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A framework for evaluating mHealth tools for Older Patients on Usability

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Abstract. Mobile health (mHealth) apps can play a significant role in supporting older patients. The aging process is yet related to progressive degradation of sensory, physical and cognitive abilities. mHealth apps with touch screen based interfaces thus need to be adapted to the, often impaired, skills and special needs of older patients. However, existing design guidelines for mHealth apps do not address the aging barriers that older users face in working with touch screen based applications. By means of a constructed conceptual framework on cognitive, motivational, physical and visual impairments of older adults, this study revealed possible aging barriers concerning identified usability issues of an mHealth app for older patients. Insights into the aging process barriers that underlie usability issues supports developers in (re)designing mHealth apps that are better attuned to the needs of the older patient population.

Keywords. Usability – Older adults – Cognitive Walkthrough – User Interface Design Guidelines

Introduction

Mobile health (mHealth) apps are promising tools for older patients to improve their quality of life. These apps can play a significant role in supporting them in independent living, self-management of (chronic) diseases and hospital appointment attendance [1-3]. The aging process however, is related to progressive degradation of sensory, physical and cognitive abilities. Accordingly, mHealth solutions with touch screen based interfaces need to be adapted to the, often impaired, skills and special needs of older adult patients [3]. Issues such as the limited screen size of smart phones, small buttons combined with touch screen navigation, and complex interactions may result in rejection of these apps. Consequently, these apps might not live up to their assisting potential in care.

The rapid uptake of smart phones by older adults enhances the need for a deeper understanding of age related usability issues for touchscreen based mHealth apps for smart phones. The Health Care Information and Management Systems Society (HIMMS) recently developed design guidelines for mHealth apps [4]. Yet, these design guidelines do not address the aging barriers older users face in working with touchscreen based mHealth apps. Therefore this study developed a conceptual framework based on literature on Human Computer Interaction (HCI) characteristics of older adult users to categorize detected usability problems by known aging barriers of

this user group [3,5]. This paper reports on the value of this framework 'mHealth for older users' applied in a case-study analysing usability issues of a procedural mHealth app designed for older patients. The mHealth App is developed to support older patients in their hospital visit. It offers a patient the possibility to view his/her appointment schedule and make use of a taxi transport service from home to the hospital and back. This service includes personal guidance and assistance inside the clinic by a medical student during and after the consult. In this study we assessed whether the framework 'mHealth for older users' provided support in understanding the aging barriers that underlie usability issues concering mHealth applications.

1. Methods

Background App design

Figure 1 displays the four main screens of the App. In designing the App 'Simplicity' was used a starting point by the app designers. Simplicity in design refers to everything from lack of visual clutter and concise information display to inclusion of only functionality that is needed to effectively accomplish tasks [4]. The App's home interface showed four large buttons for navigation. Navigation was three layers deep as a maximum.

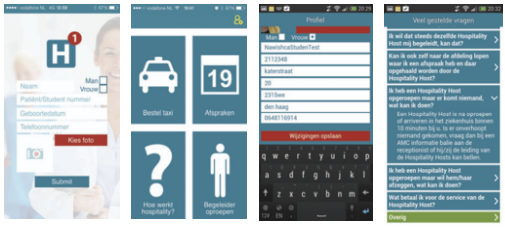

Figure 1. Screenshots of the App for older users

Conceptual Framework 'mHealth for Older Users'

Four contextual categories were identified based upon literature on older adults' degradation of sensory, physical and cognitive abilities in relation to technology use and motivational issues [3,5]. Per category it was determined which age related concepts and age dependent abilities could influence the experienced ease of use of mHealth apps by older adults. For example, a decrease in flexibility of finger joints of older adults could increase error rate in the App's usage. The conceptual framework 'mHealth for older users' is shown in figure 2.

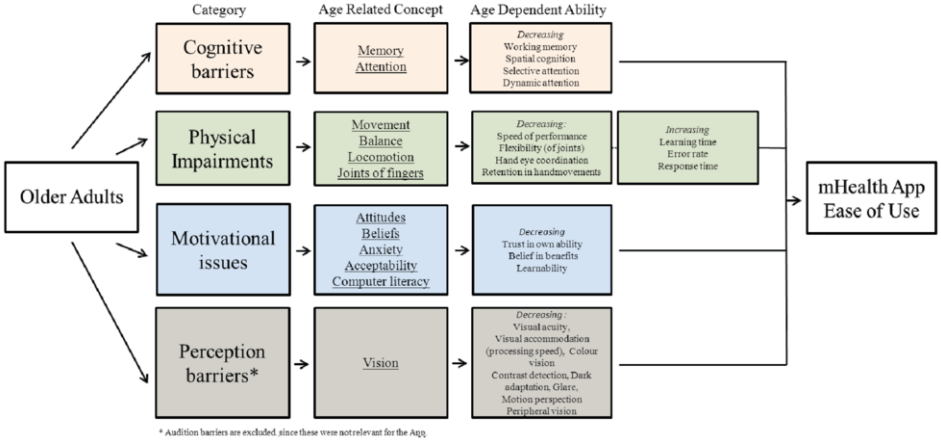

Figure 2. Conceptual Framework 'mHealth for Older Users'

Identification of usability issues

Usability issues were first identified by means of two standard usability evaluation methods: the cognitive walkthrough and by performing a cross check with the Health Care Information and Management Systems Society (HIMMS) Design Guideline for 'mHealth' [4]. Five evaluators performed the usability analyses on the beta version of the App before its launch to patients at the Gastro-Intestinal Oncology Center Amsterdam (GIOCA), an outpatient oncology clinic of the Amsterdam Medical Center (AMC) in February 2014. Prior to the analyses the evaluators received instructions on the App's use, the tasks to perform and an older adult patient persona, in order to assess the App from on older adults' perspective.

Firstly, the encountered issues were clustered amongst the themes of the HIMMS Design Guideline for mHealth. Secondly, the issues were prioritized by means of a severity rating from 0 to 4 according to Nielsen classification of severity [6]. By applying the conceptual framework of mHealth for older users, two of the five evaluators (GW, LP) independently analyzed the identified usability issues and mapped them onto the framework. Agreement was reached on all categorizations of detected usability problems.

2. Results

In total 28 usability issues of the App were considered to hamper older adult users in using the App. The ten usability issues ranked with a high severity (3 or 4) are shown in table 1.

Issues occurred at 7 of the 10 themes of the HIMMS Design Guideline. Most issues arose at the themes: 'simplicity', 'forgiveness and feedback' and 'naturalness'. The most severe issue was related to unnatural navigation through the App. Of the framework of mHealth for older users, cognitive barriers and motivational issues were both rated as influential in 6 of the 10 severe detected usability problems. The age related concept 'computer literacy' was found to be the most common motivational

barrier. Of the physical impairments and perception barriers, respectively impairments influencing 'longer learning time' and 'visual acuity' were regarded to be most common age related abilities underlying the usability issues.

Table 1. Encountered usability issues with severity 3 or higher by HIMMS usability guideline and Conceptual Framework mHealth for Older Users

Usability issues			Problems of older adults
Theme	Description usability issue	Severity	Barriers influencing the usability
Simplicity	[1] The icon to change profile information could be overseen because of its size and location and could inhibite older adults to change their profile data.	3	**Perception:** Visual acuity, contrast detection
	[2] Information via the Frequently Asked Questions (FAQ) help function was difficult to locate in the app and it was unclear how to use this in the app.	3	**Cognitive:** Cognitive complexity due to slow(er) cognitive performance, **Motivational:** Poor understanding of benefits, Low computer literacy
Foregiveness & Feedback	[1] f the "Save Changes" checkbox is not selected, changes are lost when navigating to the next screen.	3	**Motivational:** Low computer literacy
	[2] Lack of app feedback on saved changes made in the personal and adress information.	3	**Motivational:** Technology anxiety, low computer literacy
Naturalness	[1] Immediate click effect when swiping is confusing	4	**Cognitive:** complexity due to slow(er) cognitive performance **Motivational:** Technology anxiety, low computer literacy **Physical:** Impairments influencing longer learning time, error rate and retention (memory) over time
	[2] Ineffecient navigation; directed back to home screen when not needed	3	**Cognitive:** Cognitive complexity due to slow(er) cognitive performance, **Motivational:** Technology anxiety **Physical:** impairments influencing longer learning time and speed of performance
Effective use of language	[1] English terminology was used: 'Submit' appears in Dutch app	3	**Motivational:** Technology anxiety
Effecient interaction	[1] Close proximity of gender boxes on a smart phone screen could inhibit older adults in easy selection.	3	**Physical:** impairments influencing speed of performance, error rate and subjective satisfaction **Perception**: Visual acuity, visual accomodation
Effective information presentation	[1] Colour use in the app is not intuitive, and could lead to misinterpretation. Specifically the use of red in buttons.	3	**Cognitive:** Cognitive complexity due to slow(er) cognitive performance **Perception:** Color vision, contrast detection
Preservation of context	[2] Information overload in FAQ, low readability complex hierachy of information in FAQ format	3	**Cognitive:** Cognitive complexity due to slow(er) cognitive performance; learning time; **Physical:** impairments influencing longer **Perception:** Visual Acuity

3. Discussion

The developed conceptual framework on older adults usage of mHealth provided a valuable reference model to analyze the detected usability problems of the mHealth App from an older user perspective. The study showed that the App could be difficult for older adults to use due to its unclear interface elements, lack of feedback and forgiveness, and unnatural navigation structure. De Barros et. al. report on a usability study of an exercise app targeted at fall prevention for older adults [8]. Interestingly, the results of this study appear similar to the usability issues detected in our study. The framework of 'mHealth for older users' aimed to support the interpretation of these results by identifying user characteristics that might be the source of assessed usability issues. By mapping the usability issues on the framework insights on the potential underlying characteristics of older adults that might cause the usability issues became apparent. For example, issues regarding unclear interface elements and a lack of user feedback might be extra problematic for older adults due to degradation of their cognitive capacities. Since the navigation structure was inconsistent, motivational barriers like a low literacy regarding the usage of smartphones will jeopardize the ease of use of the App by older adults. Physical impairments of older adults will hamper them in using the App specifically since problems in the naturalness of task flow in the App exist, thus enhancing error rate and decreasing learnability. Perception barriers of older adults will further compromise effective interactions with the App, thereby inhibiting its ease of use.

The results show that the HIMMS mHealth guidelines are not sufficient for developing a highly usable app for older adults. The conceptual framework on mHealth for older adults developed and pilot-tested in this study can support usability evaluators

and mHealth app designers in understanding the intrinsic aging barriers that are inherent to usability issues encountered by older users. The framework can guide the (re)design and evaluation of mHealth apps specifically targeted at older mHealth users.

To fully grasp how the age barriers influence older patients' experienced ease of use of mHealth apps, studies on realistic use by these patients are needed [9, 10]. For this reason, a first follow-up study will evaluate the App with older adult patients from different age groups and medical conditions by means of the Think Aloud method. In doing so, the constructed conceptual framework will be further validated and specified for older adult patients, both the younger seniors and the elderly. The validated conceptual framework, combined with known HCI recommendations for older adults, will lead to mHealth design guidelines that take the decline in abilities of older adults into account. These guidelines can be applied in designing and evaluating mHealth tools for older patient populations.

Competing interests – None.

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