A Study of Novice Older Adults and Gestural Interaction on Smartphones

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Abstract
This paper presents two studies that investigate older adults' gestural interaction on smartphones. Specifically, the studies investigated gesture discoverability, the possibility of identifying a user-defined gesture set and the potential of contextual help mechanisms in teaching current gestures to users.

Author Keywords
Older adults; gestural interaction; smartphone.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): User Interfaces.

Introduction
Smartphones are becoming increasingly widespread, and are expected to be adopted by all segments of the population. In 2012 smartphones accounted for 44% of the mobile phone market share in the European Union (EU), and for nearly 42% in the US [1]. Moreover, industrialised countries have been suffering an acute demographic change, where the population is becoming increasingly older. In the EU 22.6% of the population is expected to be 65+ by 2030 [2]. In the USA this figure is expected to be 19.3% by 2035 [3].

Task	**Current smartphone gesture**
1. Scroll content	Swipe
2. Pan content	Swipe
3. Move an item	Swipe/drag
4. Select an item	Tap
5. Stop scrolling content	Tap
6. Zoom-in	Spread/ double-tap
7. Zoom-out	Pinch/ double-tap
8. Reveal contextual menu	Tap and hold/ shake device
9. Show magnified view of cursor	Tap and hold
10. Rotate	Rotate device

Table 1. Tasks for eliciting user-defined gestures, and corresponding current smartphone gestures.

Despite the current proliferation of touchscreen devices, several authors have noted issues related to the discoverability of the gestures used to manipulate these systems [4-6]. In addition, it has been argued that such discoverability issues could be due to the fact that existing gestures were mostly defined by systems' designers and have been essentially preoccupied with recognition issues and technical concerns, rather than their final usability [7]. In this context, Leonardi et al. [8] investigated gesture discoverability with older adults but did not consider all existing smartphone gestures, such as *pinch* and *spread*. In addition, several authors have explored the possibility of creating user-defined gesture sets with the objective of enhancing the usability of gestural interfaces by overcoming gesture discoverability issues [7, 9]. However, these studies have focussed on young adult users who are likely to be technologically more proficient than their older counterparts. In this context, our study aimed to assess the possibility of a novel gesture set created by older adults without any prior touchscreen experience.

Eliciting user-defined gestures

This study aimed to answer the following research questions: (1) are current smartphone gestures easily discoverable for older adults? and (2) do older adults, without prior touchscreen experience, perform the same gestures as those currently implemented by systems' designers? If not, which gestures do they perform?

Participants and apparatus

This study included the participation of twenty older adults, without prior touchscreen experience, recruited from several retirement homes and day-care centres within the city of Porto (14 female and 6 male), aged between 62 and 89 *(Mean = 74.2*). The study was conducted on a Samsung Galaxy Nexus measuring 135.5 x 67.94 mm, with a 1280×720 px display at 316 ppi. The sessions were video recorded on a Noldus Mobile Device Camera attached to the smartphone. The whole setup was light and easy to hold in one hand.

Procedure

In order to answer our research questions, we employed the method described in [7], where the authors present a study that investigated user-defined gestures for a large touch-surface. As in [7], participants were presented with an animation demonstrating the consequence of a gesture, and were then asked to perform a gesture they feel could result in that consequence. As seen in Table 1, an individual task was created for every function associated with a common smartphone gesture. No gestures were exemplified or explained during the pre-session debriefing, since we did not want to influence participants' performance, and intended to find the gestures that would be more "natural" to inexperienced users. All participants were asked to complete the same ten tasks.

Results

The most widely performed gestures were *taps* and *swipes*, which were respectively performed by 70% and 45% of participants on the *select an item* and *scroll content* tasks. Although a few novel gestures were performed (for e.g. swiping diagonally, from the centre of an object outward, in order to zoom-in) throughout the ten tasks, none of them was carried-out by more than 10% of participants and therefore could not be generalised into a user-defined gesture set. In addition, we found that more complex gestures such as *double-tap, touch and hold, pinch* and *spread* were not understood or discovered by any of our participants. Furthermore, when considering current smartphone gestures and comparing these with the gestures performed by participants, we found that on

Task	**Current smartphone gesture**
1. Scroll content	Swipe
2. Pan content	Swipe
3. Move an item	Swipe/drag
4. Select an item	Tap
5. Stop scrolling content	Tap

Table 2. *Tap* and *swipe* tasks for assessing the potential of contextual help mechanisms in teaching current gestures.

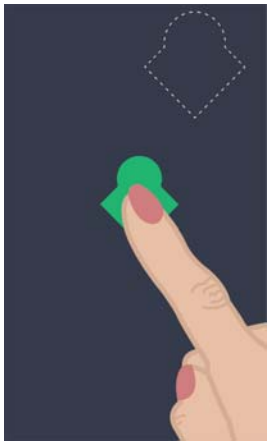

Figure 1. Example screenshot of the animated tutorial for the *move an item* task

existing smartphones (1) only 52% of participants would have correctly solved tasks requiring a *swipe* gesture; (2) 70% would have correctly solved tasks requiring *tap* gestures; (3) 20% would have solved those requiring *pinch* or *spread;* and (4) none would have correctly performed tasks requiring *touch and hold*. However, when analysing these results, it is noteworthy that in many cases participants stated not to know what gesture to perform, or how to solve the task, and would then proceed to simply *tap* or *swipe* the screen. This could mean that the high percentages of correct gestures seen for *tap* and *swipe* tasks could indeed be biased. Nonetheless, it seems that these two gestures were simple enough to act as stand-ins for cases when no other gesture was immediately obvious, which is consistent with the findings of [10] and [11]. Nonetheless, our results indicate that in many cases participants would not have been able to correctly perform a common set of smartphone tasks, hence we decided to further our investigation by assessing if we could effectively teach current smartphone gestures to our target-users.

Teaching smartphone gestures to older adults

This phase of research aimed to answer the following research question: if current smartphone gestures prove to be problematic, and if older adults do not propose a set of user-defined gestures, can we effectively teach them how to use the current ones?

The use of tutorials to teach touchscreen gestures to users has been explored by several authors [5, 6], with younger adult participants. In order to investigate the effectiveness of such tutorials with older adults, we developed a set of animated tutorials (Fig.1) for each of the gesture/task pairings to be evaluated. These tutorials had the objective of demonstrating not only the physical and motor execution of a gesture, but also which specific tasks each gesture can solve. However and unlike in the first study, only tasks that make use of *tap* or *swipe* gestures were considered (Table 2). Both these gestures, although still problematic, revealed to be the most immediate for older adults in the first study; they are also the most essential to operate a smartphone. Moreover, all other gestures, such as *tap and hold, double-tap, pinch* and *spread*, generally have UI buttons that substitute them, allowing users to accomplish the task without requiring the use of the 'correct' gesture. Therefore, we decided to assess the effectiveness of contextual help mechanisms in teaching the most essential gestures — *tap* and *swipe,* leaving the remaining gestures for future work.

Participants and apparatus

A new set of twenty older adults (15 female and 5 male), without prior touchscreen experience, recruited from several retirement centres and adult day-care centres within the city of Porto participated in this study, with ages between 60 and 90 years (Mean = 74.3 years old). The apparatus used was the same as described in the first study.

Procedure

As previously mentioned, only tasks requiring *tap* and *swipe* were considered, as outlined in Table 2. The animated tutorials were shown to the participants on the smartphone itself, after which participants were asked to solve each of the five tasks by making use of the gestures seen in the tutorials.

Results

Our results indicate that the introduction of the tutorials did improve correct gesture performance (Table 3) when compared to the first study. In sum, improvement levels

Task	(%) Correct gestures performed Study 1	(%) Correct gestures performed Study 2
1. Scroll content	45%	70%
2. Pan content	50%	85%
3. Move an item	65%	80%
4. Select an item	70%	90%
5. Stop scrolling content	75%	85%

Table 3. Comparison of participants' correct gesture performance between studies 1 and 2, according to each task.

for all tasks can be summarised as: (1) 25% for *scroll content*, (2) 35% for *pan content*, (3) 15% for *move an item,* (4) 20% for *select an item,* and (5) 10% for *stop a scrolling list.* The performance improvement supported by the introduction of tutorials is consistent with [12], where the authors believe that proper training can positively influence older adults performance and attitudes toward ICT devices.

Discussion

The initial goal of creating a user-defined gesture set was not accomplished. Contrary to what was expected, participants without prior touchscreen experience did not perform a novel set of gestures. The fact that older adults did not perform new gestures could be explained by the lack of previous experience with gestural interaction systems, where participants did not have the necessary knowledge to allow them to more freely explore gestures for the tasks presented to them. This is likely to change as new generations of older adults come into play.
Participants did perform *tap* and *swipe* gestures, although in many cases, this happened when participants did not know what else to do. The introduction of the animated tutorials did have a positive effect on correct gesture performance. In the future, it would be interesting to assess the long-term learnability of such gestures, with the aid of contextual tutorials, in real-world settings.

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References

[1] comScore *2012 Mobile Future in Focus*. 2012.

[2] European Commission and Economic Policy Committee, The 2012 Ageing Report: Underlying Assumptions and Projection Methodologies, 2011. p. 294.

[3] Department of Health & Human Services. *AoA (Administration on Aging)*. 2011 [05 December 2011]; Available from: http://www.aoa.gov/aoaroot/aging_statistics/index.aspx.

[4] Norman, D., The way I see it: Natural user interfaces are not natural. *interactions, 2010*. 17: p. 6.

[5] Bau, O. and W.E. Mackay, OctoPocus: a dynamic *guide for learning gesture-based command sets, in Proc. 21st annual ACM symposium on User interface software and technology 2008*, p. 37-46.

[6] Bragdon, A., et al., Gesture play: motivating online gesture learning with fun, positive reinforcement and physical metaphors, *in Proc. ITS 2010*, p. 39-48.

[7] Wobbrock, J.O., M.R. Morris, and A.D. Wilson, User-defined gestures for surface computing, in *Proc. CHI 2009,* p. 1083.

[8] Leonardi, C., et al., *An exploratory study of a touch-based gestural interface for elderly*, in *Proc. NordiCHI '10*2010, ACM Press: New York, USA. p. 845.

[9] Mauney, D., et al., Cultural similarities and differences in user-defined gestures for touchscreen user interfaces, in *Proc. CHI 2010,* p. 4015-4020.

[10] Beringer, N., Evoking Gestures in SmartKom - Design of the Graphical User Interface, in *Revised Papers from the International Gesture Workshop on Gesture and Sign Languages in Human-Computer Interaction 2002*, Springer-Verlag. p. 228-240.

[11] Voida, S., et al., A study on the manipulation of 2D objects in a projector/camera-based augmented reality environment, *in Proc. CHI 2005,* p. 611-620.

[12] Broady, T., A. Chan, and P. Caputi, Comparison of older and younger adults' attitudes towards and abilities with computers: Implications for training and learning. *British Journal of Educational Technology, 2010.* 41: p. 473-485.