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Understanding the Adoption of Mobile Health Applications: Insights from User Tests with Older Adults

Research in Progress

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Abstract. With the digitalization of healthcare and the wide distribution of smartphones, mobile health applications are increasingly established in medical care. Older adults, especially those affected by chronic conditions, can benefit from these applications but use them comparatively rarely. Studies on their adoption behavior are scarce. Through user tests, this study examines older adults' adoption behavior when using a mobile health application prototype. The Senior Technology Acceptance Model serves as an expandable theoretical framework. Preliminary results reveal that, alongside prior technical experience, self-perception has the most decisive influence on actual usage behavior. Physicians play a crucial role in the adoption of mobile health applications, as they are trusted to assess their utility and necessity but are barely considered in technology acceptance models. Further research is required to substantiate these findings.

Keywords: *mobile health, technology adoption, older adults, self-perception*

1 Introduction

The almost ubiquitous dissemination of smartphones within society and the increasing utilization of information and communication technologies in healthcare have strongly contributed to the development of mobile health applications (mHealth apps) (Pan, Dong, & Bryan-Kinns, 2021). According to a representative study, 93% of the German adult population owned a smartphone in 2023, and around 60% of these users monitored health, fitness, and vital signs using it (Deloitte, 2023). MHealth apps, predominantly used on smartphones, have positively contributed to more efficient, cost-effective, and patient-centered care (Schroeder, Seaman, et al., 2023; Uncovska et al., 2023). They can offer patients tailored medical information and health education and contribute to patient empowerment by enabling self-management and tracking of symptoms (Vo, Auroy, & Sarradon-Eck, 2019). Especially for managing chronic conditions and prevention, mHealth apps are widely used and help to reduce the burden on healthcare systems (Kenny & Connolly, 2017; Pan, Dong, & Bryan-Kinns, 2021).

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MHealth adoption can decrease the number of emergency department visits, especially among older adults, and thus also contribute to prolonged, independent living at home (Bertolazzi, Quaglia, & Bongelli, 2024; Fox & Connolly, 2018). The importance of digital care is also underlined by the efforts of countries worldwide to integrate digital therapeutics, like prescribable and reimbursable digital health apps (DiGA) in Germany, into primary care (Dahlhausen et al., 2021; DigitalTherapeuticsAlliance, 2024; Fürstenau, Gersch, & Schreiter, 2023). Although they could particularly benefit from using mHealth apps, the adoption among older adults is relatively low (Kenny & Connolly, 2017). Demographic change and the increasing proportion of older persons within society necessitate that they utilize and benefit from digital health technologies (Kenny & Connolly, 2017; Pan, Dong, & Bryan-Kinns, 2021). Considering the retirement age and common definitions within medicine, we define older adults as those aged 65 years or older (Sabharwal et al., 2015). Within research on technology adoption, however, few studies focus on their adoption of mHealth apps (Pan, Dong, & Bryan-Kinns, 2021; Schroeder, Seaman, et al., 2023). Previous studies indicate that sociopsychological and health-related aspects play a significant role in older adults' technology acceptance and are not sufficiently reflected in traditional technology acceptance models (Schroeder, Dodds, et al., 2023). Personality traits, such as perceived self-efficacy, social influence, cognitive age, and emotions, are recognized as important, influential factors that should be considered when investigating seniors' technology adoption (Schroeder, Dodds, et al., 2023). We aim to contribute to this research gap by applying a qualitative and explorative approach in which we let older adults try out the prototype of a mHealth app and investigate the factors that influence their utilization.

The **Senior Technology Acceptance Model (STAM)**, which is generally designed for the adoption of technology by older adults, serves as our theoretical foundation (Chen & Chan, 2014). Using the STAM as a framework, we want to examine whether it adequately reflects the necessary factors concerning the acceptance of mHealth apps. Taking these aspects into account, our approach yields the following overarching research question (RQ):

Which factors are decisive for older adults' actual use of a mHealth app?

2 Theoretical Background

The World Health Organization (WHO) describes **mHealth** as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices." (WHO, 2011). Studies focusing on the adoption of mHealth frequently draw on established technology acceptance models in information systems (IS) research (Fox & Connolly, 2018).

One of the most widely applied models in IS research for predicting and explaining technology adoption is the **Technology Acceptance Model (TAM)**. It is based on the core assumption that *perceived usefulness* (i.e., whether the technology is perceived as helpful) and *perceived ease of use* (i.e., whether the technology is perceived as simple to use) are the two predominant factors influencing a person's attitude towards technology adoption and thus the behavioral intention to use it and its actual use (Davis,

Bagozzi, & Warshaw, 1989). Despite the inclusion of external factors within the model affecting *perceived usefulness* and *perceived ease of use*, the TAM is criticized for lacking both general and specific determinants of these two constructs (Venkatesh & Bala, 2008). Consequently, the TAM has been further developed in various studies and enhanced with context-related and generic influential factors (Koufaris, 2002; Venkatesh & Bala, 2008; Venkatesh & Davis, 2000). The TAM and its extensions are also extensively used in adoption research on digital health technologies (Pan, Dong, & Bryan-Kinns, 2021; Rahimi et al., 2018). However, these models are only partially applicable to older adults, who often differ diametrically from younger user groups in terms of their abilities, experience, and attitude toward technology and state of health (Martin-Garcia, Redolat, & Pinazo-Hernandis, 2022; Mitzner et al., 2019).

To consider these characteristics, the **STAM** has been developed, which incorporates determinants such as *physical functioning*, *health conditions*, *social relationships*, *gerontechnology self-efficacy*, or *gerontechnology anxiety* (Chen & Chan, 2014). In this model, *gerontechnology* is defined as digital or electronic services or products that enable older adults to live independently in relatively good health, safety, and comfort and increase their social participation (Chen & Chan, 2014). *Gerontechnology self-efficacy* refers to older persons' assessment of whether they can use this technology successfully. *Gerontechnology anxiety* describes older adults' negative feelings, like insecurity or nervousness, caused by the potential use of such technology (Chen & Chan, 2014; Ha & Park, 2020). Due to its specific focus on technology adoption among seniors, the STAM is well-suited as a theoretical foundation for our study. The components of the STAM are depicted in Figure 1.

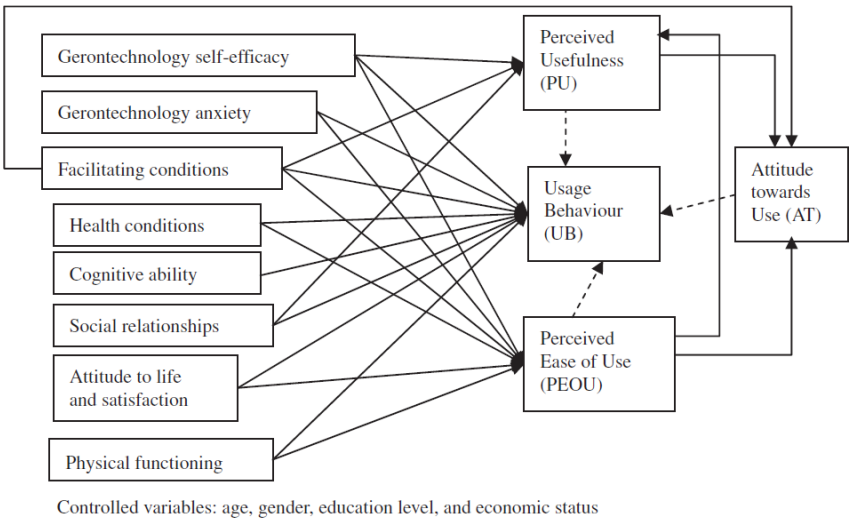

Figure 1. STAM (Chen & Chan, 2014).

Since technology adoption and usability issues are closely interlinked, especially concerning older people, usability aspects must be considered when analyzing the actual technology use (Mitzner et al., 2019). The literature-based framework **"mHealth for older users" (MOLD-US)** was developed to identify age-related barriers to the usability of mHealth apps. It covers the four categories *physical ability, cognition*, *perception*, and *motivation*. Restrictions in *physical ability* result, for instance, from rheumatoid arthritis, impairments in *cognition* from nervous disorders, limitations in *perception* from chronic eye conditions, and *motivational* constraints from concentration issues (Wildenbos, Peute, & Jaspers, 2018). These categories are also reflected in usability guidelines and within the constructs *health conditions, cognitive ability*, and *physical functioning* of the STAM (Chen & Chan, 2014; Morey et al., 2019).

3 Research Methods

To examine our research question, we conduct user tests with older adults with and without previous technical experience for a self-developed mHealth app prototype. This prototype is designed to record symptom-based health data and to assist in monitoring health conditions. The design concept is kept for simplicity to guide users through it intuitively. Attention is paid to large font sizes and high color contrast. In analyzing older adults' attitudes towards the mHealth app and potential barriers to its adoption, we follow the STAM (Chen & Chan, 2014) along with the MOLD-US framework (Wildenbos, Peute, & Jaspers, 2018) and assess the constructs through questionnaires and observations. Using *theoretical sampling* (Glaser & Strauss, 1967), ten older adults have been recruited to date, each of whom has tested the mHealth app for around 45 minutes on a provided test smartphone. In the first iteration, we recruited participants from a nursing home with age-related physical and visual impairments, and in the second iteration, participants from a socially active seniors club. Inclusion criteria were an age of 65 years or older and an equal distribution of male and female participants. By this approach, a broad spectrum of seniors should be represented.

As part of the user tests, the participants tried out the app in free exploration and performed predefined tasks. These tasks included recording pain areas and specific values within the app and monitoring the course of the entered data. A combination of the *think aloud method* and the *cognitive walkthrough* was chosen as the methodological framework (Jaspers, 2009), with one of the authors (KK) asking questions about the performed processes and providing minor assistance during the tests. Before the tests, a questionnaire on demographic factors (age, gender, children, people living in the household) and the assessment of the respondents' technological affinity and previous experience with mHealth apps on a six-point Likert scale was completed. After the tests, six-point Likert scales were used to capture factors like perceived ease of use and usefulness of the tested app. All scales were developed based on the survey methods used by Chen and Chan (2014) for the STAM. We follow an *informed grounded theory* approach in analyzing the qualitative data collected during the tests (Glaser & Strauss, 1967; Thornberg, 2012) to derive novel insights concerning our field of research inductively. Due to our currently small sample size, our study does not claim general validity.

4 Preliminary Findings

Our sample currently comprises 50% men and 50% women and covers an age range from 65 to 85 years with an average age of 74 years. Except for one participant with intense gerontechnology anxiety, all participants were able to use the mHealth app and work through the predefined tasks with or without assistance. Our findings in the qualitative tests underscore the **usability requirements** regarding older adults identified in the literature: Due to limitations in physical functioning, buttons within the app have to be large, and the interface has to be intuitive (Caprani, O'Connor, & Gurri, 2012; Morey et al., 2019). Due to visual restrictions, the font size and contrast must also be large (Ishihara et al., 2001; Morey et al., 2019). Terminology in foreign languages should be avoided due to comprehension issues, and the navigation and graphical representation of data progression within the app should be kept simple (Morey et al., 2019).

Despite the small sample size, our results indicate an effect of all STAM constructs on older adults' **technology acceptance**. Constructs such as *physical functioning*, *health conditions*, and *cognitive ability* were also covered by the MOLD-US framework and affected participants' usage behavior and the perceived ease of use. The fewer the physical and cognitive limitations, the easier it was for the participants to use the app. *Gerontechnology anxiety* was the biggest barrier to using the mHealth app, whereas *social relationships* (e.g., family members and friends or consultation hours in intergenerational get-togethers) had a positive effect on usage behavior. Family members and friends are the first contact point for most participants regarding technical problems. The most considerable immediate influence on the actual use of the mHealth app was the **prior technical experience** that is not explicitly mapped in the STAM. Within the scope of our tests, the construct *of gerontechnology self-efficacy* proved to be the most significant influential factor on older adults' attitudes towards technology use and, thus, the actual usage behavior. The perceived gerontechnology self-efficacy was strongly influenced by one's **self-perception**, which is also not depicted explicitly in the STAM. During our tests, we discovered a considerable discrepancy and mismatch between some participants' self-perception and their actual ability to use the mHealth app. The older adults' specific age was less decisive for utilizing the mHealth app than their self-perception. We identified four user types, which are depicted in Table 1.

Table 1. User types identified from user tests.

User Type		Real Ability to Use the mHealth App	
		Low	High
Perceived Self-Efficacy	High	Overestimator	Matching High
	Low	Matching Low	Underestimator

When recommending or prescribing mHealth apps, physicians must be able to recognize and differentiate between these user types. This poses a challenge, particularly concerning users who misjudge their technological competence. The most interesting and surprising participant group for us are the "underestimators", who underestimate their technical competence and gerontechnology self-efficacy and have fewer difficulties using the mHealth app than assumed. These participants mainly rated their technical experience as "2" on a Likert scale ranging from "0" (not experienced at all) to "5" (very experienced), suggesting that they may not be able to use the mHealth app without assistance. This perception turned out to be wrong during the test, as this user group could mostly use the app independently and successfully complete the predefined tasks. Although these users could use the mHealth app autonomously, they would probably fall through the cracks of potential users if their doctor considered prescribing one. Research on how physicians could identify this user group and motivate them to participate and adhere to the usage of mHealth apps is required. These results, and particularly the identified mismatch between self-perception and actual capability to use the mHealth app, raise the following questions that we intend to investigate in our further research:

Which criteria, in addition to a corresponding diagnosis, influence the doctor's decision regarding which patients a mHealth app can be prescribed or recommended for? Does the patients' self-perception of their ability to use technology also influence the doctor's third-party perception and, thus, the willingness to prescribe a mHealth app?

5 Limitations and Next Steps

Due to the small sample size, our study only reveals indicators that shall be examined and substantiated in further research by enlarging the number of participants. As our preliminary results indicate that the participants' specific age has less influence on the actual use of the mHealth app than their self-perception, it is unclear whether this also applies to younger age groups. Further research with users of mHealth apps, including younger age cohorts, is required. Additionally, no DiGA or publicly available mHealth app was tested in our study, but a self-developed prototype. Testing other mHealth apps, which probably are less targeted at older adults, could yield different results.

In addition to practical implications for the usability of mHealth apps, like high color contrasts, intuitive interfaces, and large font sizes, our study contributes to research on seniors' technology acceptance by emphasizing the vital importance of perceived self-efficacy and indicating a potential mismatch between older adults' self-assessments and their actual ability to use technology. We intend to address these aspects more intensely in future research. Another focus of our research shall be on physicians, who play a crucial role in prescribing or recommending mHealth apps and are thus upstream of users' actual adoption decisions. In this context, additional models should be considered since the STAM may fall short of addressing the physician's specific role in the adoption process. Other extensions of the TAM, like the approach by Rau and Haerem (2010), including the perspective of organizational learning in the TAM, place more emphasis on technological gatekeepers' roles (Rau & Haerem, 2010).

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