# Aging and Medication Adherence: Exploring the Perceived Usability of Personal Digital Assistants

Christopher B. Mayhorn , Aaron M. Watson, Michael S. Wogalter, and Vincent R. Lanzolla

*Department of Psychology, North Carolina State University*
*640 Poe Hall, Campus Box 7801, Raleigh, North Carolina, 27695-7801 UNITED STATES*
*Chris_Mayhorn@ncsu.edu*

**Medication adherence is essential to retaining functional independence in older adulthood. In the study reported here, 28 older and 32 young adults were asked to learn to use medication adherence software supported by a personal digital assistant (PDA). In addition to an assessment of PDA skill acquisition over time, participants completed a questionnaire to assess their perceived usability of the PDA. Measurement used six rating scales: (a) overall satisfaction, (b) simplicity of operation, (c) ease of medication information entry, (d) ease of learning, (e) error recovery, and (f) likelihood of future use. While usability ratings were generally positive, age differences were observed for simplicity of operation and error recovery such that older adults' ratings were lower on those dimensions than younger adults. Participant comments regarding the value of PDA features were generally consistent across age groups; however, differences in design preferences in future models of PDAs did emerge. Potential directions for hardware design and future research are discussed.**

## INTRODUCTION

In addition to the well-documented changes in cognition and perception that co-occur with age [1,2], chronic conditions such as osteoarthritis and hypertension frequently necessitate older adults' use of as many as 10 or more medications [3]. An estimated 71% of older adults fail to adhere to their medication schedules, apparently in large part due to forgetfulness [4].

Remembering to take medication requires the use of prospective memory which can be defined as remembering to perform an action some time in the future. One way to assist in the accomplishment of prospective memory tasks is to provide environmental support. Active supports such as alarm clocks call attention to themselves and have been shown to be effective in facilitating prospective memory.

Personal digital assistants (PDAs) are handheld computers that possess multiple features such as address books, to-do-lists, and calendars that can serve a mnemonic function. Given the functions of

PDAs, they have the potential to benefit older adults with complicated medication schedules. These devices could potentially relieve one's reliance on memory of the medication schedule and serve as an active support by activating an alarm to announce a scheduled dosage.

The realization of the potential benefits of PDAs is dependent on the attitudes and usability needs of this special population. For instance, if one does not possess a positive attitude in the utility of learning to use such a device, the PDA is not likely to be adopted to assist medication adherence tasks. In terms of the device itself, the small screen displays on PDAs are small and lack the ability to display sharp contrasts than larger monitors do. In addition, the messages displayed and the controls are small making it more difficult to read and manipulate the interface. It has been reported[5] that older adults take longer to learn to use PDAs and commit more errors when entering information into a PDA-based medication software application. However, these performance data do not provide subjective judgments that may be valuable in redesigning and promoting PDA use by older adults. The purpose of the present article is to supplement these performance data by describing the perceived general usability of PDAs by young and older adults. Perceived PDA usability was measured using six rating scales: (a) overall satisfaction, (b) simplicity of operation, (c) ease of medication information entry, (d) ease of learning, (e) error recovery, and (f) likelihood of future use. Comments to open-ended questions regarding the value of hardware features were also examined. The goal was to determine whether age differences in perceived PDA usability are present following interaction with these devices and how differences might influence the likelihood of future use.

## METHOD

### Participants

Of the 60 participants in this study, 32 were students from the participant pool available at North Carolina State University, ages 18 to 25 ($M$ = 18.43, $SD$ = 1.27). The remaining 28 participants were older adults, ages 60 to 83 ($M$ = 69.43, $SD$ = 5.34), recruited through introductory computer education classes available at a local senior center. Only participants with some computer experience and no PDA experience were allowed to participate. This was done to ensure at least minimal computer literacy and yet not introduce the confound of prior PDA experience.

Demographic information was obtained on several variables. There were no significant age group differences in self-reported health based on ratings that used a scale of 1 ("Poor") to 5 ("Excellent"). Mean responses from both age groups approximated 4 ("Very Good"). No significant differences were found in computer attitudes or in computer anxiety. Thus, the participants were relatively healthy individuals who held generally consistent attitudes toward computers and technology in general. As computer anxiety is a powerful predictor of computer training success [6], the lack of a

statistical effect here demonstrates that both age groups held generally positive attitudes toward learning to use the computers and this effect might extend to PDAs.

**Stimulus Materials and Procedure**

Prior to the subjective evaluations which are the main concern of this article, participants were asked to enter information into a popular medication tracking software package on a PDA. The PDAs provided by the experimenter were Palm Zires (Palm Model m150), utilizing the Palm operating system (version 4.1), with a 160x160 pixel monochrome display.

The On-Time Rx[7)] medication adherence software used in this study is commercially available and advertised by the manufacturer as intuitive and easy to use. The on-screen keyboard was used as it is On-Time Rx's default method of data entry.

Participants were individually tested. Following an experimental session where they entered medication data into a PDA on three occasions, participants were asked to complete the six usability agreement ratings before answering the three open-ended questions regarding PDA feature utility. The procedure of the preliminary "familiarity" phase is described elsewhere [5).]

To assess the perceived usability of the PDA hardware, participants were asked to complete a questionnaire where they rated their agreement with the following statements:

1) Overall, I am satisfied with how easy it is to use the PDA.
2) I could effectively enter medication information into the PDA.
3) I felt comfortable using the PDA.
4) It was easy to learn to use the PDA.
5) Whenever I made a mistake using the PDA, I could recover easily and quickly.
6) I am likely to use a PDA in the future.

Each statement was accompanied by a Likert-type scale with whole-number anchors ranging from one to seven. On the scale, 1 was labelled "strongly disagree," 4 was labelled "neutral," and 7 was labelled "strongly agree."

Next, participants were asked to complete the following open-ended questions regarding utility judgments of the "best,""worst," and "future"PDA features:

1) Describe one thing you consider best about this PDA.
2) Describe one thing you consider worst about this PDA.
3) Describe something new you would most wish to see in a future version of a PDA.

After participants completed the questionnaire, they were debriefed, thanked, and excused.

## RESULTS

### Usability Agreement Ratings

The mean usability agreement ratings for each age group are presented in Table 1. For all questions, the mean agreement rating was above 4.95 which indicates that each age group on average held positive attitudes regarding their first experience with PDAs. T-test comparisons revealed age differences in perceived usability when younger adults rated the PDAs as significantly simpler to use and rated their error recovery as higher than that of the older adults; $t$ (58) = 2.12, $p < .05$ and $t$ (58) = 3.05, $p < .01$, respectively. Comparision of the remaining four mean ratings revealed no age differences on the statements regarding overall satisfaction, ease of medication information entry, ease of learning, and likelhood of future use. Interestingly, the older adults rated their likelihood of future use as slightly, but not significantly higher than that reported by the young adults.

**Table 1** *Mean usability agreement ratings*

| | Young | Older |
|---|---|---|
| Overall satisfaction | 6.19 | 5.79 |
| Simplicity of operation | 6.28 | 5.71* |
| Ease of information entry | 6.41 | 5.96 |
| Ease of learning | 6.28 | 5.89 |
| Error recovery | 6.03 | 4.96** |
| Likelihood of future use | 5.06 | 5.39 |

*Note*. *$p < .05$, **$p < .01$.

### Inter-Rater Reliability

Responses to the open-ended questions were transcribed and coded by two independent raters. Percentage agreement between the ratings of the coders was calculated to determine inter-rater reliability. The high percentage agreement which was 97.6% indicated that the coding scheme was sufficiently defined and reliable.

### Responses to Open-ended Questions

While the open-ended questions concerning the "best,""worst," and "future" PDA features asked for "one thing," some participants included multiple responses in their answers. For this reason, frequency was counted based on the observed occurrence, not by individual participant.

### "Best" PDA Feature

When asked for the BEST "thing" about the PDA, the younger adults gave the following

responses: 15 (46%) stated that the device was generally easy to use, 12 (36%) noted the small/portable size of the device, and 4 (12%) made reference to its potential use for personal organization. The older adults gave the following responses to the same question: 11 (38%) noted the small/portable size, 6 (21%) stated that the display was easy to read, and 3 (10%) noted that the quality of the menu/screen organization made the device easy to use. Thus, young and older adults were generally in agreement regarding their opinion of the "best" features of the PDA: portability and ease of use.

### "Worst" PDA Feature

When asked for the WORST "thing" about the PDA, young adults gave the following responses: 9 (27%) disliked the small display screen, 5 (15%) commented on the monochrome display, while 2 (6%) described problems using the stylus and 2 (6%) expressed difficulty reading the screen because of glare. The older adults gave the following responses to the same question: 5 (17%) disliked the small screen display, 4 (14%) expressed annoyance at the idea of keeping the device with them, and 4 (14%) described difficulty with the stylus. Less frequent responses included: small button size, unappealing appearance of the PDA, and poor screen contrast making the device display difficult to read. Thus, the age groups were generally in agreement that the small display size and difficulty manipulating the stylus reduced perceived PDA usability.

### "Future" PDA Feature

When asked to describe "something NEW" in future versions of the PDA, 6 (18%) young participants mainly expressed revisions to the visual layout (e.g., shape, color, button configuation) of the device, whereas 5 (15%) expressed a preference for a color screen. By contrast, 3 (10%) older adults wanted voice interaction, 2 (7%) wanted an emergency button (e.g., 911) for rapid-assistance communication, and 2 (7%) requested a larger, color screen. Less frequent responses included: backlighting of the display, privacy measures for medication information, and better sound features. Thus, other than both age groups expressing interest in a color screen, the two groups differed in their preference for future design. The younger adults wanted cahnges to the visual layout whereas older adults wanted future PDAs to include voice interaction and an emregency button.

## CONCLUSIONS

Given the opportunity to interact with a PDA, results from the present study indicate that older and younger adults share generally positive attitudes regarding their usability. Mean usability ratings of overall satisfaction, ease of medication information entry, ease of learning, and likelihood of future use indicate, perceived usability does not appear to vary by age even when older adults are aware of potential difficulties with error recovery. Most surprising was

the finding that older adults expressed a larger mean agreement than young adults to the likelihood of using PDAs in the future. Perhaps these findings indicate that the older adults in this study viewed the potential benefits of PDA use as more important than what they considered to be minor usability issues. The resilience of these positive attitudes regarding the utility of PDAs should be considered in relation to the performance data[5] where these same older adults required more time to learn to use these devices and committed more errors. Because these errors declined with practice over time, it is conceivable that the present results reflect older adults' beliefs that they can learn to use PDAs if given sufficient time and practice.

When asked to make utility judgments of PDA features, opinions of the "best" and "worst" features were generally consistent across age groups. However, the pattern of results for "future" features are suggestive. While the young participants appeared to be interested in altering the appearance of PDAs for more aesthetic purposes, the ideas of the older adults were more associated with improving function to compensate for reduced usability. Although both age groups described difficulty with using the stylus as one of the "Worst" features of the PDA, only the older adult suggestion of voice interactivity approximates a design solution. Likewise, the request for an emergency assistance button suggests that older adults are aware of their potential need to use such a feature to compensate for physical vulnerability. Moreover, these data illustrate the value of using older adults to test the usability of devices such as PDAs because users in other age groups may also benefit from the inclusion of features that increase safety and privacy functionality.

While the results of this study are potentially informative for future hardware design, a number of limitations must be mentioned. First, this study was a best-case scenario—only relatively high-ability older adults participated in this study. Because the older adult participants were recruited from introductory computer education classes, they may have already possessed positive attitudes regarding general technology as suggested by the lack of an age effect with the measure of computer anxiety. Therefore, other older adults with less technology experience and less positive attitudes might be likely to make more errors, and have greater difficulty learning to use PDAs which in turn may affect perecived usability. Second, the behavior of a relatively small sample of individuals from each age group was observed. Although the sample was larger than the accepted norms governing general usablity studies, caution must still be used in interpreting trends in the data. Third, PDA use measures and perceived usability ratings were collected in the controlled environment of the laboratory where all of the participants were aware that they were being observed. To address these potential shortcomings, future investigations should consider observing the naturalistic behavior of larger,

more diverse samples such as special needs populations within the older demographic.

Future work in this area will also focus on facilitating error recovery by isolating perceptual and cognitive factors associated with different types of errors. Identification of such usability issues coupled with knowledge of design recommendations based on previous cognitive aging research should be informative for hardware and software designers [8]. In conclusion, this study illustrates the value of including an older adult sample in usability studies of new technology because designers can observe difficulties and obtain the comments of a rapidly growing segment of the user population.

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