Journal of Assistive Technologies

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Peer-reviewed paper

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Abstract

Purpose – *Cognitive changes occur with age and cognitive limitations can negatively influence computer use. Human-interaction studies show that especially older adults benefit considerably from using web platforms. The purpose of this paper is to measure the possible impact of cognitive impairment in web usability and to analyse the differences between older adults with and without cognitive impairment.*

Design/methodology/approach – *In the presented pilot study, 50 older adults tested a web-based interface on a PC and tablet computer that was designed based on a styleguide for this specific user group. In two sessions participants had to conduct six tasks. In a third session older adults were left unsupervised in the laboratory where they were confronted with unexpected events triggered by a principal investigator.*

Findings – *The performance results differed significantly between the two groups. Older adults with mild cognitive impairment (MCI) needed more time and were more likely to make mistakes when using a web platform. After analysing error data, it became apparent that errors made by older adults with MCI occurred due to a lack of orientation in websites.*

Originality/value – *Little is known about web performance of older adults with cognitive impairment. The authors present valid data of this interesting target group and reveal their specific problems when handling a new online platform. The importance of a flat website hierarchy can be essential in developing senior friendly web pages. The authors also highlight methodological issues and illustrate the importance of qualitative information of the usability data, e.g. the different types of problems or errors.*

Keywords *Older adults, Cognitive deficits, Mild cognitive impairment, Usability studies, User-centred-design, Web usability*

Paper type *Research paper*

Received 25 November 2014
Revised 1 June 2015
26 June 2015
Accepted 30 June 2015

This paper was produced as part of a project which was supported by the German Federal Ministry of Education and Research under grant number 16SV5638K. Responsibility for the contents of this publication lies with the authors. In conclusion, the authors would also like to thank the partners German Research Center for Artificial Intelligence, Phoenix Software GmbH, Vitapublic GmbH and Evangelisches Geriatriezentrum Berlin gGmbH.

1. Cognitive change in old age/mild cognitive impairment (MCI)

The decline of cognitive capacities is a part of normal human ageing. Studies show that working memory, spatial abilities, attention and perceptual speed decline with age (Boutet *et al.*, 2007; Park, 1992). MCI is a clinical syndrome which describes a transitional zone between normal cognitive status and dementia (Fischer *et al.*, 2007). The classification of MCI in older adults is a challenge. It is still very difficult for general practitioners to identify cases of early dementia and MCI (Kaduszkiewicz *et al.*, 2010). As yet, there is no consistent agreement on a single set of criteria for MCI. According to the definition of Winblad *et al.* (2004) for persons with MCI, they are neither normal, nor have dementia and show an objectively measured decline in cognitive task performance over time. Their activities of daily living are preserved and complex instrumental functions are either intact or minimally impaired. However, older adults with MCI have difficulties in performing social and other complex activities which rely heavily on memory and complex reasoning (Pérès *et al.*, 2006; Perneczky *et al.*, 2006). There are a variety of cognitive screening assessment instruments. A common instrument for the classification of MCI is the Mini-Mental State Examination (MMSE). A score of 24 points or more represents only light or no impairment (Brandt, 2001; Pezzotti *et al.*, 2008). It can be conducted in less than ten minutes and is used in geriatric clinics as a first step in detecting cognitive impairment (Fabrigoule *et al.*, 2003). However, older adults diagnosed with MCI often have several impairments and cannot be viewed as a homogenous group.

There is a growing interest in technology-based interventions that may potentially support older adults suffering from MCI and early-stage dementia in enhancing independent living. Therefore, persons with MCI are a compelling target group for usability research since MCI is characterised by a high probability of progression to dementia. Contrary to what is commonly believed, older adults with MCI do have the ability to learn new computer or app usage from which they could benefit in later life.

2. Cognition and computer usage in older adults

Research demonstrates that the use of everyday technology differs between people with and without MCI (Malinowsky *et al.*, 2010) but there is still a lack of knowledge about the use of specific modern technologies, such as website usage. Nygård *et al.* (2012) found that both the self-perceived and observed ability to use everyday technology differs between older adults with and without MCI. A certain degree of computer literacy as well as the ability to access and use the internet are now more relevant than ever in order to engage in every aspect of today's society (Koopman-Boyden and Reid, 2009). The new hindrances due to technological development could lead to reduced participation in society for people with MCI. Therefore, these groups may benefit from internet access in a social and psychological way (Taveira and Choi, 2009). There are several studies pointing out that use of the internet can reduce social isolation and loneliness and facilitate communication with family and friends (Sum *et al.*, 2008; Shapira *et al.*, 2007; Cotten *et al.*, 2013; Choi *et al.*, 2012).

Recent surveys show that older persons constitute the fastest growing demographic group of web service users (Morrell *et al.*, 2000). However, even without MCI, older adults may be at a disadvantage compared to younger users. Website complexity has significantly increased, with websites now featuring not only text and images but various media such as audio, videos and flash animated graphics (Butkiewicz *et al.*, 2011). Age and cognitive abilities influence successful navigation of such websites. Users with developmental cognitive disabilities have difficulties to successfully navigate websites (Small *et al.*, 2005) and overall poorer performance on computer tasks has been shown (Czaja *et al.*, 2001). The effect of age-related impairments of older adults, such as visual, auditory, motor and cognitive deficits, is indisputable, but it is unclear which limitations have the strongest effect (Czaja and Lee, 2008).

Almost no website is specifically aimed at people with cognitive impairment or has been designed for the needs of this target group. Software developers are often afraid of developing websites for people with cognitive impairments. However, it has been demonstrated that people with memory difficulties are capable of learning. Once they have been learned, knowledge and skills can be retained over an extended period of time (Glisky and Schacter, 1988). This even applies to people with early-stage dementia, if suitable learning approaches are used (e.g. errorless learning methods) (Clare *et al.*, 2000; Hertzog *et al.*, 2008). Although there is very little research examining how such difficulties can be minimised, some authors suggest that age-related cognitive decline can be mediated by the manner in which web services are designed (Fernando *et al.*, 2009). Therefore, specific web accessibility guidelines for this target group have been developed (Friedman and Bryen, 2007). However, to our knowledge, these guidelines are theory-based concepts and have not yet been validated by older adults with cognitive impairment.

3. Cognitive influence factors of website usage in older adults

A considerable number of older adults suffer from cognitive limitations that could affect their ability to use a computer. For example, computer users may have impairments that affect their ability to group visual elements into patterns, recognise faces, build effective mental representations of perceptual or conceptual spaces, or retrieve linguistic representations during composition and comprehension (Fairweather and Trewin, 2010). For some of these abilities, evidence has been found on their role in computer and website usage. However, strong clinical trials are, to our knowledge, still missing.

There has been little research so far, investigating specific differences between attitudes of older adults with and without MCI towards websites (Haesner *et al.*, 2014). There is some evidence that a variety of cognitive impairments can have a detrimental impact on web performance (Mead *et al.*, 2002). Fairweather and Trewin (2010) presented five functional abilities which could be impaired in older adults with MCI and are connected to the use of web 2.0 platforms: pattern recognition, face recognition, visuospatial abilities, word finding and social interaction.

Difficulty with navigation is one of the largest problems for users (Laberge and Scialfa, 2005). This is characterised by problems searching for information and getting lost while navigating. Research shows that due to a decline of working memory capacity with age, which can weaken the ability to process and manage information, performance difficulties occur when task complexity is increased. It is therefore necessary to reduce the general cognitive load (e.g. distractive elements) (Laberge and Scialfa, 2005). This affects the understanding of written texts on websites, which is often difficult for the target group due to their difficulties with comprehension of text (Kempler *et al.*, 1988). When the text has an abstract content and/or contains specific internet terms this is especially the case. Holt and Morrell (2002) demonstrated that efficiency of text comprehension by older adults is improved when the text is well organised and clearly presented in short segments on web pages (Holt and Morrell, 2002; Romano Bergstrom *et al.*, 2013). However, the European Union (EU) funded project MyLife proposed the use of modern expression forms for text and pictures noting that older adults with MCI should not be seen as "prehistoric creatures" (Hellmann and Schulze, 2012).

Assistive technologies for web interfaces are not very popular (Kurniawan *et al.*, 2006) and there is a tendency for older users to deny the need for assistance technology (Lunn and Harper, 2011). Instead, user inquiries revealed a demand for an interface that can be used without a lot of effort and preserves the original appearance.

Web accessibility research and developing guidelines for specific target groups has been going on for years (National Institute on Aging and National Library of Medicine (NIH and NLM), 2002; AARP, 2005; Kurniawan and Zaphiris, 2005; Fidgeon, 2006). The National Institute of Aging's checklist is one example of a senior friendly guideline (NIH and NLM, 2002) that focuses on readability, presentation of information, using different types of media, navigation and recommends usability testing before final use. Kurniawan and Zaphiris (2005) developed a more extensive set of 38 web design standards in 11 categories for older adults. Several were seen as especially important for cognitive impairment: the relevance of graphics for presenting information, lack of unnecessary animations, avoiding pull down menus, being able to differentiate between unvisited and visited sites, fewer choices for the user to support recognition rather than recall. Another well-known guideline is the Web Content Accessibility Guidelines (WCAG 2.0) with the four main principles: perceivable, operable, understandable and robust which provide criteria for accessible web content.

4. Aim of the study

As summarised, current studies show an effect of specific declined cognitive capacities on web performance. However, only little to no systematic applied research has been conducted on the effects of age-related cognitive impairment on the use of web services or other information systems (Czaja *et al.*, 2006; Fernando *et al.*, 2009). Moreover, these studies analysed specific tasks and not typical website features. However, the question arises whether there is a general difference in website usage between persons with cognitive impairment and non-impaired older adults? It would be a great benefit for web developers to learn more about the specific impact of cognitive impairment.

The aim of the study presented here was to investigate the impact of MCI on web performance and user interaction with web platforms as well as to identify problems which remain even in a system developed based on accessibility guidelines.

5. Methods

5.1 Participants

In the present pilot study, 50 older adults over 60 years of age were included (54 per cent female). Participants were recruited from classes at the Senior University, Berlin and former contacts of user studies. All participants gave their informed consent. On average, participants were 71 years old (61-93 years), generally well educated and were living in an urban area. The convenience sample was divided into two groups according to MMSE-score (Folstein *et al.*, 1975): 25 older adults with cognitive impairment (MMSE 25-28) and 25 without cognitive impairment (MMSE 29-30). Overall, computer ownership and internet usage was relatively high. In total, 85 per cent of the participants reported possessing a computer and 76 per cent reported using the internet regularly. Moreover, they were very interested in technology. Two-thirds of the older adults reported a high interest in technology and technical issues. In a validated technology commitment questionnaire (Neyer *et al.*, 2012), the participants achieved an average score of 15 points (20 points being the maximum score) in the subcategory "agency beliefs". Only 22.4 per cent of the participants stated they had ever used a tablet computer before.

5.2 Measures and procedures

In the study we investigated the performance of older adults with a prototype version of a web platform both on a standard PC and a Samsung Galaxy II© tablet.

5.2.1 Platform design. Developing the platform as part of the German publicly funded LeVer project, State of the art guidelines for design and interaction were analysed. The results were implemented in a styleguide for PC and tablet applications. Besides specifications for text, colours, target sizes and further interaction patterns, such as a progress bar or a three-step volume control, the styleguide also defines the multimodal interactions, including gestures, speech interaction and navigation widgets. The learning platform consists of four main components: general settings, cognitive exercises, personal area with the possibility to communicate with other users and lastly specific information on healthy ageing, nutrition and cognition.

5.2.2 Testing the platform. After initial screening and formal inclusion in the study, several clinical tests assessing fine motor skills (Nine-Hole-Pegboard Test; Mathiowetz *et al.*, 1985), visual thinking (Paper folding test; Ekstrom, 1976) and problem solving (Tower of Hanoi; Anderson and Douglass, 2001), were conducted. Furthermore, the comprehensive neuropsychological test battery CERAD (Consortium to Establish a Registry for Alzheimer's Disease; Morris *et al.*, 1988) was conducted by a psychologist. In addition the participants were asked several questions regarding socio-demographic data, computer and tablet usage and self-efficacy.

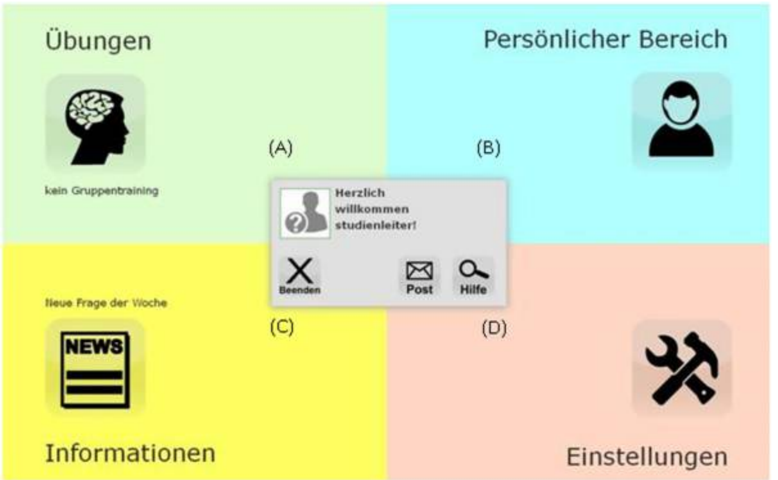
Three sessions were conducted on the same visit in the usability laboratory of the Geriatrics Research Group. The tests took approximately two hours. In the first and second session, the elderly participants completed six different standardised tasks on the prototype version. The initial terminal device (PC or tablet) was randomised in order to take a potential learning effect bias of the second run into account. We chose standardised tasks, which are basic operations when using web platforms. The tasks to be completed in each setting were (Figures 1-3):

- login to the platform;
- write a comment in the forum;
- return to the home page;
- write a message;
- change the mail settings; and
- start an audio-video call.

Figure 1 Login page of the lever platform

Notes: (A) Username; (B) password; (C) login; (D) register; (E) forgotten password; (F) help

Figure 2 Main page of the lever platform with four components



Notes: (A) Exercises; (B) personal area; (C) information area; (D) settings

Written instructions were provided. To ensure that the participants had fully comprehended the formulated tasks they were asked by the study assistant if any questions or unclarities remained. For each task, task duration and task success (error rate) were documented manually by a study assistant using a standardised protocol. An error was recorded when the participant did not find the most efficient path to complete a task. For all tasks, common errors were predefined and were protocolled as critical incidents (CIs). An overall score for both performance parameters was computed. Additionally, both the number of times a participant asked for assistance and the kind of assistance requested was also recorded.

Figure 3 Settings

Notes: (A) Change font size; (B) change volume; (C) input acknowledgement; (D) notification; (E) notification sound; (F) notification via e-mail

After the first session, the following instruments were used to assess satisfaction with the system as well as its emotional valence: The Mini-Attrak-Diff questionnaire (Hassenzahl) for assessing attractiveness of the system, consists of seven pairs of opposing concepts on which participants are required to rate the system. The Rating Scale of Mental Effort (RSME) (Zijlstra and Doorn, 1985) for measuring perceived effort, consists of a continuous scale of 110 mm length with so-called anchor points every 10 mm on which users mark their effort in using a website. Subsequently, the System-Usability Scale (Bangor *et al.*, 2008) a rating of the overall usability of the system on a five-point Likert scale, and a questionnaire regarding the evaluation of the design were completed independently by the participants. After the second session, the participants were asked about their preferred device and the advantages and disadvantages of PC and tablet.

To create a test environment as realistic as possible, a third session was conducted with a PC in which the staff left the room and left the older adults unsupervised. Written instructions for further tasks were provided and the participants were requested to respond to all events which occurred during this unsupervised third session. They were then confronted with an incoming call, an incoming message, a stressful exercise and a technical bug in one section of the platform. Lastly, the After Scenario Questionnaire (Lewis, 1995) and the RAW-TLX (Hart and Staveland, 1998) were completed by the participants.

5.3 Data analysis

The data were analysed using IBM SPSS Statistics 21.0. Quantitative descriptive analysis included the performance time, the frequency of asking for help, the error rate, type of error and the rating of overall usability were conducted. Qualitative data from the research assistants' documentation were analysed using the content analysis method (Mayring, 2010).

Tests on normal distribution and variance homogeneity were conducted regarding success rate, task duration and error rate. In cases of normal distribution (e.g. success rate), *t*-tests were performed, otherwise non-parametric Mann-Whitney *U*-tests were conducted (e.g. number of errors, duration). For differences between both groups and the success of the tasks of the third session the χ^2 test was used.

6. Results

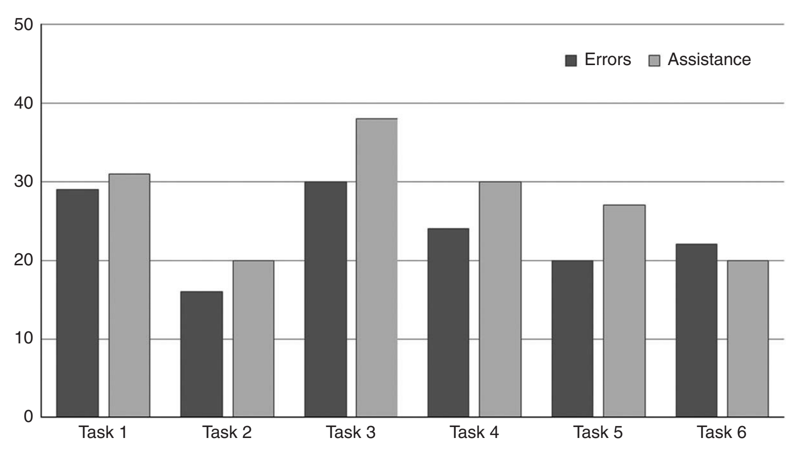
6.1 Web performance

The participants had severe problems solving the six tasks without mistakes and assistance. As seen in Figure 4 more than half of participants needed assistance in their first session and could not solve the tasks without errors. The scores of both sessions were added so that each participant could achieve a success rate with a maximum of 24 points. Only two participants completed both sessions without any mistakes or assistance. The average success rate of all participants was 14.7 points. Most participants needed assistance while performing the tasks. For both the number of errors (6.1 and 7.8 points, $U = 195$, $p < 0.5$) and assistance given (6.7 and 9.1 points, $U = 182$, $p < 0.5$), statistically significant differences between the two groups were found.

On average, all participants without MCI (No MCI group) needed 491 seconds (08:11 minutes) to complete all six tasks. The time required to complete the tasks ranged from 185 seconds (03:05 minutes) to 1,270 seconds (21:10 minutes) by comparison the participants with MCI (MCI group) needed significantly more time to complete the tasks (average 684 seconds, 11:24 minutes, 04:05 minutes to 21:40 minutes; $t = 2.43$, $p < 0.05$). The time the users required for data entry was not added to the duration due to the different message lengths (Table I).

The errors differed between the two groups. A qualitative content analysis of the CIs that occured in task 1 (login to the platform) showed differences in the nature of the errors and revealed specific errors of the MCI group. Reasons for individual errors were not the misunderstanding of the task instruction but in difficulties with typical web operations. These web operation errors differed in the No MCI and MCI group. The most common problems involved opening the virtual keyboard and finding the delete button, whereas the No MCI group more often entered their password incorrectly. The MCI group needed significantly more time for this task ($t = 3.06$, $p < 0.05$) and had a lower success rate ($U = 394$, $p < 0.5$) than the non-MCI group. In task 2, which required the participants to write a comment in the forum, the same errors occurred in the MCI group as in task 1 (problems with opening the virtual keyboard on the tablet or finding the delete button). Both groups performed equally successful on task 3 (returning to the home page). In task 4, apart from selecting the wrong area of the platform, opening and especially closing the virtual keyboard and selecting the receiver (in this case the prinicipal investigator) were particular problems of the MCI group. These types of errors were observed less frequently in the No MCI group. In task 5, specific errors for the MCI group were made regarding the orientation in the target section and subsection of the platform, and the target button was frequently not recognised as such.

Figure 4 Received assistance and errors per task in the first session



Note: $n = 49$

Table I Performance for both sessions

	Non-MCI	*MCI*
All tasks		
Duration*	491 s	684 s
Success rate*	16.8	12.6
Task 1		
Duration***	77 s	136 s
Success rate*	3.2	2.3
Task 2		
Duration	132 s	168 s
Success rate*	2.3	1.3
Task 3		
Duration	18 s	20 s
Success rate	3.4	3.0
Task 4		
Duration*	102 s	132 s
Success rate	2.8	2.0
Task 5		
Duration	88 s	118 s
Success rate*	2.9	2.0
Task 6		
Duration	78 s	109 s
Success rate	2.1	1.9

Notes: $n = 49$. $^*p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.005$

6.2 Overall usability issues

In spite of the high number of errors and assistance given, the developed platform was not perceived as very complicated. The participants were generally satisfied with the design and control of the platform. More than 80 per cent described it as partially user-friendly or very user-friendly (Table II). No statistical differences between both groups were found.

The RSME Scale for assessing subjective mental workload showed overall little mental effort while conducting the different tasks (Figure 5). The Attrak-Diff Scale showed an overall acceptance of the platform. According to the participants, the prototype was quite simple to handle, predictable, creative and clearly structured. The design aspects were also rated equally positive.

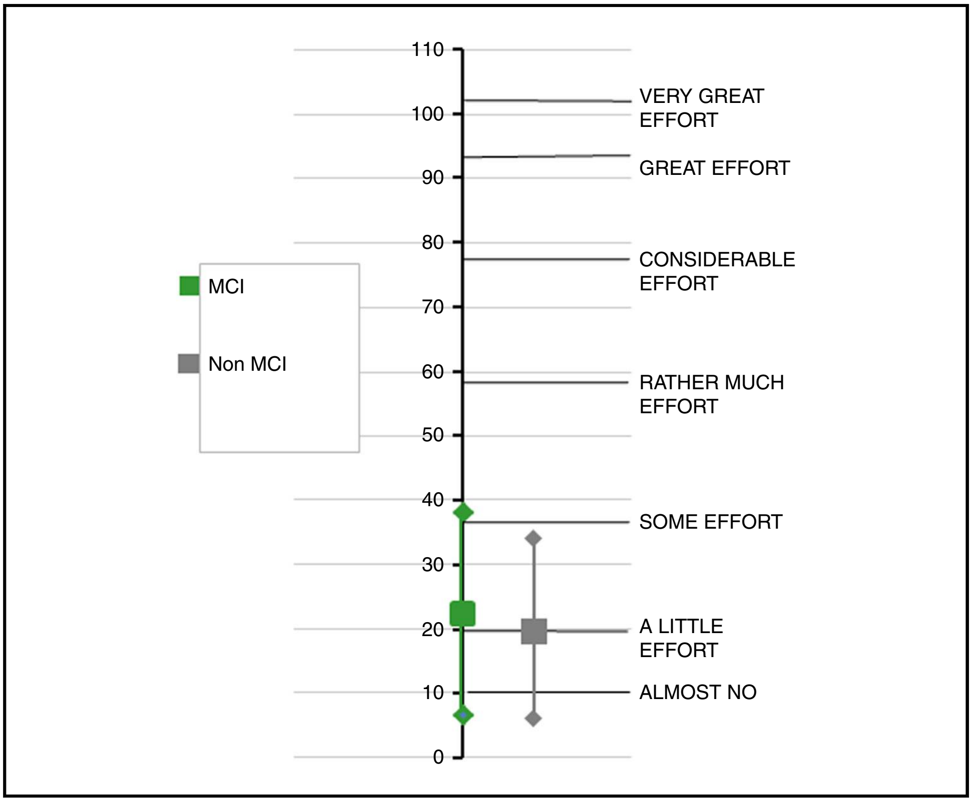
6.3 Differences between the sessions

By analysing the data of both sessions, it was found that there were statistical differences in success rate and duration for both groups in both sessions. In both sessions, the MCI group showed lower performance scores compared to the participants without cognitive impairments. The MCI group needed over one minute longer to accomplish all tasks and the average success

Table II Usability of the system

How user-friendly do you find handling the system?	*Non-MCI (%)*	*MCI (%)*
Not at all	0	0
A little	0	8.3
Somewhat	4.0	8.3
Mainly	48.0	37.5
Very much	48.0	45.8

Figure 5 RSMSE scale



rate was more than two points lower. Despite an improvement in the second session, the results of the MCI group showed similar results to the No MCI group in the first session (Table III).

Nine participants solved all six tasks in the second session without mistakes or assistance. Significant improvements between the first and second session were observed for both groups. The MCI group scored an average of 7.1 points in the second session (first session 5.0 points) and the No MCI group 9.6 points (first session 7.2 points). In the second session, the average completion time in the MCI group was 04:55 minutes, which was an average improvement of approximately 22.7 per cent. The No MCI group needed 03:12 minutes on average (improvement of 31.4 per cent). No significant differences were found between improvements in both groups.

6.4 Unsupervised tasks

In the third session three new tasks were assigned and participants were left alone and had to respond to unexpected actions of the principal investigator. In total, 80 per cent of the MCI group

Table III Differences between first and second session

	MCI	*Improvement*	*No MCI*	*Improvement*
Success rate				
1st session*	5.0	2.1 points***	7.2	2.4 points***
2nd session*	7.1		9.6	
Duration				
1st session	6.5 min	–22.7 %***	5.1 min	–31.4 %***
2nd session*	4.9 min		3.2 min	

Notes: $n = 49$. $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.005$

answered the incoming audio-video call via the platform, whereas only 56 per cent of the participants without cognitive impairment were able to solve the task. The task "responding to an incoming message" was successfully completed by more than 80 per cent of the participants in both groups. The MCI group needed, on average, 1.8 minutes longer to answer the incoming message ($t = 1.07$, ns) than the No MCI group. In task 3, more than 80 per cent in both groups could complete the stressful exercise. In total, 24 per cent of the MCI group and 36 per cent of the No MCI group managed to find the FAQ section of the platform to write a message to the principal investigator about a technical bug as required in task 4.

Although the overall success rate of the tasks in the third session was not very high, 75 per cent of all participants stated that they had no problems in solving the tasks. In the MCI group 87 per cent replied, indicating that they were very confident of solving the tasks correctly.

For the After Scenario Questionnaire and the RAW-TLX, no differences between the two groups could be detected.

7. Discussion and conclusions

Cognitive impairments seem to have a significant impact on website performance as previously demonstrated by Mead *et al.* (2002) and Fairweather and Trewin (2010). Our research indicates that people who experience the first signs of cognitive impairment, such as MCI, need more time and are more likely to make mistakes when using a web platform irrespective of the usability of the platform and easily understandable tasks, Participants with MCI had severe problems solving the six tasks without mistakes and assistance. Recently published data shows age-related differences in ability to use websites successfully (Romano Bergstrom *et al.*, 2013), but older adults with MCI were not considered.

In many usability studies, researchers often ignore the qualitative component of the usability data. When comparing two user groups, apart from measuring the number of errors or providing assistance, it seems to be interesting to analyse the different types of problems or errors which occurred when using a web platform. Detailed error analysis revealed that different types of errors occurred between the two groups when using the web platform. The non-MCI group mostly made careless mistakes (e.g. spelling incorrectly), whereas the errors made by participants with MCI, seemed to be caused by lacking abilities such as lack of orientation in websites. Thus, problems occurred when participants with MCI had to find the correct menu options in the three-level site hierarchy. These results correspond with the findings of Laberge and Scialfa (2005), where difficulty with navigation in websites was seen as one of the largest problems for older users. When developing online platforms aimed to also be used by participants with MCI, developers should avoid the use of multiple navigation levels. Older adults with MCI have particular demands which are different from those of older adults without cognitive impairment. In usability studies, it seems to be necessary to separate these groups to find specific performance barriers of older adults with cognitive impairments in order to avoid a complete rejection of website usage.

The subjective ratings of prototype usability were quite positive. This result stands in contrast to the objective test data showing that almost none of the tasks were conducted without errors or assistance. Participants with MCI in particular seemed to overestimate their ability to successfully complete tasks; questionnaires probably will not bring sufficient results. A use of mixed methods in usability studies with objective electronically generated data and subjective statements of the participants may show a more accurate picture of the user competence. It is not advisable to rely only on data of usability questionnaires when conducting usability studies with older adults.

The results clearly show that both groups can benefit equally from training sessions. Improved performance can be expected with appropriate training, as is shown by the participants' improvement in the second session. Due to repetition, the number of errors declined significantly. Here, besides a senior friendly introduction, it seems to be absolutely necessary that technically inexperienced older adults conduct an independent individual training programme. Much is known about the positive effect of procedural training and its effect in web performance. According to these results and our experience of out-of-the-box usability tests, regular web use of older adults with MCI can only be successful with an integrated training sessions. In this respect, national and EU social policy should foster training sessions for technology and new media to reduce the digital divide and to strengthen independence of older adults even with cognitive impairment. Technologies or newly developed web platforms for older adults with MCI should be combined with detailed user guidelines and continuous support services to avoid frustration and refusal. However, the results must be interpreted very carefully to avoid generalised statements assuming that older adults with dementia can benefit in the same way.

At this point, we would like to examine limitations regarding our work. The sample size is quite small and results are not representative for the German or European population. Due to the high prevalence of multimorbidity in older adults, it is quite difficult to separate abilities and disabilities. There are no results regarding the interaction of impairments and their possible effects on web usability. Also the developed online platform embodies some typical features but it is not clear whether the measured problems of older adults with MCI are generalisable towards other online platforms. Furthermore the administered MMSE is a common tool but also has limitations regarding reliability if used as the only tool to evaluate cognitive impairment. There is a need for more usability testing with older adults to learn more about user behaviour, ordinary use and potential barriers of these new devices. Further studies are planned to more closely focus on the influence of cognitive skills such as spatial ability, effects of training and especially support during longer test phases. It is of great interest to gather data not only from laboratory testing in a controlled environment, but also from a field trial to take into account unexpected events and individual reactions of the target group. In our publicly funded project, a field trial will be conducted, measuring the effectiveness of the cognitive exercises on the platform as well as the long-term motivation of using such a platform. The planned field trial will take place in the home environment of 80 older adults in Berlin and the surrounding area.

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