Training the Elderly in the Use of Electronic Devices

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Abstract. Technical devices and software applications with an increasing number of functions are appearing on the market. With an aging population, there is a growing need to consider less experienced users. Integrating training applications in technical devices is a promising approach to close the knowledge gap of these users. But how should a training application be designed? We developed a training program which teaches the use of a mobile phone in a task oriented manner. Training versions were designed which differ in their degree of interactivity: The learner trained either with an improved paper-based manual or with an interactive e-learning application, which integrates guided exercises in the learning process. These training versions are compared experimentally. Preliminary results show that both groups learned successfully to use a mobile phone.

Keywords: older adults, training study, e-learning, interactivity, paper-based manual, mobile phone, training success.

1 Introduction

With an aging population, there is a growing recognition of the need to consider elderly users when designing products. In general, electronic devices such as mobile phones have not been designed with the elderly in mind and are usually difficult to use for them. There are different approaches to improve the matching between technical devices and elderly users.

One approach is to design special products for the elderly. This may appear to be very simple: design devices with a large display and a small selection of big buttons offering some basic functions only. These simple products often seem to be over-accommodated; this occurs when the technical device is too reliant on negative stereotypes of aging [7]. Over-accommodation poses problems such as creation of parallel technologies, growth of the gap in the use of current electronic systems and discrimination of the elderly. Nevertheless, usability of technical systems has to be

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addressed in the design process, because well-designed products support understanding and learning.

Another approach is to bridge the gap and help the elderly to learn how to handle current devices. This approach focuses on the potentials and resources of the elderly and has some benefits. Through adequate training individual resources are activated and deficits are compensated. Elderly users are able to transfer their knowledge and experience to other devices and are independent of specific products.

Our research project aims at assisting the elderly in learning to use electronic devices. But what technology training is appropriate for elderly people with little experience in the use of electronic devices? Taking the example of mobile phones, we investigated how elderly, less-experienced people can be supported in learning to use technical devices.

2 Theoretical Background

Generally, aging is associated with a decline in sensory and motor performance as well as cognitive basic capacities [18]. For instance, Freudenthal [8] found that in comparison to younger adults the elderly perform slower in an information retrieval task which required searching in a hierarchical structure. Moreover, differences between younger and older adults could often be traced back to the generation effect, i.e. elderly users having less experience with technical devices [15]. For example, handling a hierarchical structure relies on knowledge about interaction techniques - such as multiple mapping - that are unfamiliar and confusing to less experienced users. Baldi [1] found no relationship between age and training success after adjusting for trainees' knowledge of technical devices. Furthermore, elderly users differ from younger ones regarding their computer-related self-confidence [13]. Jay and Willis [10] show that the age-related lack of computer-related self-confidence can be modified by direct experience with computers.

Baltes and Baltes [2] postulate that the elderly optimize their performance by extensive practice. There is strong consensus that older adults are able and willing to learn the use of technology [14] [1] [6]. Comparing younger and older novice adults, the elderly take longer to get trained, perform less well after training, and need more help [1] [4] [6]. This decreased performance is correlated with the complexity of the technical device [20]. Computer-related self-efficacy (e.g. expectation of training success) mediates the relation between age and skill acquisition [1] [16]. Therefore, any training application should keep the initial barrier low.

Fisk et al. [6] give some recommendations about how training for elderly users should be designed. The subject matter should be divided into short lessons that motivate through immediate success. There is a favorable effect if lessons and exercises take turns [6] [9]. In contrast to young people who like exploration-based learning, the elderly prefer explicit training [15].

Further hints for designing training for the elderly could be derived from an interview study [3] which we conducted with 20 mobile phone users aged from 58 to 80 years (mean 68). It became clear that a complete step-by-step explanation of required actions is needed. To address the needs of inexperienced users, a chapter providing an easy introduction to basic functions is necessary. This is in line with

Morell et al. [14], who found that simple step-by-step instruction facilitated the elderly's skill acquisition better than expanded instructions. When reading manuals, many elderly users practice every function extensively. In doing so, they prefer task-oriented descriptions augmented by feedback from the display. Additionally, the participants suggested that cartoon illustrations might help, showing the buttons that have to be pushed and the associated changes in the display. In line with Fisk et al. [6] [5], elderly users tend to learn better when the instructions are highly structured, task-oriented and consistently organized.

3 Designing Training Applications

A task-oriented training application was designed which teaches all basic functions of a mobile phone in short lessons. The user interface of a mobile phone was simulated on the computer (Fig. 1). The simulation is as complex as current mobile phones and provides basic functions for several components such as phone book, calling lists and messages (see Fig. 2). The trainees interacted with the simulated mobile phone via a touch screen.

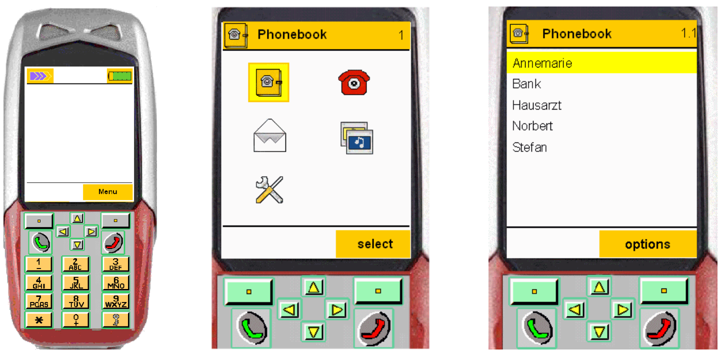

Fig. 1. Screenshots of the simulated mobile phone (menu language translated from German): complete (left), main menu (middle), phone book list (right)

Every lesson starts from the initial display of the mobile phone. The order of the lessons is based on the complexity of the training tasks. Tasks ranged from easy ones, like "dial a number ", to more complex ones, like "add a new number to your telephone list". Complexity is defined as the number of new rules that must be acquired to perform the task successfully. Following Lee et al. [12], a new rule is unique to the current task or is appearing for the first time in the training series. Every lesson has three parts: (1) Introduction to motivate the trainee and explain the goal of the lesson, (2) Step-by-step guided tour from the first display through the task and back and (3) Exercises with which to practice the task.

Two training versions were designed: an interactive e-learning application and a paper-based manual (Fig. 2). Both training versions provide the same content in 27 lessons and are based on the basic approach outlined above. The paper-based manual offers the step-by-step guided tour by text instructions, which are structured into paragraphs with coloured screenshots of the mobile phone. In the case of the interactive training, the step-by-step guided tour is realized by speech. When the trainee presses the correct button, the next step will start. The speech-based training can be fully integrated into a mobile phone.

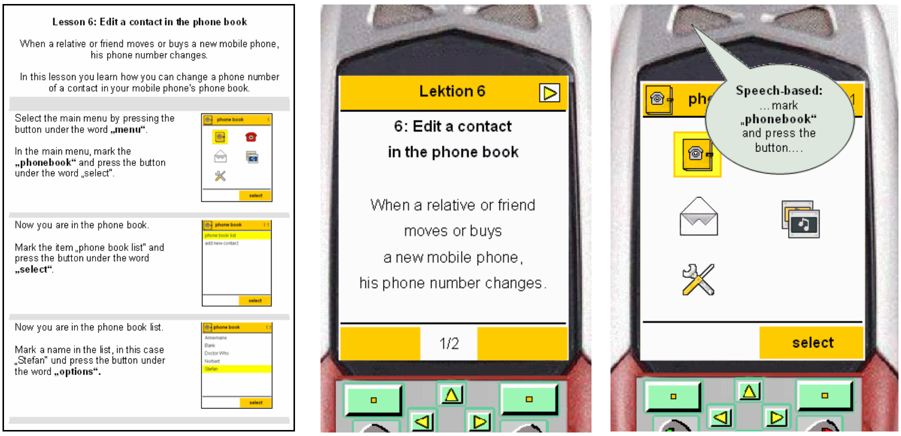

Fig. 2. Compared training versions (menu translated from German): paper-based manual (left) versus interactive e-learning application (middle and right)

Interactive training seems to have some advantages over paper-based training with manuals. Through interactive training the attention is guided to important aspects and the understanding of the link between actions, changes in display, and intended functions is supported. Ritter and Wallach [17] compared two learning environments with different activity demands on learners: an interactive and a non-interactive learning application. They found strong effects of interactivity on training success. Furthermore Morell et al. [14] as well as Kemper and Lacal [7] reported that switching between different tasks or media caused high cognitive effort for elderly users. Switching costs arise if the trainee has to alternate between paper-based manual and technical device. Since interactive training is integrated in the device, switching costs are reduced. Kelley and Charness [11] and Baldi [1] summarized that computer-based learning offers context-based feedback, which has positive effects on learning.

However, training with a manual has advantages, too. Paper offers more space than the small display of a mobile phone, so pictures can be used to visualize action sequences and the trainees can get an overview. Furthermore, paper-based instructions are available over the whole training period and the trainee can make their own notes, which may be helpful. A further advantage is assumed: paper-based training creates cognitive effort, because the trainee has to actively connect instructions and changes in the display. Active learning has positive effects on the mental effort for learning [19]. Finally, elderly people are more familiar with paper-based manuals than e-learning applications.

4 Method

An experiment was conducted to compare the effects of the training versions on the younger elderly and the older elderly.

4.1 Participants

49 individuals (eleven men), aged between 50 and 77 years (mean 65.3 years), participated in the study. Participants had no or little experience with mobile phones. They were recruited by an advertisement for free mobile phone training in a local newspaper.

4.2 Design

Two independent variables were included (Table 1). The first independent variable is the factor "training version" consisting of two treatments ("paper-based manual" and "interactive e-learning application"). Each participant accomplished 27 lessons with one of the two versions. The groups were parallel regarding the participants' age and experience with mobile phones and other technical devices. Our hypothesis was that the interactive version and the paper-based version would differ in their effects on training success.

The second independent variable was "age" with the "younger elderly" aged between 50 and 65 and the "older elderly" aged between 66 and 80. Our hypothesis was that no differences in training success occur between the age groups.

Table 1. Design

		independent variable "training"	
		interactive	*paper-based*
independent variable "age"	*younger elderly*	X	X
	older elderly	X	X

4.3 Dependent Variables

Several methods were used to measure training success. For performance measurement, subjects had to complete operating tasks of varying difficulty. Indicators were time, number of keystrokes, and use of support. Perceived effort was measured before, during, and at the end of the training (scale from zero to 220). A cloze-test was conducted to measure subjects' explicit knowledge of the mobile phone. Mental representation of action sequences and hierarchical structure was assessed using a card-sorting technique. Participants had to sort pictures of different states of the trained interface. A score ranging from zero (lack of representation) to twelve (deep representation) was calculated on the basis of the correctly and incorrectly sorted pictures. Additionally, participants completed a questionnaire measuring acceptance and self-efficacy.

4.4 Procedure

The experiment took place on two training days, with a four to seven day gap (see Fig. 3). Each participant was trained in a single session. Each training session lasted from 90 to 150 minutes. First, participants were interviewed about their experience with mobile phones and completed a questionnaire about experience with and attitude towards technical devices. The perceived effort after the interview was used as a baseline. The data about participants' experience with mobile phones and other technical devices were used to assign them to the training versions homogeneously. The participants practiced 14 lessons on the first training day and 13 lessons on the second training day. Performance and a rating of the perceived effort were tested at the end of the first training session (test 1), and at the beginning (test 2) and end of the second session (test 3). Every performance test consisted of eight tasks which differed in the degree of transfer needed to solve the task. After training, subjects completed a questionnaire about their self-efficacy and acceptance of training. At the end of a training session, participants solved the tests about explicit knowledge and mental representation of the trained mobile phone.

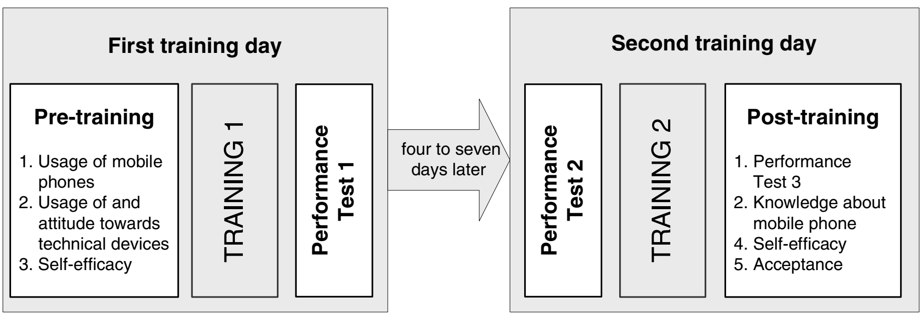

Fig. 3. Procedure and dependent variables of the experiment

5 Results

The subjects of the interactive group trained on average 92.8 minutes and the paper-based group 94.4 minutes. The older elderly needed 97.5 minutes to complete the training, and the younger elderly 89.5 minutes; differences are not significant. At the end of every lesson, exercises were offered to practice the trained functions. Participants of the interactive group practiced on average 6.6 exercises per training, the participants of the paper-based group 8.9; differences are not significant.

Both training groups rated the training as very good and rated their self-efficacy after training as good; differences were not significant. Concerning self-efficacy, significant differences were found between age groups ($Z(1)=-2.81$, $p<.01$); the older elderly rated their self-efficacy as medium and the younger elderly as high.

5.1 Performance

To assess training success, we compared the number of keystrokes, time taken, and use of help in three performance tests (see Fig. 4). The paper-based group as well as the interactive group needed less help after training (test 3) than between training days (test 1 and 2). Concerning the age groups, the younger and the older elderly completed the tasks of test 3 with less help than tasks of test 1 and test 2. Compared to the younger elderly, the older elderly used significantly more help in test 2 ($F(1,47)=4.06$, $p<.05$) which measured the performance four to seven days after the first training day.

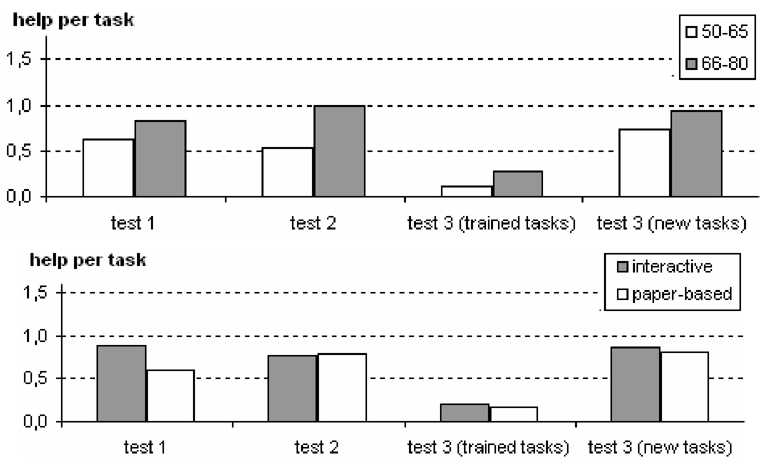

Fig. 4. Number of times help was used per task in the performance tests (test 3 divided into trained and new tasks)

In a second step, tasks of test 3 which were new, were analyzed separately from tasks which were similar to the trained tasks (see Fig. 5): no significant differences were found between groups. For the tasks which are similar to the trained tasks the subjects needed almost no help.

Concerning the number of keystrokes, no significant differences were found between training groups or age groups in the three tests. All participants completed the tasks of test 3 significantly faster ($F(2,46)=9.11$, $p<.001$) and with fewer keystrokes ($F(2,46)=8.73$, $p<.001$) than tasks of test 1 and test 2. Compared with the minimally required number of keystrokes per task, the participants needed eleven keystokes more in test 1 and test 2, but only six keystrokes more in test 3. Concerning time taken, the group of the older elderly took significantly longer to complete the tasks of test 2 ($F(1,47)=5.74$, $p<.05$) than the group of the younger elderly. No significant differences between training groups were found.

5.2 Perceived Effort

Perceived effort was measured after the interview (baseline), after the training sessions, after the performance tests, as well as after the knowledge tests (Fig. 5). The perceived effort after training did not differ significantly between the age groups. The paper-based group rated the effort after test 2 significantly higher than the interactive group ($F(1,47)=7.76$, $p=.01$). Generally, the paper-based group tended to perceive more effort before during, and after training.

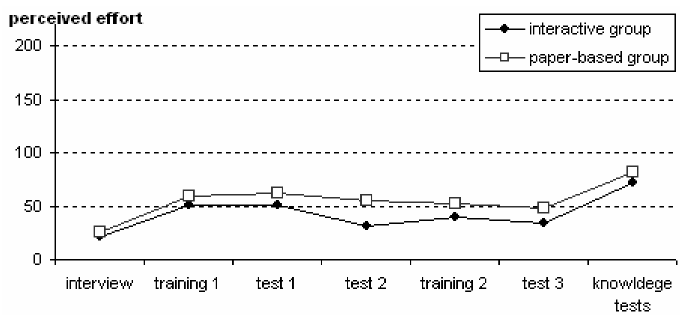

Fig. 5. Rated effort for interactive and paper-based group before, during and after training

5.3 Knowledge Tests

Explicit knowledge, measured by a cloze-test was moderate and did not differ significantly between the training groups. Concerning the age groups, the younger elderly had a significant higher score than the older elderly ($F(1,47)=11.73$, $p<.001$). The structural knowledge measured by the card-sorting technique did not differ between age groups or between training groups.

5.4 Correlations

Significant correlations were found between chronological age and the experience with technical devices measured before training (Kendall $\tau=-.25$, $p>.05$). Structural knowledge is correlated with number of keystrokes ($\tau=-.44$, $p>.001$) and time taken ($\tau=-.47$, $p>.001$) in performance test 3. The same applies to explicit knowledge. The knowledge tests are significantly correlated ($\tau=.42$, $p>.001$).

6 Discussion

Results show no significant differences for training success or self-efficacy after training between the paper-based instructions and the interactive e-learning application. The reason could be that the training versions are based on the same well designed basic concept and the same material. This conclusion is supported through the high acceptance of our mobile phone training. Many participants would like this training application to be integrated in mobile phones.

Furthermore, a ceiling effect can be observed regarding the number of keystrokes and the use of help in the performance test after training. Comparing this to the minimally required number of keystrokes, all subjects trained the usage of the mobile phone very successfully. This could be another reason for the lack of difference between training versions.

Concerning age effects, the older elderly needed more time and help in test 2. This could be a result of memory changes through aging [18]. However, after training, the older elderly used the simulated mobile phone as successfully as the younger elderly. This is in line with the findings of Morell et al. [14], Baldi [1], and Fisk et al. [6] that older adults are able to learn the use of electronic devices. However, the older elderly rated their self-efficacy lower than the younger elderly. This confirms the findings of Marquie et al. [13], who found that older adults underestimate their experience with technical devices.

7 Conclusion

The preliminary results do not prove that an interactive e-learning application is more efficient than training with printed instruction manual. But two findings suggest that the interactive version has some advantages over a paper-based version: participants rated the effort lower and trainees achieved the same training success with fewer exercises. Furthermore, stepwise training as an integrated part of a mobile phone offers some crucial advantages: it is always available, reduces situational constraints, enables users to learn when and where they want, could be an aid against forgetting, and offers training that fits the electronic devices lexically and structurally.

Training should make the learner more competent in the everyday use of a technical device in the medium and long term. Current work investigates the transfer of training success to everyday use. We are conducting a follow-up comparison of our trained groups with mobile phone users who did not participate in our training.

Currently the data regarding the trainees' behavior during training are being analyzed to obtain a deeper understanding of the relationship between learning effects and training versions. Further studies will explore which other aspects of training applications have to be considered in order to improve training for the elderly.

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References

1. Baldi, R.A.: Training older adults to use the computer: Issues related to the workplace, attitudes and training. Educational Gerontology 23, 453–465 (1997)
2. Baltes, M.M., Baltes, P.B.: Psychological perspectives on successful aging: The model of selective optimization with compensation. In: Successful Aging - Perspectives from the Behavioral Science, Universal Press, Cambridge, M.A (1990)
3. Bruder, C., Wandke, H., Blessing, L.: Improving mobile phone instruction manuals for seniors. Journal of Gerontechnology 5(1), 51–55 (2006)

4. Charness, N., Bosman, E.A., Kelley, C.L., Mottram, M.: Word-processing training and retraining - Effects of adult age, experience, and interface. Psychology and Aging 16(1), 110–127 (2001)
5. Fisk, A.D., Rogers, W.A.: Psychology and aging: enhancing the lives of an aging population. Current Directions in Psychological Science 11(3), 107–110 (2000)
6. Fisk, A.D., Rogers, W.A., Charness, N., Czaja, S.J., Sharit, J.: Designing for older adults. CRC press, Boca Raton USA (2005)
7. Kemper, S., Lacal, J.C.: Addressing the communication needs of an aging society. In: Pew, R.W., Van Hemel, S.B. (eds.) Technology for adaptive aging, pp. 131–149. National Academic Press, Washingtin D.C. (2003)
8. Freudenthal, D.: Age differences in the performance of information retrieval tasks. Behaviour & Information Technology 20(1), 9–22 (2001)
9. Gerbig, C.: Der Wechsel von Informationsaufnahme und aktiver Verarbeitung beim Lernen – Eine Anwendung in der EDV-Schulung. Dissertation, Fakultät für Sozial- und Verhaltenswissenschaften, Universität Tübingen (1997)
10. Jay, G.M., Willis, S.L.: Influence of direct computer experience on older adults' attitude towards computers. Journal of Gerontology 47(4), 250–257 (1992)
11. Kelley, C.L., Charness, N.: Issues in training older adults to use computers. Behaviour and Information Technology 14(2), 107–120 (1995)
12. Lee, A.Y., Polson, P.G., Bailey, W.A.: Learning and transfer of measurement tasks. In: Proceedings of CHI'89, ACM, New York, pp. 115–120. ACM, New York (2000)
13. Marquie, J.C., Jourdan-Boddaert, L., Huet, N.: Do older adults underestimate their actual computer knowledge? Behaviour & Information Technology 21(4), 273–280 (2002)
14. Morell, R.W., Park, C.P., Mayhorn, B.M., Kelley, L.K.: Effects of age and instructions on teaching older adults to use eldercomm, an electronic bulletin board system. Educational Gerontology 26, 221–235 (2000)
15. Poynton, T.A.: Computer literacy across the lifespan - A review with implications for educators. Computers in Human Behavior 21, 861–872 (2005)
16. Reed, K., Doty, H.D., May, D.R.: The impact of aging on self-efficacy and computer skill acquisition. Journal of Managerial Issues 17(2), 212–228 (2005)
17. Ritter, S., Wallach, D.: Interaktivität als Determinante der Lerneffektivität bei der multimedialen Wissensvermittlung. I-COM 2, 26–30 (2006)
18. Salthouse, T.A.: What and when of cognitive aging. Current Directions in Psychological Science 131(4), 140–144 (2004)
19. Sweller, J.: Instructional design in technical areas. ACER Press, Camberwell Australia (1999)
20. Ziefle, M., Bay, S.: How older adults meet complexity - Aging effects on the usability of different mobile phones. Behaviour and Information Technology 24(5), 375–389 (2005)