Stroke	2	MD
11.	45	Male	Trauma	30	MD
12.	62	Female	Stroke	2	SD
13.	40	Male	Stroke	6	MD
14.	56	Male	Trauma	2	SD
15.	51	Male	Stroke	2	MD
16.	64	Female	Stroke	2	MD
17.	64	Female	Stroke	3	SD
18.	59	Male	Stroke	3	MD
19.	37	Female	Trauma	20	SD
20.	48	Male	Stroke	2	MD
21.	54	Male	Stroke	4	MD
22.	63	Male	Stroke	5	MD
23.	58	Male	Stroke	5	GR
24.	58	Female	Stroke	25	MD
25.	64	Male	Stroke	5	GR

* Based on Glasgow Functional Outcome Scale Extended [18]

Table II
META items

Performance skills items in META
1. Identify and separate objects
2. Coordinate different parts of technology
3. Use appropriate force, tempo, and precision
4. Turn a button or knob in the correct direction
5. Manage a series of numbers
6. Identify information and respond adequately
7. Perform actions in logical sequences
8. Performance skill item, identify services, and functioning
9. Choose correct button or command
10. Follow instructions given by an automatic telephone services or answering machines

Table III

Participant number	**Session 1 META** measures in logits (s.e.)	**Session 2 META** measures in logits (s.e.)	**META** measures difference Z-score
1.	0.95 (0.32)	2.48 (0.72)	1.94
2.	0.46 (0.29)	2.14 (0.51)	2.86 *
3.	2.94 (0.71)	4.89 (1.78)	1.02
4.	4.97 (1.78)	2.94 (0.70)	-1.06
5.	5.05 (1.79)	3.94 (0.97)	-0.55
6.	2.03 (0.76)	0.00 (0.36)	-2.41 *
7.	1.49 (0.42)	1.39 (0.38)	-0.18
8.	1.06 (0.34)	1.51 (0.38)	0.88
9.	2.28 (0.59)	4.97 (1.78)	1.43
10.	2.24 (0.51)	1.83 (0.46)	-0.60
11.	0.95 (0.35)	0.47 (0.38)	-0.93
12.	0.26 (0.31)	1.02 (0.32)	1.71
13.	1.73 (0.39)	1.49 (0.34)	-0.46
14.	1.31 (0.35)	1.26 (0.41)	-0.09
15.	1.64 (0.42)	2.75 (0.57)	1.57
16.	1.34 (0.40)	0.48 (0.35)	-1.62
17.	-0.79 (0.38)	0.09 (034)	1.73
18.	0.10 (0.33)	0.11 (0.30)	0.02
19.	1.22 (0.29)	0.69 (0.30)	-1.27
20.	0.86 (0.30)	0.50 (0.28)	-0.88
21.	0.18 (0.30)	0.43 (0.31)	0.58
22.	2.26 (0.51)	0.10 (0.38)	-3.40 *
23.	2.01 (0.61)	1.15 (0.38)	-1.20
24.	0.03 (0.30)	0.51 (0.34)	1.06
25.	1.25 (0.42)	1.76 (0.46)	0.82

* Participants' do not meet the determined criteria with regard to the standardized Z-test (±1.96)