INTERNATIONAL DESIGN CONFERENCE - DESIGN 2010
Dubrovnik - Croatia, May 17 - 20, 2010.

DESIGN 2010

TAP, SWIPE & PINCH: DESIGNING SUITABLE MULTI-TOUCH GESTURES FOR OLDER USERS

C. Stößel and L. Blessing

Keywords: gesture-based interaction, multi-touch interfaces, aging, user-centered design

1. Introduction

Multi-touch technology and finger gesture interaction are gaining ground. Since the iPhone brought this interaction concept from prototypes and isolated applications to the mass consumer market, this new way of interacting with devices with one or more fingers directly on the screen surface has become increasingly popular. The technology finds its way into a huge variety of consumer electronic products, ranging from cell phones, PDAs, digital cameras, or navigation systems, to digital photo frames, music players, laptops and even desktop computers. Moreover, the recent installment of Microsoft's operating system Windows 7 explicitly supports finger gestures. The big manufacturers' marketing departments are not getting tired of advertising these products as very "natural", "easy" and "intuitive" to use.

From a scientific point of view, however, it remains largely unclear what exactly is meant by these terms, and whether this emerging technology indeed facilitates interaction. A closer look at the different systems which are currently on the market reveals a large variety of different gesture names and interaction styles, as manufactures struggle to stake their claims in becoming the next interaction standard. A first attempt to identify common interaction patterns was made by Dan Saffer in his book "Designing Gestural Interfaces" [Saffer 2008], but while he lists interaction patterns found in different products on the market, we do not know which of them were really created considering the user's expectations and previous knowledge.

1.1 Aging users

If it was true that this novel way of interacting with technology facilitates interaction and enables a more intuitively usable interface, one user group could particularly profit from this development: the older adults (60+). It is widely recognized and substantiated by numerous studies that elderly users have often particular problems when interacting with existing everyday technology. [e.g. Fisket al. 2004, Czaja and Lee 2007]. The reasons why older users struggle especially with technology are manifold, but can often be attributed to the physical, perceptual and cognitive changes that accompany the normal aging process. In many cases, the problems arise already at the interface level. Older users frequently report problems related to too small devices, buttons and text, an overload of functions, as well as too many (unnecessary) menus which are hard to understand and recall (e.g. in the context of mobile phone usage: [Kurniawan 2008]). Some of these problems could possibly be reduced through appropriate touchscreen technology and gesture interactions, while at the same time new problems related to unfamiliar technology or loss of haptic feedback arise. Stößel & Blessing (2009) give a comparison of potential benefits and drawbacks of this technology for the older generation. In order to answer the question whether finger gesture technology is indeed beneficial to older users, and what might be appropriate design guidelines, we adopt a user-centered design approach and focus our research on the knowledge, needs and capabilities of the older users.

1.2 User-generated gestures

With more and more different suggestions for gestural interfaces appearing in recent scientific publications and also in commercially available products, there has been a growing interest in grounding these gesture patterns by user-centered research. A growing number of recent publications investigate the kind of gestures that non-technical users would make, and whether these match the concepts that product designers have suggested. For example, Wobbrock et al. [2009] propose a user-defined gesture set for generic actions on a large scale interactive display (Microsoft Surface). Frisch, Heydekorn & Dachselt (2009) investigate user-generated gestures on an interactive table display within a diagram editing scenario. A large scale study investigating user-derived gesture for handheld devices was carried out by the International Usability Partners (IUP) network and presented by Thalmeier & Koller (2009), focusing particularly on cultural differences in the use of multitouch devices.

1.3 Aim of the study

With the present study we aim at extending existing literature on user-generated gestures by the question of how age might mediate the kind of gestures that users make. By investigating whether older users differ from younger users in the kind of gestures they produce, and in which ways, we hope to identify guidelines how a multitouch interface on a mobile device should be designed especially for older users. The questions we are trying to answer with this research are:

1. Which gestures would younger and older users spontaneously generate to perform a range of typical actions on a mobile device?
2. What are the differences and similarities in the produced gestures between the two age groups?
3. Is it possible to derive gesture patterns which show considerable agreement among participants that then could be used as a basis for design recommendations?

2. Method

2.1 Participants

Central focus of this study was the comparison of two age groups. The average age within the older age group was 66.4 years (SD 3.4), whereas the younger age group was 24.9 years on average (SD 3.2). The total number of 53 participants was almost equally divided in 26 older users (13m, 13f), and 27 younger users (14m, 13f). While all of the young participants were using a mobile phone, this proportion was only 85% among the older users. All but one participant were right-handed, all had normal or corrected-to-normal vision, and reported no impairments of wrist or finger flexibility.

2.2 Apparatus

The study was conducted using a custom built handheld prototype (127 x 77 mm viewable surface), with an USB webcam (Logitech Quickcam Deluxe for Notebooks, 1.3 MP) attached to an aluminum arm protruding from below the base element (Figure 1). Due to its lightweight construction the prototype could easily be held in one hand and moved around freely. A USB powered LED light was mounted to the arm to provide lateral illumination of the surface in order to avoid reflections. The base itself held a stack of 42 action cards and was closed by a removable Plexiglas cover. The action cards depicted simplified screens for which the participants had to produce a gesture command. The design of the screens followed to a large degree the depictions used by Thalmeier & Koller [2009]. The final design was conceived as a compromise between two conflicting goals: On the one hand we tried to provide as little graphical detail as possible in order to avoid associations with any screen design of existing products and to ensure maximum generalizability of the gestures that the participants produced. On the other hand, we also had to provide enough detail to portray realistic interaction scenarios and ensure validity of the produced gestures, especially in the context of specific applications. Two examples of the scenarios we used are depicted in Figure 2.

Figure 1. Prototype on which the gestures had to be performed

2.3 Procedure

Before the participants were requested to generate gestures on the prototype, they were familiarized with the capabilities of multitouch interaction through a demonstration application on the iPod Touch. Care was taken not to anticipate any of the actions investigated in this experiment. Afterwards, the experimenter explained the usage of the prototype and the task by means of an example scenario (setting a clock) and showed video recordings of four different solutions to this task. These included a direct interaction, an iconic symbol, an alphanumeric symbol, and a two-finger interaction in order to raise the participants' awareness of the possible solution space. Each scenario was presented to the participant by means of a *before* and *after* screen on a 15" monitor, and each task was verbally explained, avoiding technical terminologies. For each action, the participants were instructed to perform a finger gesture on the surface of the mobile device, which, from their perspective, would seem intuitively appropriate to proceed from the current (*before*) state to the *after* state. We asked them to dip their fingertips in a little bit of black paste, consisting of hand cream and pounded artists' pastel, in order to leave a visual trace of their movement trajectory on the surface. After each task the experimenter cleaned the surface and removed the topmost action card in order to reveal the next scenario. After each gesture, participants were shown two 5-point Likert scales concerning perspicuity of the action, and perceived aptness of the gesture. The whole session was recorded through the USB webcam at VGA resolution. In total, with 53 participants and 42 actions, 53 x 42 = 2226 gestures were registered. The order of the actions varied between participants to avoid sequence effects.

2.4 Set of actions

The set of actions for which the participants had to produce gestures consisted of 42 different typical interaction scenarios for mobile devices. The set comprised the generic actions tested by Wobbrock et al. (2009) which were also applicable to handheld devices, and those investigated by Thalmeier & Koller (2009) which seemed relevant in a mobile usage context for elderly users, provided they were sufficiently easy to explain. For example, we discarded actions like *minimize window*, *maximize window* (only really suitable for large screen interactions), *print* or *save file* (less relevant for mobile interactions), and *continuous scroll*, *stop continuous scroll* (difficult to explain with a static prototype). We reinvestigated a total of 26 generic actions that were part of one or both of the previous studies, but extended the set of actions by a range of specific application functions which are highly relevant for mobile device interaction, for example in the field of music playback (e.g. *play*, *pause*, *stop* etc.) and telephone functions (e.g. *take call*, *end call*, *write message* etc.). An overview of all the actions that were investigated in this study is given in Table 1.

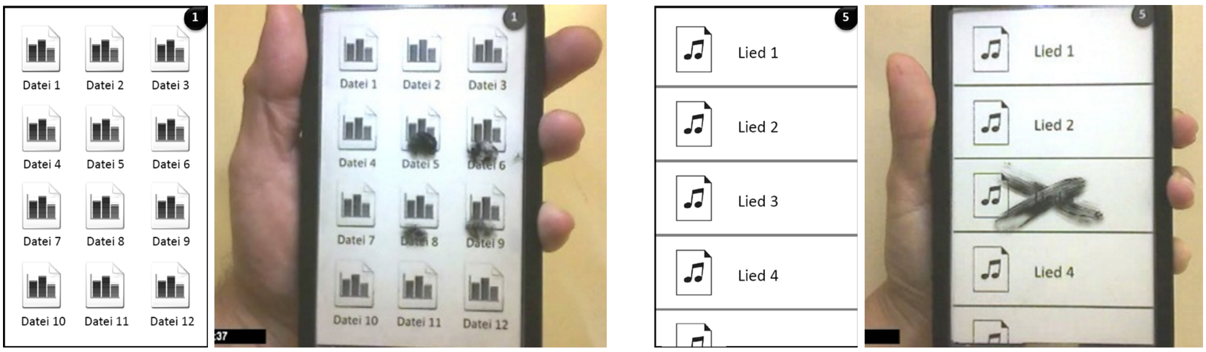


Figure 2. Two examples of the interaction scenarios and the associated user-generated gestures Left: Task "select multiple objects" together with the gesture *Tap multiple objects sequentially*. Right: Task "delete object" together with the gesture *Cross on object*

Table 1. The 42 actions for which participants had to produce gestures. Participants rated the perceived suitability of their gestures on a 5-point Likert scale (1 = very sure, 5 = very unsure)

Actions		Mean	SD	Actions		Mean	SD
1	select multiple (grid)	1,89	0,93	22	paste	2,96	1,27
2	select single	1,55	0,82	23	cut	2,77	1,20
3	select multiple (list)	1,94	0,82	24	undo	2,58	0,99
4	move object	2,06	0,97	25	redo	2,60	0,95
5	delete	2,08	0,98	26	open menu	2,42	1,12
6	confirm	1,81	0,92	27	home	2,77	1,14
7	cancel	2,75	1,07	28	help	2,72	1,08
8	open	1,91	0,99	29	play	1,55	0,70
9	close	1,94	0,93	30	pause	1,85	0,89
10	scroll down	1,81	1,02	31	stop	2,42	0,93
11	scroll up	2,00	0,96	32	fast forward	1,60	0,72
12	previous page	2,45	0,95	33	rewind	1,60	0,69
13	next page	2,23	0,91	34	next title	2,28	0,79
14	zoom in	2,02	0,95	35	previous title	2,36	1,06
15	pan (scroll side)	1,66	0,83	36	volume up	1,96	0,94
16	rotate	2,15	1,01	37	volume down	2,08	0,94
17	zoom out	2,43	1,15	38	take call	1,77	0,78
18	magnify	2,21	0,77	39	end call	2,28	1,01
19	shrink	2,30	0,97	40	make call	1,96	0,96
20	select text	1,91	1,02	41	write message	2,58	1,03
21	copy	2,72	1,04	42	send message	2,96	1,27

2.5 A gesture description language

In order to describe and categorize the produced gestures as precisely as possible, we devised a description language which was strongly influenced by the taxonomy proposed by Thalmeier & Koller [2009]. The grammar used to produce unique gesture descriptions in Extended Regular Expressions (ERE) notation reads as follows:

$$(attr?\ ((symbol\ char^*)\ |\ motion)?\ dir?\ finger?\ (rel_{space}\ loc)?\ rel_{temp}?\ sequence?)+$$

According to this grammar, a gesture description consists of at least one symbol or motion term to describe the central movement pattern, which then can be specified in greater detail by a couple of optional parameters, such as the *direction* of movement, the *number of fingers* used to perform it, as well as its *spatial relation* to screen objects and *temporal relation* to other gesture parts. The *sequence* parameter allows concatenating multiple description terms if the gesture consists of several independent parts (see Table 2 for detail).

The development of this formalism to describe the gestures was aimed at providing maximal parsimony of the gesture description, while at the same time maintaining readability. It was established as a well-balanced tradeoff between the specificity level on which a gesture is described, and the generalizability of the gesture description in order to subsume similar gestures under the same descriptor. On the most basic level, we classified the finger gestures as either *symbolic*, if the movement trajectory on the surface referred to a familiar shape or pattern (e.g. an arrow or a letter), or *direct manipulation*, if the movement trajectory signaled a direct manipulation of the entire screen (e.g. rotating the screen through a circular motion) or of specific interface elements (e.g. moving an icon by sliding the finger from start location to end location). Gestures that consisted of symbolic as well as direct manipulation elements were classified as *combination*. While the set of possible *symbols* is only limited by the user's imagination, we tried to restrict ourselves to the finite set of *motion types* listed in Table 2. The motion types we employed were precisely defined and in line with existing literature [Saffer 2008, Thalmeier and Koller 2009]. The only difference to previous descriptions is that we have subsumed all *straight movements* of a finger on the surface under the term *swipe*, irrespective of the speed of movement or the coupled functionality, and therefore created a unitary term for what has been labeled "slide", "swipe", "flick", "fling" or "drag" before.

Table 2. Elements of the gesture description language

Abbreviation	Name	Description	Examples
`attr`	attribute	Attribute of the symbol or motion, used to describe more complicated spatial patterns.	*dashed, curved, angled, cursive, semi-, quarter-*
`symbol`	symbol	A gesture visually depicting a symbol, e.g. an alphanumeric character, an arrow or other iconic depiction.	*arrow, arrowhead, letter(s), number(s,) word, plus sign, minus sign, cross, check mark, scissors, question mark, magnifying glass, bracket*
`char`	character	The sequence of one or more characters for alphanumeric symbolic gestures.	*1, 2, a, A, SMS, yes, no, ok*
`motion`	motion	The basic type of motion used in direct manipulation gestures.	*tap, double tap, triple tap, swipe, curve, pinch, spread, press & hold, circle, square, triangle, spiral, loop*
`dir`	direction	The direction in which a symbol or motion is performed.	*right, left, up, down, diagonal, diagonal up, diagonal down, clockwise, counter-clockwise, vertical, horizontal*
`finger`	number of fingers	Specifies the number of fingers or the order of finger with which a gesture part is performed.	*with two fingers, with three fingers, with 2nd finger, with 3rd finger*
rel_{space}	spatial relation	A local preposition describing the relation of the symbol or motion to the screen or interface objects.	*in, on, at, to, across, around, above, below, towards, left of, right of*
`loc`	location	Specifies where on the screen or over which interaction objects the gesture is performed. Objects could be e.g. an *icon*, a *textbox*, a *list entry*, a *progress bar* etc.	*object, multiple objects, another object, neutral space, the corner, the center, the top, the bottom, upper border, lower border, right border, left border*
rel_{temp}	temporal relation	The temporal relation in which different parts of the gesture are performed. The number of repetitions can also be coded.	*simultaneously, sequentially, twice, repeatedly*
`sequence`	sequence	A temporal preposition connecting different parts of a multipart gesture.	*then, while*

3. Results

The 2226 registered gestures were manually classified with the help of the recorded screen capture videos and the experimenter's protocol sheets. We created a glossary in which each unique gesture was referenced by a unique ID, its verbal description according to our description language, and a visual depiction (screenshot from the recorded video). Moreover, the glossary included information on the gesture's basic category (*direct manipulation*, *symbolic*, or *combination*), the *number of fingers* involved, and as an indicator of the gesture complexity, the number of *lines* and *strokes* the gesture consisted of. A *line* was defined as a section of the movement trajectory, from one resting point of the finger to the next. A *stroke* was defined as the trajectory on the surface from a touch-down event to the next touch-up event of a particular finger. The gesture glossary was sectioned according to the investigated actions. Each analyzed gesture was cross-checked with the already existing entries for this action. If it could be subsumed under any one of the already existing entries, it was referenced by the given ID; otherwise a new glossary entry was established. Within the boundaries given by the gesture description grammar, we followed the principle of parsimony: a simpler description was generally preferred if different descriptions were possible (e.g. "*tap on multiple objects sequentially*" was preferred to "*tap on object, then tap on another object, then tap on another object*"). Optional parameters were only applied if they were unambiguously evident from the video or protocol sheets, or made explicit by the participants (e.g. *tap* somewhere on the screen vs. *tap on* a specific *object*), if they were needed to set the gesture apart from similar ones (e.g. *curved arrow right* vs. (straight) *arrow right*) or generally needed by the gesture itself (an arrow needs a direction specification) or the task (the action "rotate" needs to specify whether a user-generated circular movement is performed clockwise or counter-clockwise).

3.1 Direct manipulation vs. symbolic gestures

Across all participants, direct manipulation gestures were the dominant interaction type (73.9%), while symbolic gestures were only used in 23.8% of all cases, and combined gestures only played a marginal role (2.2%). Interestingly, the proportion of symbolic vs. direct manipulation gestures differed significantly between age groups ($\chi^2(2) = 168.4$, $p < .001$). While the younger users produced direct manipulation gestures in 85.9% of the cases and symbolic gestures in only 12.4 % of cases, older users showed direct manipulation gestures in 62% and symbolic gestures in 35.3% of the cases. Figure 3 (left) reflects these different usage patterns (symbolic and combined gestures collapsed) between the younger and the older users.

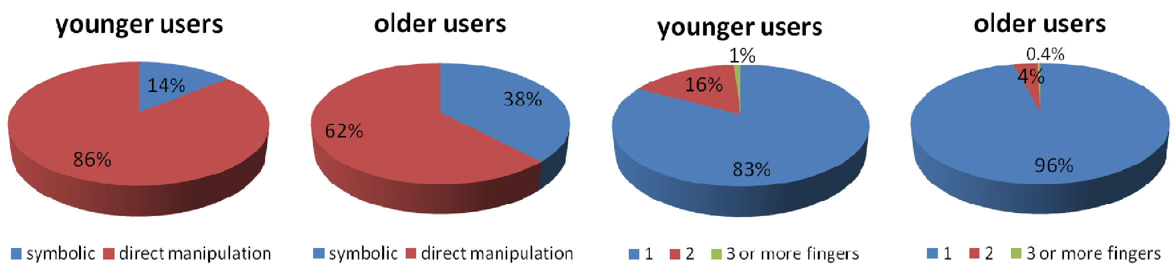


Figure 3. Left: Percentage of gesture type for older and younger users; Right: Percentage of the number of fingers younger and older users used to perform a gesture

3.2 Single- vs. multi-finger gestures

Even though participants were familiarized with multi-finger interaction on an iPod Touch device before the experiment and experienced the example of a multi-finger gesture during the instruction phase, they were free to choose the number of fingers they want to use for performing the gesture. Not surprisingly, the vast majority of proposed gestures (82.9% for the younger users, 96% for the older users) were performed with only a single finger, and the rest was performed almost exclusively with two fingers. Only 16 gestures in total (0.7%) were carried out with 3, 4 or 5 fingers. It is interesting to notice, however, that the younger users employed significantly more multi-finger gestures than the older users ($\chi^2(2) = 99.94$, $p < .001$) (Figure 3, right side).

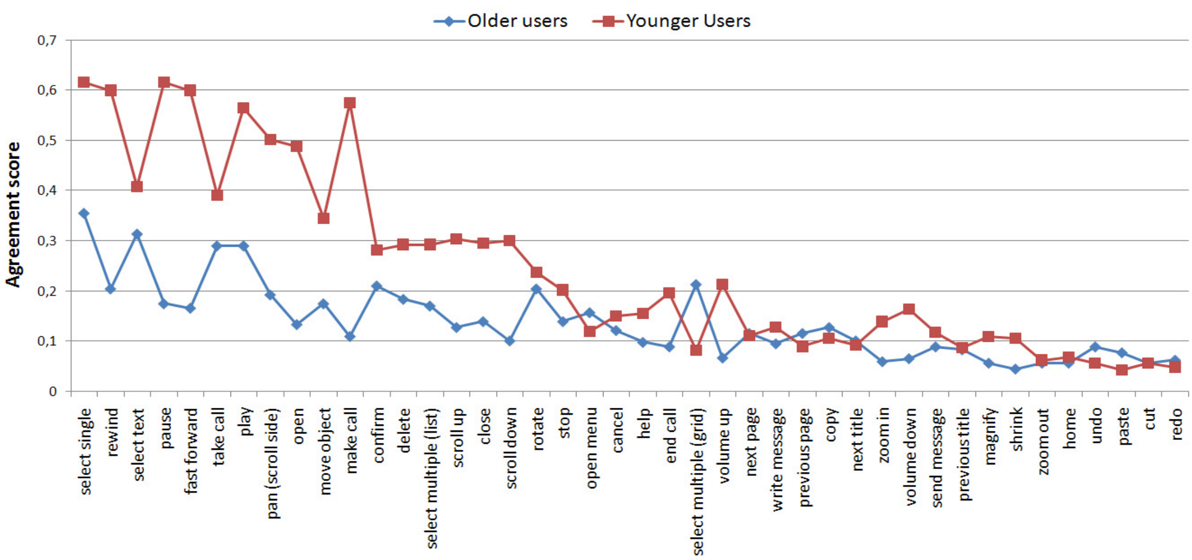


Figure 4. Agreement scores sorted from the highest to the lowest overall agreement

3.3 Agreement score

Of central interest in this line of research is to identify mappings between a gesture pattern and the function it triggers that are intuitive for a larger percentage of potential users. Using the described classification method, we obtained a minimum of nine different proposed gestures (e.g. for the actions "play" or "pan (scroll sideways)"), and a maximum of 40 (for the action "paste"), with an average variety of 22.6 different gestures per task. These numbers already show the high diversity of the produced gestures, but disregard the distribution of users over the proposed gestures. In order to assess the general agreement of users on their proposed gestures, we adopted the measure proposed by Wobbrock et al. (2005), which is defined as *agreement score A:*

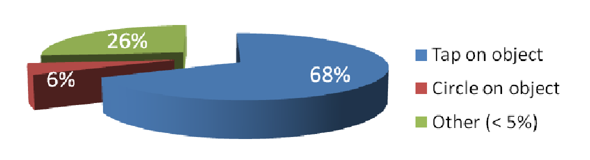
$$A = \frac{\sum_{r \in R} \sum_{P_i \subseteq P_r} \left(\frac{|P_i|}{|P_r|} \right)^2}{|R|} \qquad (1)$$

In this equation, R denotes the set of all tested actions, P_r is the set of registered gestures for a particular action, and P_i is the subset of identical gestures within P_r. The range for A is $[|P_r|^{-1}, 1]$. The higher the value of the agreement score, the higher the tendency of the participants to settle on the same gesture. We calculated agreement scores independently for the younger ($A = 0.247$) and older ($A = 0.137$) user group, which proved to differ significantly across the investigated actions ($t(54,24) = -3.56$, $p = .001$). Younger users appear to be more coherent in the gestures proposed for a particular action, while older users agree less and show a larger diversity of suggested gesture commands. The agreement scores for each action independently are shown in Figure 4.

3.4 Popular gestures

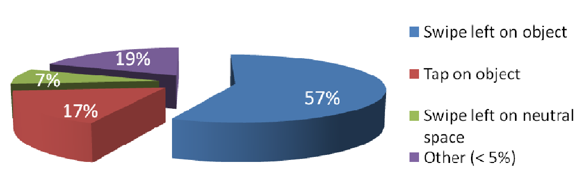
It is beyond the scope of this article to present and discuss the results for all the 42 investigated actions. We therefore limit ourselves here to the eight tasks where participants showed most agreement. The following pie charts display the overall percentages of the produced gestures, showing all gestures with less than 5% averaged occurrence collapsed into the "other" category.

Select single



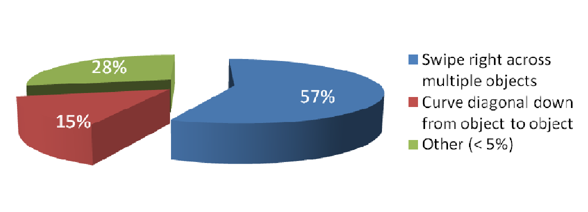
The selection of a single object (from a list) was consistently performed most often by a single *tap on the object* (old: 57.7%, young: 77.8%). While younger users also performed a *double tap* for selection (7.4%), older users also circled the object (7.7%) or drew a check mark on top (7.7%).

Rewind (Song)



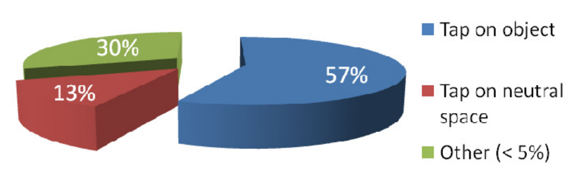
The most common gesture to rewind a song was a swipe left on the song progress bar (=dragging its end further left; old: 38.5%, young: 74.1%). While the younger users almost exclusively interacted with the progress bar (tapping further left was the alternative gesture, 22.2%), older users also interacted with the surrounding space, e.g. swiped left on neutral space (15.4%).

Select Text



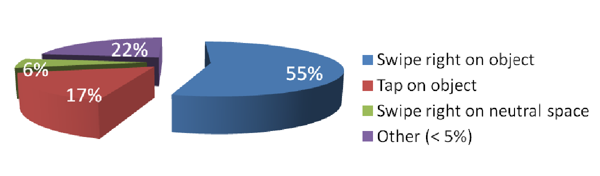
Both young (59.3%) and old (53.8%) users preferred to swipe right across several words in order to select a text segment. As the text segment had to be selected across a line break, the only other gesture that achieved some consensus was to move down from the beginning of the first word to the end of the last word, imitating a text selection across lines with pressed mouse button (young: 22.2%, old: 7.7%).

Pause



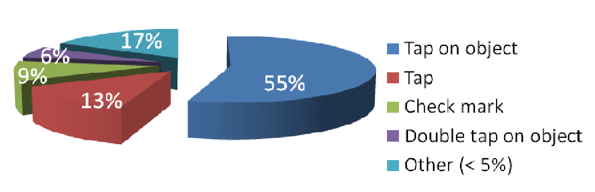
Pausing a music playback was mostly attempted by tapping on the play symbol (▶), which was intended to signal the current playback mode, but was conceived by the participants as an interaction object (young: 77.8%, old: 34.6%). While 19.2% of the older users also tapped somewhere else on the screen to pause, only 7.4% of the younger users thought this appropriate.

Fast Forward (Song)



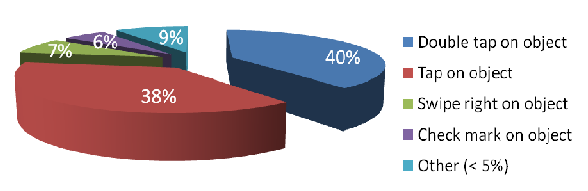
The gesture to fast forward a song was generally the opposite from the rewind gesture, therefore a very similar picture emerged: Swiping right on the song progress bar was performed by 74.1% of younger users (34.6% old), tapping further right on the progress bar was performed by 22.4 % of younger users (22.2% old), and swiping right somewhere else was only used by older users (11.5%).

Take call

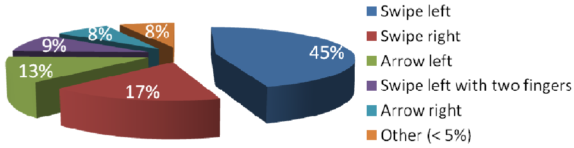


The dominant gesture to take an incoming call was to tap on a specific interface object (in our case a telephone symbol), for older users (50%) as well as younger users (59.3%). Considerably less frequently the participants performed a tap somewhere else on the screen (old: 15.4%, young: 11.1%), drew a check mark (✓) (old: 7.7%, young: 11.1%), or double tapped on a symbol.

Play



In order to play a song from a selection list, younger users preferred a double tap (70.4%) over a single tap (25.9%), while older users clearly favored a single tap (50%) over a double tap (7.7%). The symbolic gesture (check mark on object) was only used by the older user group (11.5%), and they also swiped right across the list entry more often (11.5%) than the younger users (3.7%).

Pan (Scroll sideways)	
	In this scenario participants were asked to move a map sideways, so that another section appears on the screen. Not only were the gestures quite diverse in general, younger users also solved this task quite differently from the older ones. While the younger users preferred a swipe left (66.7%), followed by a swipe left with two fingers (18.5%) and a swipe right (14.8%), older users made heavy use of arrows (left, 26.9%, right 15.4%) and swipes (left 23.1%, right 19.2%). Even though left-pointing gestures outweighed right-pointing ones, there was no clear consensus on the appropriate direction.

4. Discussion

Before we discuss the presented data, we have to keep in mind the limitations of our approach. The deliberate choice to present the screen stimuli by means of a paper prototype instead of a real device was taken in order to avoid a bias of the participants towards a certain interaction style, and second, to counter expectation that the device would react to the "right" gesture. However, the drawback of this approach was the lack of immediate feedback, which sometimes might have produced confusion that would not have arisen on a real product. For example, for the action of "scrolling a list" (up or down), we observed disagreement – in line with the reports from Thalmeier & Koller [2009] – on the appropriate direction of finger movement (e.g. for the "scroll up" action, 26.4% of the participants wanted to *swipe down across multiple objects*, while 28.3% wanted to *swipe up*). On the other hand, this approach also opens up the possibility to look beyond some seemingly well established finger gesture patters. For example, the task of "zooming out" received very low agreement scores for older *and* for younger users, even though many people, especially the younger ones, are familiar with the suggestion of a *2-finger pinch* movement that Apple advocates for this type of interaction. In our study, in fact only 13.2% of all users performed this *diagonal pinch* movement. We also have to bear in mind that all percentages and agreement scores given in this article are dependent on the granularity of the gesture categories. It should be evident that, in principal, each gesture could be described at an arbitrary level of detail ("*swipe*" vs. "*swipe down slowly with 2 fingers from second object for 3 cm near the right border of the screen…*"), resulting in different levels of agreement. We strived for a balance between specificity and generalizability (see *Methods* section), and more importantly, aimed for consistency by introducing the formal description language. The distinction between a direct manipulation and a symbolic gesture was also in some cases not as clear-cut as it might have seemed at first glance. For example, a direct manipulation *swipe right* and a symbolic *minus sign* look identical from the produced gesture patterns, and could only be told apart by additional context information, e.g. the verbal description of the participant.

This being said, we can still observe a couple of interesting findings and attempt to answer some of the questions raised in the introduction. A first interesting observation was that older users produced considerably more symbolic gestures than younger users. Where the younger users often fell back to patterns of multiple taps or swipes, older users were more creative in drawing symbols such as a magnifying glass (enlargement), a stylized letter (write a short message), a pair of scissors (cutting text), a phone receiver (calling), or a stylized house (home) on the screen. It might be the case that in less evident scenarios, iconic gestures of simple familiar shapes fit the mental model of an older user better than a somewhat arbitrary (albeit more efficient) direct interaction pattern. Another interesting result was that younger users made considerably more use of multi-finger interaction. This could be attributed to a higher level of exposure to existing multitouch devices. Even though older users were explicitly pointed to using also several fingers if they deem it appropriate, it seemed more natural and parsimonious for them to resort to single finger gestures. Thalmeier & Koller [2009] report a higher congruence of gestures among experts in relation to novice users. We observe a similar dissociation between older and younger users, with a significantly larger variety among the older user group. A possible explanation for this observation is the higher pervasion of multitouch devices in this age group, which might have led to a bias towards already familiar gesture patterns and thus created a higher level of standardization. Comparing the agreement scores with the scores reported by

Thalmeier & Koller (2009), we obtain a mixed picture. We find high similarities especially on the lower end of the spectrum, where actions like undo, redo, cut, copy and paste seem to be particularly difficult to be represented by a commonly accepted gesture. We could not recreate their particularly high agreements for the "rotate" and "move" actions, which could be due to a different coding of the actions, or a particular deviation of the older age group. The general range and distribution of agreement scores, however, is highly similar between the two studies.

5. Summary and Outlook

The present study establishes a first link between the research fields of user-driven gesture development on one side, and interface design for older adults on the other. On a general level, we could show that older users are more diverse in their proposed gestures as compared to younger users, that they rely stronger on single-finger interaction and employ more symbolic gestures than younger users. In section 2.4 we described a set of simple gestures which the participants strongly agreed upon for a limited range of actions, but also pointed out differences between older and younger users for specific actions. Further detailed analysis of all tested actions will lead to a more comprehensive picture where differences between the age groups arise, and where similarities prevail. These findings should be of relevance for all designers of interfaces or interactive products employing multitouch and gesture technology, to ensure an inclusive, senior friendly interaction concept.

Acknowledgement

This research is supported by the German Research Foundation, (DFG - 1013 `Prospective Design of Human-Technology Interaction') and by the National Research Fund Luxembourg, FNR (AFR grant). Special thanks to Sylvia Le Hong (User Interface Design GmbH) and Dan Mauney (Human Centric) from the International Usability Partners (IUP) for valuable insights into their interesting research, and in particular for the cession of the prototype. We thank Christine Sturm for her help with study preparation and data analysis.

References

Czaja, S. J., Lee, C. C., "The impact of aging on access to technology", Universal Access in the Information Society, Vol.5, 2007, pp 341–349.

Fisk, A. D., Rogers, W. A., Charness, N., Czaja, S. J., Sharit, J., "Designing for older adults", CRC Press Boca Raton USA, 2004.

Frisch, M., Heyekorn, J., Dachselt, R., "Investigating Multi-Touch and Pen Gestures for Diagram Editing on Interactive Surfaces", Proceedings of the ACM International Conference on Interactive Tabletops and Surfaces (ITS 2009), Banff Canada, 2009.

Kurniawan, S., "Older people and mobile phones: A multi-method investigation", International Journal of Human-Computer Studies, Vol.66, No.12, 2008, pp. 889-901.

Saffer, D., "Designing Gestural Interfaces", O'Reilly Media Sebastopol CA, 2008.

Stößel, C., Blessing, L., "Is gesture-based interaction a way to make interfaces more intuitive and accessible?", In HCI 2009 Electronic Proceedings: WS4 - Prior Experience, Cambridge UK, 2009.

Thalmeier, S., Koller, F., „Multi-Touch-Produkte: Welche kulturellen Unterschiede und Gemeinsamkeiten gibt es bei der Nutzung von Gesten?", Proceedings of the Usability Professionals 2009, Berlin, 2009.

Wobbrock, J. O., Aung, H. H., Rothrock, B., Myers, B. A., "Maximizing the guessability of symbolic input". CHI '05 extended abstracts on Human factors in computing systems, 2005.

Wobbrock, J. O., Morris, M. R., Wilson, A. D., "User-defined gestures for surface computing", Proceedings of the 27th International Conference on Human Factors in Computing Systems, 2009.

Christian Stößel, M.Sc.
Research Training Group "prometei", Center for Human-Machine Systems
Technische Universität Berlin, Franklinstrasse 28-29, D-10587 Berlin
Telephone: +49 (0)30 314 29638
Email: christian.stoessel@zmms.tu-berlin.de
URL: http://www.prometei.de