Designing a Web-Based Application to Train Aging Adults to Successfully Use Technologies Important to Independent Living

Ronald W. Berkowsky(✉), Sara J. Czaja, and Philip D. Harvey

University of Miami Miller School of Medicine, Miami, FL, USA
{rxb285, sczaja, PHarvey}@med.miami.edu

Abstract. The purpose of this study was to develop and pilot-test a web-based application that could train a diverse group of aging adults to more successfully use technologies vital to functional tasks and independent, everyday living. The training application simulated the use of automatic teller machines (ATMs) and the use of a mobile phone to call and fill a prescription. Thirty-two adults (age range 28–71, 63 % aged 55+) were assessed at baseline on functional task performance by being given an ATM task and a prescription task assessment to complete. Participants then underwent 2 weeks of training before being given a follow-up assessment; informal evaluation interviews were also administered. Overall, participants found it easy to use the training interface and that the presentation of material was favorable, however some would have preferred less repetition in training tasks. Recommendations on application-development and design as well as training structure are discussed.

Keywords: Aging · Functional living · Independent living · Simulation training technologies

1 Introduction

In an increasingly technological society, more and more everyday activities are utilizing more advanced gadgets and devices with the purpose of making completion of these activities easier and more efficient. However, for groups who are at risk for decreased technology utilization or decreased tech-literacy and for those at risk for experiencing cognitive impairment (e.g., older adults) use of these advanced gadgets and devices may make completion of these activities more difficult. As an example, older adults who are used to filling a prescription by visiting a pharmacy and who have little experience with mobile phones (e.g., cellular phones or smartphones) may have difficulty with using these devices to refill a prescription. Previous research has shown that online-based training can increase the accuracy of successfully completing technology-based functional tasks. The purpose of this study was to develop and pilot-test a web-based application that could train a diverse group of adults, including middle-aged and older adults, to more successfully use technologies vital to functional tasks and independent, everyday living. The training application was developed with a touchscreen interface and designed to simulate technologies aging adults may need to use in their daily lives:

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automated teller machines (ATMs) and mobile phones used to call a pharmacy and refill a prescription. We discuss the design of the application and the training procedure and discuss results taken from evaluation surveys given to participants at the completion of the training. We also make recommendations on application development and design as well as training structure based on participant responses.

1.1 Background

Technologies are evolving at a rapid pace, so much so that they have become unavoidable in everyday life [1]. While most new technologies introduced to the market are developed with the purpose of making the completion of everyday tasks easier and more efficient, use of these technologies typically requires a certain level of technical know-how to successfully use and are not always intuitive. As such, those with little to no experience with technology or those with decreased tech-literacy are at a risk for not being able to successfully use new and evolving technologies which, in turn, can inhibit daily functioning [2–4]. The challenges of this disadvantaged group can be exacerbated among those experiencing cognitive impairment as this can inhibit the learning process and make mastery of new technologies more difficult [5–13]. Despite difficulties with learning and mastering new technologies, many aging adults recognize that it is an important endeavor to pursue in an increasingly technological society [1, 14, 15], although many lack the resources (access to the technology, lack of sufficient training) or the motivation to do so [2, 10].

Advanced technologies such as information and communication technologies (e.g., Internet-connected computers or smartphones) can be especially useful to aging adults experiencing functional limitations, as the communication and information capabilities of these gadgets and devices can allow the user to transcend these limitations [16]. As an example, frail older adults with mobility concerns (e.g., inability to drive, needing assistance to walk) can use ICTs to accomplish daily tasks that would typically require them to leave their home, such as grocery shopping or banking. Despite the advantages of ICTs and other advanced technologies in enhancing the lives of aging adults, those experiencing functional limitations are also less likely to utilize these technologies [11, 17].

A major barrier to successful use of evolving technologies among aging adults experiencing functional limitations, aside from physical barriers such as poor vision preventing the user from being able to see screens or buttons [11], is that of literacy. With technologies becoming embedded into our daily routines, successful use requires knowledge across a variety of domains, increasing the complexity of certain tasks especially to those with little technology experience. As an example, studies examining aging adults' use of online personal health records shows that successful navigation and use of such sites requires not only technological expertise, but also a certain amount of health literacy and numeracy skills [18–20].

Catering technologies to differing users based on digital and technological literacy, health literacy, or numeracy skills is not always feasible or possible. In the absence of more catered technologies, training designed to enhance technology use and make gadgets and devices easier to use becomes a necessity. Previous work has found that

when developing training protocols specifically for older adults and technology, online instructional programs that provide hands-on practice with task components (in contrast to instructional programs that provided written or visual information but do not allow for practice with the technologies or with simulations of the technologies) facilitated increased knowledge acquisition and transfer performance [4]. This study contributes to the previous literature by pilot-testing an online-based training application designed for aging adults to increase their technology skills, increase confidence in being able to use technologies associated with functional living, and allow them to perform daily tasks important to independent living.

2 Method

Data for this study come from a project titled "The Development and Validation of Computer Based Cognitive Assessment and Functional Skills Training Package" conducted at the University of Miami Center on Aging in the Summer of 2015. The purpose of the project was to develop a technology-based functional skills training application suite that could ultimately be integrated with cognitive assessment and cognitive training protocols; the final product would be able to assess the cognitive ability of the user based on functional task testing as well as train the user to gradually improve functional task skills. The sample consisted of 32 individuals: twenty identified as having severe mental illness or mild cognitive impairment and 12 identified as cognitively healthy. As this study was a pilot test of the training application, enrollment was open to adults aged 18+. Age ranged from 28–71, with 63 % of participants aged 55+.

The training application was designed to simulate the use of an ATM as well as the use of a mobile phone to call a pharmacy and refill a prescription. These tasks were deemed important to functional, independent living due to the prevalence of these technologies as well as their widespread use. The application was designed to be used with a touchscreen interface (e.g., touchscreen desktop computer, tablet) so as to more closely mirror the physical requirements of using ATMs and mobile phones (rather than using a mouse to click on the appropriate buttons). Our pilot-test was conducted using a touchscreen desktop computer. As shown in Figs. 1, 2 and 3, the visual appearance of the ATM and prescription training application emulated what one might see with these technologies in a real-world setting.

2.1 Training Procedure

The training sessions were designed based on previously tested guidelines regarding technology training for aging adults [21, 22]. Participants were asked to come in for 6 sessions: a baseline assessment, 4 training sessions, and a follow-up assessment. The first of the participants' 6 visits included acquiring informed consent, completing a baseline survey packet (more thoroughly detailed in the next section), and completing baseline assessment tasks. The baseline assessment tasks consisted of 1 ATM task and 1 prescription task wherein the participants were given instructions on completing an exercise related to using an ATM and filling a prescription using a mobile phone. Participants were allowed to complete the baseline assessment at their own pace.

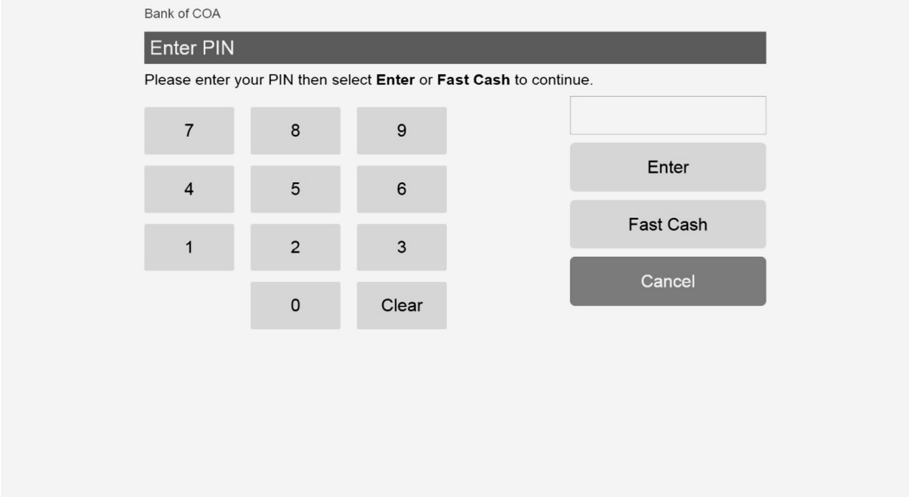

Fig. 1. Screenshot of "Enter PIN" screen from the ATM training application

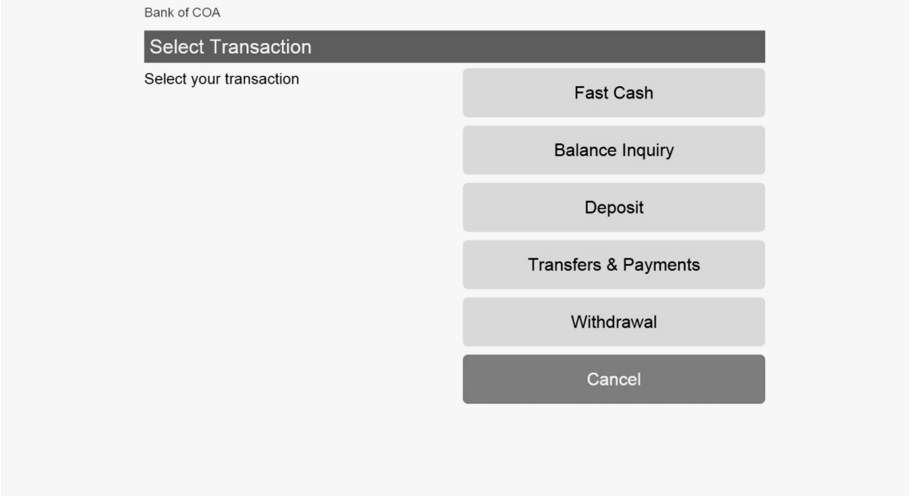

Fig. 2. Screenshot of "Select Transaction" screen from the ATM training application

After the baseline assessment, participants returned for 4 training sessions. The training sessions, when possible, were scheduled within a 2-week timeframe, however in some cases the timeframe was extended if there were conflicts with the participants' schedules. There were no time limits set for the training sessions (participants were given a certain number of tasks to complete and were thus free to complete them at their own pace); some were able to complete the trainings relatively quickly (approximately 30 min) while others took a great deal longer (90+ min).

Fig. 3. Screenshot featuring mobile phone and two pill bottles from prescription training application; participants must successfully choose which prescription should be re-filled based on information provided on bottles.

Participants were given a series of tasks to complete during each training session: 6 tasks related to using an ATM and 4 tasks related to filling a prescription using a mobile phone. At the beginning of each task, the participants were given instructions on how to complete the task. The training sessions would begin with simpler tasks (e.g., for the ATM training the first task involved viewing the balance of a checking account, and for the prescription training the first task involved filling the prescription of one empty pill bottle). If the participant made a mistake while completing the task, a pop-up window would appear re-stating the instructions of the task. If the participant continued to make mistakes, pop-up windows would continue to appear with detailed tips on how to complete the task. If the participant made mistakes even after these tips were revealed, the training application would then reveal the step-by-step procedure of how to complete the task by highlighting the correct buttons to push.

The training started with simple tasks but increased in difficulty (i.e., "levels") as the participant progressed. For the ATM training, tasks that the participants were asked to complete included withdrawing cash, transferring funds from one account to another, and depositing checks/cash. For the prescription training, participants would be provided multiple prescription bottles and would need to assess, based on the information from the bottles, which prescriptions needed to be refilled and then go about refilling the correct prescription(s) (e.g., in one task the participant is provided with two prescription bottles but only one bottle has remaining valid refills, and so the participant can only refill the prescription of the bottle with the remaining refills). A more detailed description of the levels is provided in Table 1.

Upon completing a set of tasks, the participants would then be asked to repeat the tasks based on their success in the first set. During this second set of tasks, the participant would begin with "level" below the last in which they made a mistake.

Table 1. ATM and prescription training task level descriptions

Task	Level and description
ATM	(1) View checking account balance
	(2) Withdrawal $175 in cash from checking account (note: because the ATM can only dispense $20 bills, participant must withdrawal $180 to complete task)
	(3) View checking account and make a withdrawal from checking account
	(4) View checking account, replenish checking account by transferring appropriate amount from savings to checking account, and withdrawal funds from checking account
	(5) Transfer funds into checking account (note: for this task the participant is provided with a checking account and 2 savings accounts; to successfully complete the task they must transfer funds from the correct savings account outlined in instructions)
	(6) Deposit 2 checks and cash into 3 different accounts (note: each check and the cash can only be successfully deposited in the corresponding account described in the instructions)
Prescription	(1) Participant provided with 1 prescription bottle – must call pharmacy and follow audio instructions to refill prescription
	(2) Participant provided with 2 prescription bottles – must call pharmacy and follow audio instructions to refill both prescriptions
	(3) Participant provided with 2 prescription bottles – must call pharmacy and follow audio instructions to refill the prescription which has remaining refills (note: only 1 of the bottles had refills remaining, the other had 0)
	(4) Participant provided with 2 prescription bottles – must call pharmacy and follow audio instructions to refill the prescription which had not expired (note: only 1 of the bottles had prescriptions that did not expire)

As an example, let us imagine a participant who, during the first set of ATM tasks, was able to complete levels 1, 2, 3, and 5 without any mistakes but then made mistakes on levels 4 and 6 – in this instance, when the participant begins the second set of tasks, they would begin with level 3 (a level below 4, the task in which they made their first mistake). Upon completing the tasks a second time, the participants would then be instructed to complete the tasks a third time, once again beginning a level below their last mistake made. The training session would end upon the completion of the third set of tasks.

If the participant was able to complete a set of tasks without making any errors, in the next training set the participant would be asked to begin from the first level and repeat all tasks. If the participant was able to complete all the tasks again without errors, the training session was ended early. Upon completing the 4 training sessions over 2 weeks, participants returned for a follow-up assessment where they were given 1 ATM and 1 prescription task to complete.

2.2 Data and Analysis

At the baseline assessment, participants were administered a survey collecting information on demographic characteristics, prior computer and Internet experience, attitudes towards computers, and self-assessed proficiency of computer use. A series of tests measuring cognitive ability were also administered. Participants were also given a Computer Tasks Evaluation Questionnaire at the completion of the baseline assessment tasks so that they may give their opinions on the training application (e.g., legibility of the text, touchscreen easy to use). At the follow-up assessment, the tests measuring cognitive ability were administered again as well as the Computer Tasks Evaluation Questionnaire once the follow-up assessment tasks were completed.

An informal, qualitative evaluation interview was also conducted at the follow-up assessment so as to allow for participants to give more detailed feedback on the training application and the training procedures. These interviews provide the primary data for this investigation. Participants were asked open-ended questions about whether they found the training useful, whether they found the training enjoyable, if they thought the training would help them carry out the tasks on a day-to-day basis, and how the training could be improved. These evaluations were systematically reviewed by researchers with qualitative training for common themes and concepts regarding what the participants liked and did not like about the training.

Data was also collected during the training sessions themselves in the form of log data and task observations completed by study personnel; however this data is not used for this investigation.

3 Results

3.1 Descriptive Statistics

The mean age of participants was 53 (as previously reported, 63 % of the sample was aged 55+). Sixty-three percent of the sample identified as male with most participants indicating they had a high school degree or less (67 %). Approximately 59 % of the sample identified as Black/African and 22 % identified as White Hispanic/Latino, 4 % as White Non-Hispanic/Latino, and the remaining 15 % as multi-racial or other. All participants who revealed income information reported a yearly household income of less than $40,000; fifteen percent reported less than $5,000 per year, 33 % reported between $5,000–$9,999 per year, 26 % reported between $10,000–$14,999 per year, and the remaining respondents reported somewhere between $15,000–$39,999 (note: 1 participant chose not to report income while 1 was unsure of the total). Regarding occupational status, most categorized their employment as “other” and, when asked to elaborate, indicated that they were unemployed due to disability (30 %). Eleven percent indicated that they were working full- or part-time, 11 % indicated they were retired, 7 % indicated they primarily performed volunteer work, and 15 % indicated that they were unemployed due to being laid off/actively seeking employment. The remaining participants indicated they were unemployed but did not indicate they were actively seeking employment.

3.2 Training Evaluation

The informal evaluation interviews administered after the follow-up assessment showed that a majority of participants were pleased with the training. Ninety-four percent of participants indicated that they found the training useful, 91 % indicated that they found the training enjoyable, and 91 % indicated that they believed the training would help them carry out the ATM and prescription tasks on a daily basis.

When asked to elaborate on how they found the training useful, common themes mentioned were that the training taught the participants something new and potentially important to everyday life (22 %), that the training helped to increase overall task performance to the point that the participants felt comfortable in their ability to perform the tasks outside of a training setting (25 %), and that they felt the training helped to train their memory and increase their attention and awareness to detail (31 %). As noted in one interview:

> *Was able to apply skills from the training classes to real-life. Indicated he actually filled a prescription via phone for the first time ever a week prior to follow-up, said "I wouldn't have been able to do it without this study. It was great."*

When asked to elaborate on how they found the training enjoyable, two predominant themes emerged: that the challenge of completing the tasks in conjunction with new skill acquisition was appealing, and that the training itself was fun and almost game-like despite not being designed as a game. From the evaluation interviews:

> *Tasks were challenging. "I like to challenge myself. I get enjoyment out of challenging myself." Liked how tasks made him "stop and think about things."*

Forty-one percent of participants highlighted that they gained personal satisfaction from the training through the process of learning something new and challenging themselves. Twenty-two percent specifically highlighted how they found the training fun. Interestingly, while the training was not designed to be used as a game, a few participants treated it as such to make the experience more enjoyable and to challenge themselves. As one participant noted, during each training session he would attempt to do it "as fast as I can" and try to complete the tasks faster with each session.

While some participants indicated that they had previous experience with using an ATM or using a mobile phone, the majority still indicated that the training would help them in accomplishing tasks on a day-to-day basis. Twenty-eight percent indicated that the training either taught them something new about completing these tasks or helped to reinforce what they already knew. The theme of memory and paying attention to detail also re-emerged, with 4 participants discussing how the tasks highlighted things they would not usually think much about:

> *The training helped to "reinforce what I already know." He felt he didn't learn anything new but the training made him more attentive. He brought up an example from the prescription tasks: "I pay attention to the writing on the prescription bottles more."*

Participants were also asked to be critical of the training application and training sessions and provide recommendations on what they felt may improve the experience. When asked how the training could be improved, the most prominent theme was that of repetition. Eight of the participants (25 %) felt that the tasks were repeated too often

with 6 others indicating that they would have preferred additional tasks that were more challenging and more diverse in the skills that were taught. Two participants also indicated that they would have liked to see more training programs that went beyond ATM and mobile phone/prescription tasks (e.g., training on the basics of using the Internet). Only one participant suggested tailoring the training sessions based on skill level, recommending that a survey be administered prior to the training measuring task knowledge and having the training sessions cater to the "problem areas" identified in the survey. Nine participants (28 %) indicated they wouldn't change anything about the training.

4 Conclusion

Research has shown that individuals with low levels of tech-literacy and experience and those experiencing cognitive declines may be less successful at utilizing technologies in everyday life [2–13]; this can pose as a significant issue for this group as technologies become more embedded in daily activities, potentially preventing these individuals from carrying out necessary tasks of daily functioning. This study pilot-tested an online training application suite designed to train aging adults in successful use of an ATM and use of a mobile phone to promote independent living. Results from informal interviews conducted after the training revealed that online-based programs simulating real-world technologies can benefit aging adults. However, a common criticism noted by participants was the repetition of tasks. While repetition is recommended in technology training [2] so that older adults can more easily absorb new material, many of our participants felt that this took away from the novelty and enjoyment of the experience, making some of the training sessions almost "boring." Participants also requested increased diversity in tasks as well as more challenging tasks.

As mentioned previously, the ATM and prescription training applications were the first of a proposed web-based application suite that would train aging adults to more successfully use gadgets and devices vital to functional tasks and independent, everyday living. In addition to modifying the design of the ATM and prescription applications as well as modifying the training procedures to better reflect the training needs and preferences of aging adults, our intent is to expand the number of training applications. Applications currently under development would train aging adults to more easily and successfully use ticketing kiosks, self-checkout counters (e.g., self-checkout kiosks found at a grocery store), and technologies used during a doctor's visit (e.g., a check-in kiosk). Such an application suite could assist aging adults with living independently in an increasingly technological society by training them to use technologies they may be unfamiliar with or training them to more successfully use technologies they may have little experience with or little understanding of.

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