Efficiency of a Video and a Tutorial in Teaching Older Adults to Interact with Smartphones

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Abstract. While smartphones and tablets increasingly offer the possibility to act as healthcare devices, older adults, who may benefit from these new technologies, might be left behind due to technological illiteracy and lack of proper instructions. This study documents an experiment to evaluate and compare different instructional methods to teach older adults to perform a task on a smartphone. Although we did find that older adults were able to learn, no significant differences between instructional methods were found, and retention period is not known. The qualitative analysis suggests some influence of the users' initial perception of task difficulty over task performance.

Keywords: Older adults, learning, smartphone, instructional materials.

1 Introduction

Information and Communication Technology (ICT) is becoming increasingly prevalent, namely within healthcare [1]. Disruptive services allow people to monitor their health at home and at their own pace [2]. Specifically, smartphones are being widely used as health monitoring devices. However, a number of older adults may be left out of these new possibilities due to technological illiteracy or inefficient instructions.

Guidelines on how to design for older adults may be found in the literature; however, there is a lack of studies focusing on whether or not older adults are able to learn certain aspects of interaction with ICT and what techniques may be used to enhance the learning process. Previous studies have examined older adults' preferences and needs for learning to use technology [3] and mobile devices [4], or have explored novel interfaces to improve learnability [5]. Other studies have assessed the efficiency of different instructional materials on older adults' ability to learn to use technological devices. Mykityshyn et al. focused on a blood glucose meter [2], Rogers et al. on Automatic Teller Machines [6], and Struve and Wandke on ticket vending machines [7], but to our knowledge, there are no studies focusing on smartphone applications. The goal of this study was two-fold: 1) understand how older adults learn to use touchscreen enabled interfaces and 2) assess the effectiveness of 2 different learning methods and compare their perceived ease of use by older adults. Ultimately, the results of this study aim to inform the design of solutions that support older adults in the process of learning novel interactions.

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2 Methods

The study was structured in two complementary phases that took place approximately two months apart. In the first phase we explored the effectiveness of an instructional video as a learning method with a control group; in the second phase we introduced an interactive tutorial. The protocol for each condition included two sessions that took place at different points in time – between 8 and 14 days apart (M = 11.45 days) – in order to understand short-term and long-term effects of the different learning methods (retention). Sessions took around five to thirty minutes and were video recorded.

Participants of the first phase were randomly assigned to either the instructional video or the control group; participants of the second phase were directly assigned to the tutorial condition. A demographic questionnaire was administered at the beginning of the experiment to gather information regarding participants' technological and educational background. In the first session participants were introduced to the smartphone and were taught the basics of the touchscreen interaction in order to provide a common ground among participants. The application and tasks were then described to all participants and additional instructions were given according to participants' assigned conditions. During the test participants did not have access to the instructional material. Before the beginning of each test participants were asked to rate their confidence; after the test they were asked to rate the task ease of use [8]. After the first test, participants in the two learning conditions were also asked two questions regarding the learning material.

The test consisted of two tasks: Task 1 required participants to turn off an alarm, and Task 2 involved participants adding a new alarm. Participants were required to complete two trials per session.

2.1 Materials

All tests were conducted with an HTC Titan with a 4.7' screen, running Windows Phone 7.5, and configured with the "dark" theme. The application used in the experiment consisted of the alarm clock that comes by default with the Windows Phone 7 (WP7). This application was chosen because 1) older adults are most likely familiar with a traditional alarm clock; 2) since it takes advantage of previous knowledge and experience of older adults with traditional alarm clocks, it was easier to devise and explain tasks to participants; 3) the task addresses a potential need of older adults, so they are more likely to be motivated and engaged; 4) it is not overly complex; and 5) it comes by default with WP7.

2.2 Instructional Materials

Instructional Video. The video used in the experiment guided participants step-by-step through the tasks. The video portrayed a person using the device form the user's point of view and was shown to participants through the device, given that on a realistic scenario the video would likely be used to assist older adults within the application. The video was also accompanied by the narration of the steps being performed.

The instructional video was 34 seconds in length and participants watched it between 1 and 6 times (M = 3.00).

Interactive Tutorial. The tutorial allowed participants to have a first contact with the application before the actual test. The goal of this learning method was to provide seniors with a hands-on experience and to explore a common learning pattern: learn by doing. Most participants chose to carry out the tutorial only once; only two participants completed the tutorial twice.

Fig. 1. Add a new alarm (left); Change the hour (right)

The tutorial consisted of a simulated interface of the alarm clock that included additional information to guide participants through the steps. In the interactive tutorial provided to participants steps were separated into discrete units, each one shown on a different screen. Each step required participants to complete a single action, which could be a tap or a swipe. To teach participants what were the trigger elements, screens were dimmed down, except for the areas relevant to the task (Fig. 1. , left). Based on a successful previous experience [9], a box with an arrow pointing to the trigger element was used to describe the action that had to be performed. To teach participants to swipe, an illustration of a hand pointing to the swipe area and with an animation of the correct gesture was used (Fig. 1. , right). While visually the tutorial was identical to the alarm clock, the interaction of was somehow different and stricter than the original time picker.

2.3 Participants

The study was conducted with thirty-three older adults with ages between 61 and 92 (M = 74.79, SD = 6.84), recruited from local day-care centers. Details of the participants may be found on Table 1. No formal screening was used to assess older adults' cognitive abilities or visual acuity. Participants were only required to be able to read.

Seniors' educational background varied greatly, ranging from no complete primary education to a doctoral degree. Nevertheless, the majority of participants only finished primary school or less (n = 21, 64%), seven participants (21%) went to middle school, and five (15%) achieved some sort of higher education. On average participants completed 6.56 years of education (SD = 3.82).

Most participants did not own a computer, nor had experience with computers or related technology. Only five participants owned a computer, and one participant was used to use one at work (this senior retired recently and did not use a computer since then). In contrast with computer usage, the majority of participants owned a mobile phone (90.9%, n = 30); only three participants did not own one, and in the tutorial group all participants owned a mobile phone. Of those participants who own a mobile phone, 70% use it every day. Although most participants stated that they use their phone on a daily basis, the usage that they give to the device is rather limited. From the feedback gathered, a large number of seniors would only use the phone to receive calls from their family. Frequently, the phone was a gift from their children or grandchildren. Older adults would recurrently comment that they did not know how to send or reply to messages or how to perform other more complicated tasks, and that they needed to ask their sons, granddaughters or nieces for help.

Of all thirty-three participants in the study only one owned a touchscreen device – this mobile device was not what it is ordinarily defined as a smartphone, but rather a feature phone with a resistive touch screen. However, sixteen participants (48%) had previous contact with smartphones through usability tests. While 71% (n = 5) of seniors had taken part in previous usability tests with smartphones, three of them had participated in those tests more than a year ago.

Table 1. Participant categorization

	Control (n = 13)	Video (n = 13)	Tutorial (n = 7)
Age (years)	73.23 (6.78)	75.92 (4.48)	75.57 (10.08)
Gender	8 F, 5 M	9 F, 4 M	6 F, 1 M
Education (years)	7.08 (4.03)	5.23 (4.51)	6.57 (3.82)
Computer	23%	7%	29%
Mobile phone	84%	92%	100%
Familiarity w/ smartphones	46%	38%	71%
Retention (days)	12.55 (1.58)	12.00 (1.67)	8.86 (1.07)

3 Results

3.1 Instructional Materials

In the end of the first session participants in the learning conditions were asked to evaluate on an 8-point scale how clear the instructional material was, and how easy it

was to learn to use the application. Participants in the video condition attributed an average rate of 4.15 to the first question and 4.23 to the second one. Participants in the tutorial condition attributed an average rate of 5.20 to the first question, and an average rate of 5.00 to the second one. When compared to the instructional video, these results may suggest that the tutorial has better acceptance among older adults, but with only five data points in the tutorial condition, a confident conclusion cannot be offered.

Nevertheless, when we consider that test subjects in general, but older adults in particular, tend to praise the material that they are being presented [10] and blame themselves for the difficulties experienced [11],the results obtained are rather low and seem to indicate that participants had real trouble understanding the instructional material. In sum, it seems that in both cases the overall learning experience was not as positive as desired.

3.2 Confidence Ratings

Confidence ratings were collected on an 8-point scale before each trial. The average scores for each trial are presented in Fig. 2. Participants in the learning condition began the experiment less confident than those in the control group. There was also an overall increase in participants' confidence ratings between trials within the same session, with the exception of participants in learning conditions in the first session. After the retention interval there were no substantial differences between groups in terms of participants' confidence ratings. Moreover, in the learning conditions, the decline in confidence after the first trial of the session was not observed.

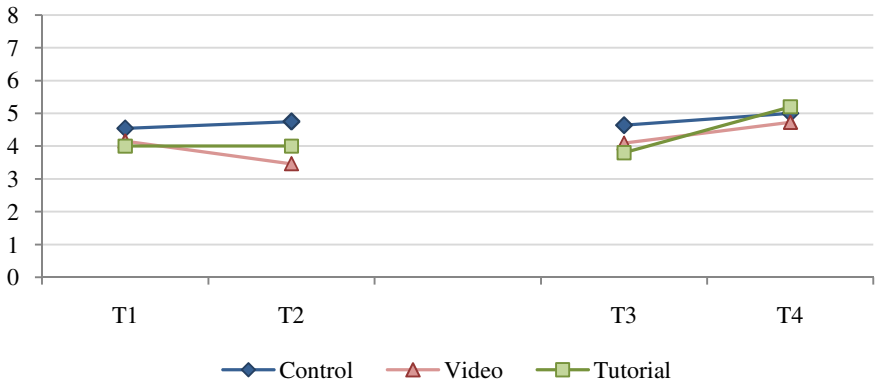

Fig. 2. Confidence ratings

3.3 Ease of Use Ratings

After each trial participants were asked to rate on an 8-point scale how easy they considered the tasks they had performed. The average scores for each trial are presented in Fig. 3. In the first session the average rates of participants in the video condition

were lower than the other two conditions, but similar to the control group in the second session. There was also a consistent increase on participants' ratings between trials, though stronger in the first session.

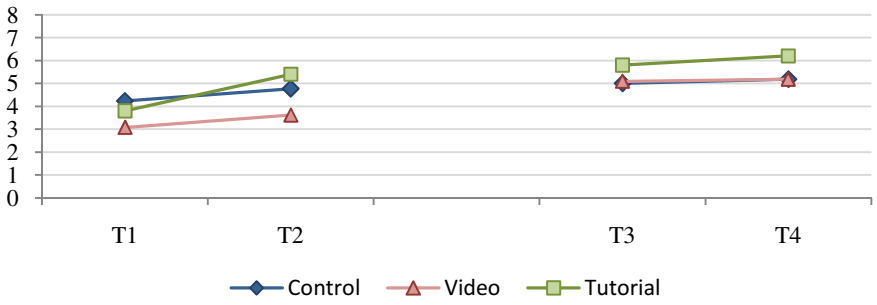

Fig. 3. Ease of use ratings

3.4 Performance

To evaluate participants' performance between groups we measured the completion rate, the completion time, and the number of errors. A task was considered completed with success when all subtasks were completed. No specific order was enforced, and subtasks were not required to be completed in a single run. The time for Task 1 was counted from the moment the phone was handed to participants, or as soon as participants finished reading the instructions (for those who chose to read the task instructions again), until the instant they turned off the alarm. The completion time for Task 2 was considered from the moment participants completed Task 1, or as soon as they finished rereading the instructions, until the moment they saved the alarm. Only participants who completed the task were considered in the completion time analysis.

	T1		**T2**		**T3**		**T4**	
	TC	T	TC	T	TC	T	TC	T
				Task 1: Turn off the alarm				
Control	92%	00:19	92%	00:06	73%	00:11	91%	00:04
Video	100%	00:05	85%	00:05	100%	00:08	100%	00:06
Tutorial	100%	00:03	100%	00:02	86%	00:05	100%	00:05
				Task 2: Add a new alarm				
Control	58%	02:09	58%	01:16	64%	02:29	73%	01:21
Video	69%	01:39	62%	01:34	82%	01:45	91%	01:15
Tutorial	86%	04:51	86%	02:27	71%	02:40	71%	01:29

T1-T4: Trials; TC: Task completion; T: Task completion time (mm:ss).

3.5 Task 1: Turn Off the Alarm

In the first trial participants in the learning conditions were more successful and faster than participants in the control group. Differences between conditions are less expressive after the first trial, which seems to indicate a threshold below which is not possible to complete the task faster.

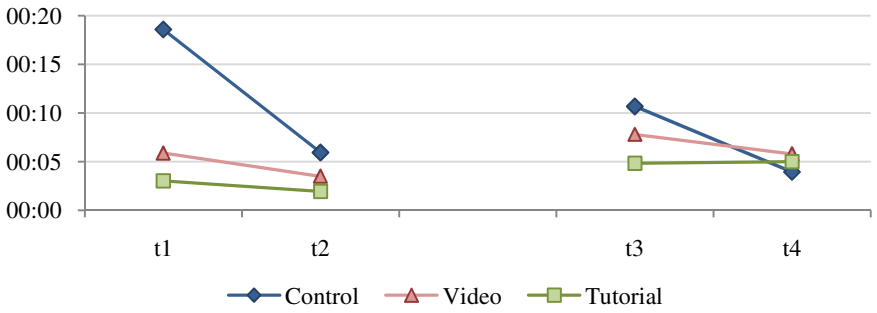

Fig. 4. Task completion time (geometric mean)

3.6 Task 2: Add a New Alarm

Compared to the results from Task 1, participants in the tutorial condition were slower than participants in the other conditions. On the other hand, these participants achieved a higher success rate. There were also considerable improvements between trials within the same session.

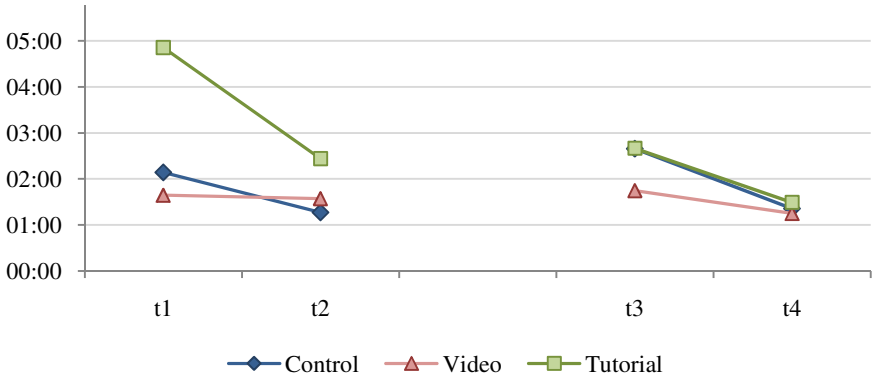

Fig. 5. Task completion time (geometric mean)

3.7 Gestures

To understand the influence of each condition in the teaching of new gestures, we looked into how seniors interacted with the time picker, since that was the only control that could be manipulated by tapping or swiping. This analysis took into account data from the first trial and included participants who had been excluded from the main analysis because they had not completed all sessions. As a result, the analysis included 12 participants from the control group, 13 from the video condition, and 9 from the tutorial. In the case of the tutorial condition, we excluded participants who were not able to swipe during the training stage, for the reason that they would not be able to transfer a gesture they did not have an opportunity to learn.

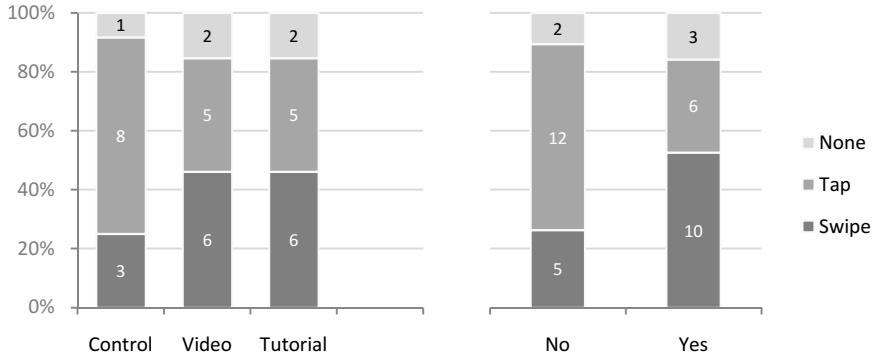

Fig. 6. Types of gestures performed by participants according to condition (left) and familiarity with smartphones (right)

The results suggest a positive effect of both learning conditions in coaching older adults the swipe gesture. That is, participants in the learning conditions were more likely to swipe while using the time picker. When we take into account familiarity with smartphones, the results also suggest a relation between familiarity with smartphone and swipe incidence.

4 Discussion

In this study we aimed to assess the effectiveness of an instructional video in teaching older adults to use a smartphone interface. We were not able to find consistent and significant differences between conditions in terms of seniors' learning, but we observed some differences worth analyzing. Furthermore, while this study pertains to a different domain and the methods are somehow distinct, these results are not consistent with findings from previous studies that found a positive effect of an instructional video [2] and a hands-on experience [6] in teaching older adults to use an interface.

We observed some noteworthy differences between conditions in some metrics. The first distinction that ought to be made is in the length and complexity of tasks.

The first task in the experiment was rather simple and only required participants to tap a simple button, so the burden on seniors' memory was minimal. Participants only had to recall where to tap and both learning conditions were effective in teaching older adults how to turn off the alarm: older adults were faster and more efficient. While most participants were able to turn off the alarm, seniors in the learning conditions were faster, and to our understanding, more certain of their actions. This does not mean that seniors in the learning conditions had a deep understanding of workings of the system or that they were fully aware of their actions, but indicates nonetheless that they were able to replicate what they had experienced moments before. While it is just a part of the learning process, mimicking some procedure can be a valuable step towards learning how a system works.

The second task was considerably more complex and it involved older adults performing several actions. Unlike the first task, the positive effect of the learning methods on participants' performance is practically nonexistent. In fact, participants in the tutorial condition were slower in the first session. Whereas in Task 1 seniors only had to recall a single action, in Task 2 they had to go through a sequence of screens with multiple actions. Given its complexity and length, completing Task 2 required participants to possess some grasp of computer interface idioms or to memorize the entire succession of steps. Knowing that seniors in the experiment had a very limited experience with computer interfaces, and that working memory capabilities are known to decline with age [12], can help to explain the ineffective role of both learning conditions in the second task.

Regardless of participants' actual performance, both learning methods seem to have induced a negative effect on seniors' perception. Participants in the learning conditions began the experiment less confident than seniors in the control group who only had a vague idea of the tasks. In short, knowing in advance the content of the experiment did not help making seniors more at ease; in fact, it might have done the opposite. Moreover, by the second trial participants' confidence had declined or stayed the same, an effect that was not observed in the control group or in the second session. Regarding the video, the origin for the conflict between participants' performance and perception pertains perhaps to the reference point that the video had created, that is, participants who watched the video possibly evaluated their performance against what they saw in the video. Thus, to be able to complete the task with success one ought to replicate the video. Given that tasks in the video were completed in an optimal manner, attaining an equivalent level of success was not unchallenging. The results from the assessment of the tasks' ease of use seem to pertain to the same underlying issue. That is, older adults in the video condition seem to have been conditioned by the video, and because they were not able to complete the task with the same level of accuracy/dexterity as the person in the instructional video, they assumed the task as being more difficult than what it really was. An implication of this finding is that a video that appears to be complicated might lead older adults to assume that they are not very capable, and thus reject the application.

In order to assess older adults' acquired knowledge, participants were retested after a retention interval of approximately 12 days, a period during which participants did not have access to the application or smartphone. Despite some improvements in

certain metrics, our results do not indicate consistent differences between sessions, which may suggest that the retention interval was enough to dissipate most of what older adults had learned in the first session. Only the results from Task 1, from participants in the control group, seem to show some retention between sessions. These participants were notably faster in the second session, which, given the ease of the task, may indicate that some learning occurred.

4.1 Gestures

With regard to the influence of learning condition in the type of gestures performed while interacting with the time picker, our results seem to suggest a relation between conditions and gesture performed: elders in both learning conditions were more likely to address the time picker with a swipe than participants in the control group. The swipe is arguably a less natural gesture than a tap, thus less likely to be inferred with ease. Even if brief, seniors in the learning conditions had a previous contact with the swipe, so they would only have to recall what they saw or did; whereas seniors in the control group would have to infer on their own how to manipulate the time picker. The result may be nevertheless cofounded to some extent with participants' previous experiences, since there was also a relation between the type of gesture performed and familiarity with smartphones, i.e. seniors who had used a smartphone before were more prone to swipe. Moreover, a closer analysis of participants in the control group who were able to swipe reveals that these seniors were the only ones in the control group who had experience with computers, and one even owned a touch device. These results support the idea that without prior knowledge, to infer a rather simple gesture such as swipe from the interface alone is not as natural as it may seem.

Although our results may suggest that both learning conditions attained some level of success in teaching older adults to swipe, it is not clear the extent to which seniors grasped the concept behind swiping – e.g. we cannot assert that seniors realized that a swipe is typically used to disclose hidden information. What we can at least hypothesize is that older adults in the learning conditions were able to develop an association between the swipe gesture and the action of changing the hour. For instance, one participant would start moving his hand over the screen, emulating the swipe, when asked to change the hour, even though he was on a screen that did not have any scrollable element; he just knew that in order to change the hour he had to do that gesture. While seniors were able to learn how to swipe with some level of success, further tests are needed in order to understand how well that concept was interiorized.

4.2 Limitations

A main limitation of this study lies on the sample, both in terms of size and in terms of older adults' representativeness. Thirty-three seniors distributed across three conditions took part in the study, which is a relatively small sample in particular when one considers the high variance in cognitive abilities and experience of participants.

The problem caused by the small sample is even more expressive in the tutorial condition, since we were only able to collect data from seven participants. Samples were also not entirely unbiased given that the study was divided in two phases and seniors in the second phase were assigned directly to that condition.

Older adults in this study also had a low educational background, and no experience, or almost no experience with computers and related technology. While older adults in this study may characterize a large portion of Portuguese seniors, they might not be representative of the overall senior population. By contrast with similar studies, the educational background of older adults in this study was considerably low. For instance, older adults in Mykityshyn's study [2] had on average 14 years of education, in contrast with approximately 7 years of seniors in this study. Given the small sample, an inhomogeneous group of seniors, and a not very representative sample, it is difficult to generalize the results with confidence.

5 Conclusion

In this paper we explored how effective two learning conditions – video and tutorial – were in teaching older adults to interact with a touch interface. We also looked at the long-term and short-term effects of the learning conditions for which we collected two data points. Despite noteworthy results in some metrics, we were not able to find significant differences between conditions, neither were we able to find consistent improvement across sessions. The problem may lie in the small and inhomogeneous sample; therefore further tests with better controlled samples may lead to more conclusive results. Further tests should also consider simpler and discrete tasks, in order to focus on the qualities of learning methods, and to not overload seniors' short-term memory.

Nevertheless, older adults in the study were able to learn. We found consistent improvements between trials within the same session, and older adults who had had previous contact with smartphones through usability testing achieved better results in their first session. The question is what the best strategies to instigate learning are, and for how long are older adults able to retain what they learn. Previous work showed that an interval of 24 hours does not produce a significant decline in performance [6]; whereas this present study and others [2] found a meaningful decline in performance after a longer period without access to the test material. Future work should also attempt to determine when a sudden decline in performance occurs in order to identify when the learning process has to be reinforced.

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