Developing an Interactive Computer Interface for Elderly Patients

Alison Tytell Brenner
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A)</td>
<td>Background</td>
<td>3</td>
</tr>
<tr>
<td>A1)</td>
<td>The Decision Aid</td>
<td>3</td>
</tr>
<tr>
<td>A2)</td>
<td>Decision to Convert to Computer</td>
<td>3</td>
</tr>
<tr>
<td>A3)</td>
<td>Development of the Interface</td>
<td>4</td>
</tr>
<tr>
<td>A3a)</td>
<td>Technology</td>
<td>4</td>
</tr>
<tr>
<td>A3b)</td>
<td>Theory and Development Plan</td>
<td>5</td>
</tr>
<tr>
<td>B)</td>
<td>Design Testing</td>
<td>7</td>
</tr>
<tr>
<td>B1)</td>
<td>Development Testing</td>
<td>9</td>
</tr>
<tr>
<td>B1a)</td>
<td>Development Testing Final Report</td>
<td>12</td>
</tr>
<tr>
<td>B2)</td>
<td>Functionality Testing</td>
<td>15</td>
</tr>
<tr>
<td>B2a)</td>
<td>Functionality Testing Final Report</td>
<td>16</td>
</tr>
<tr>
<td>C)</td>
<td>Next Steps</td>
<td>19</td>
</tr>
<tr>
<td>C1)</td>
<td>Completing the program</td>
<td>19</td>
</tr>
<tr>
<td>C2)</td>
<td>Future plans</td>
<td>19</td>
</tr>
</tbody>
</table>
A) Background

A1) The Decision Aid

*Making a Decision about Colon Cancer Screening*, a decision aid designed for patients aged 75 and older, was developed and tested in paper form between December 2005 and December 2007. Six versions, targeted by age group and gender, were created and tested at the Cecil G Sheps Center for Health Services Research in conjunction with the Lineberger Comprehensive Cancer Center.

A2) Decision to Convert to Computer

The decision to convert this existing decision aid to a computer-based format was based on a two-fold reasoning structure. First, with the oldest of the Baby Boomers reaching their 60’s, computer programming with emphasis on the older users is becoming more important.¹ Several theories of likelihood of technology use for health education cite as two of the constructs perceived usefulness and perceived ease of use. As the population of older computer users transitions into one with more computer experience, the likelihood of use of computer-based tools will increase.² Secondly, a computer-based system can tailor information more specifically per patient with less possibility for error. Beyond the six different versions based on age group and gender, algorithmic programs imbedded in the interface can be utilized to tailor information to much more specific variables, resulting in a large number of slightly different versions that would be impracticable on paper.
A3) Development of the Interface

Theories of computer interface development, health education, and concerns regarding age-related decline in fine motor control and visual acuity informed our design of this computer interface. We utilized Adobe’s Flash CS3 to realize our design.

A3a) Technology

We chose to create the computer program using Flash CS3, a powerful graphic animation program that allows customizable interactivity and can be integrated with automatic data collection applications such as MySQL and PHP. We chose to write the background of the program in ActionScript 3.0, which is the programming language that Flash is able to understand. Within the ActionScript, we embedded PHP protocols that allow the program to send data regarding the user’s interaction with the interface directly to a Microsoft Access database.

Over the course of the spring semester, 2008, I completed an independent study learning Flash CS3 programming techniques and completing a literature search regarding computer program design for the elderly. The purpose for this independent study was to provide me with the skills to complete my practicum, designing and building an interactive, computer-based decision aid for elderly patients to assist in age-appropriate decision making regarding colon cancer screening. For the programming component of my independent study, I followed the book Flash CS3 Professional by Todd Perkins from the Hands-On Training series of computer guidebooks. The topics covered ranged from an initial introduction to Flash CS3 to publishing and exporting a finished program. The book includes
interactive exercises to illustrate the techniques. I supplemented these lessons and exercises with information regarding techniques necessary in my program design from a variety of web-based resources.

**A3b) Theory and Development Plan**

In the literature search component of my independent study, my first goal was to gain a working knowledge of the current understanding of human-computer interaction with regards to elderly, impaired, and/or non-computer users. The guiding model I will utilize in the theoretical design of the computer program is called the Unified Theory of Acceptance and Use of Technology (UTAUT), outlined by Viswanath Venkatesh.\(^2\) It is a combined theory utilizing constructs of the Theory of Reasoned Behavior, the Technology Acceptance Model, the Innovation Diffusion Theory, and Social Cognitive Theory, among others. The model, shown below, can be employed practically in a similar fashion to the Health Belief Model, in which appropriate positive or negative manipulation of the various constructs, in theory, increases the likelihood of the desired behavior, in this case, computer use.

My second goal in this literature review was to gain an understanding of the design process, particularly with regards to non-computer users and the elderly or impaired.

David Norman’s seminal User Centered Design theory is the basis for all design theory.\(^4\) It states that in order to create a program that is useful to the target audience one must involve members of the target audience in the design process for iterative feedback. This is particularly important in designing programs for elderly, impaired, or non-computer users because of the large knowledge gap
between the programmers and the users. Additionally, in designing for elderly users, Eisma, et al found, during their UTOPIA (Usable Technology for Older People – Inclusive and Appropriate) project, that the earlier older users are involved in the process the more likely a programmer is to create a program that will be usable and appropriate for elderly people.

![Research model](image_url)

**Figure 1.** Unified Theory of Acceptance and Use of Technology
From Phang, et al

My final goal was to gain a working knowledge of the current body of literature regarding aesthetic design for elderly users. I started this process with several articles from Patricia Neafsey, et al regarding her design of an interactive program for elderly patients for the purpose of finding unintentional drug interactions. Her research group used extensive focus group testing in all aspects of the design of their Personal Education Program, from font color and size to graphic picture style. Some key points will be translated directly into my design. I moved from
Neafsey’s specific work to Andreas Holzinger’s more general work testing various methods of functionality with regards to age-related motor and cognitive decline. ¹⁰⁻¹³

My conclusions to the actual layout of the program were bolstered by an article by Reed and Monk that showed positive results when using familiar technologies in new ways when working with the elderly.¹⁴ As one layout option for presentation to members of the target audience in the initial stages of tier 1, development testing, of my design process, I created an animated book that will allow the user to flip through the decision aid as they would a printed book.

This independent study has been extremely successful for me, and has provided me with the practical and theoretical knowledge base necessary to effectively complete my field practicum. The first tier of development testing began in May 2008. The third tier was scheduled to conclude in August 2008, but will continue into December 2008.

B)Design Testing

In the development of the interface for the computer-based edition of Making a Decision about Colon Cancer Screening, we employed an iterative design process, involving members of the target audience early in the process as suggested in David Norman’s seminal User Centered Design (UCD).⁴ This has been shown to be particularly important in the design of computer programs for elderly people due to both the large gap in technological familiarity and experience between the young designers and the older users, and because of age-related loss of dexterity and cognitive decline.⁵, ⁶, ¹³ A three-tiered program design process has been shown to
be effective with elderly users, working from commentary on paper-based mock-ups of screen shots.\textsuperscript{12} We will employ the think aloud technique, as described by Nielsen and as utilized by Holzinger, asking participants “to verbalize and describe their thoughts, feelings and opinions while interacting with the system.”\textsuperscript{11, 15} As Holzinger notes, the main benefit of this method in interface design is that we will be able to better the mental models of our target audience with regard to our program and their interaction with it, but we will also be able to identify some common terminology utilized by our target audience regarding components of the program which can be incorporated either into the program or into the methods we eventually utilize to implement the program post-development. Program prototypes will be reviewed in the three phases as Strickler and Neafsey did in development of their interactive personal education program (PEP).\textsuperscript{9}

Based on these theories, and on other literature, I developed a three-tiered development testing process, shown below.

This first phase of the testing process is comprised of three stages. The first two were completed in the first round of testing, which we called Development Testing, and the third in the second round of testing, which we called Functionality Testing.
Design testing took place over the course of two days at the Robert and Pearl Seymour Senior Center in Chapel Hill, NC. We asked participants to complete three tasks:

- Pick a layout from amongst three shown to them on paper in black and white.
• Pick a color scheme from amongst three shown to them on paper in the context of their layout of choice.

• Choose from several title possibilities

Probes included asking about font sizes and picture placements.

Figure 3. Layouts.

Layout 1. Content frame

**Layout 3. Book-style with title bar**

<table>
<thead>
<tr>
<th>Program Title Here</th>
<th>Program subtitle here</th>
</tr>
</thead>
</table>

**Figure 4. Color Schemes**

**Color Scheme 1.**

```
[Color Swatches]
```

**Color Scheme 2.**

```
[Color Swatches]
```

**Color Scheme 3.**

```
[Color Swatches]
```
B1a) Development Testing Final Report

Population:

Recruitment:

10 participants were recruited from the Seymour Senior Center in Chapel Hill, NC on May 21-22, 2008, with 4 women and 6 men.

Computer use breakdown:

2 had never used a computer
1 had not used a computer in over 20 years
1 had not used a computer in 7 or 8 years
1 used computers less than once a week
1 used computers 2-3 times per week
1 person used computers once a day
3 used computers more than once a day

Layouts:

Participants overwhelmingly (6/10) chose the L1 layout, modeled after CHOICE 6.0. Among comments in its favor were:

- It is more simple and self explanatory
- One column for the text per page
- “One screen”
Suggestions for improvement included:

- Increase the size of the content text
- Make the content screen more square
- Increase the size of the photos—can’t see the faces

Participants who weighed in were equally divided regarding whether the title bar should be there the whole time or if it should disappear after the first screen.

*Colors:*

Even more overwhelmingly (7/10), participants agreed with the literature and chose the color scheme modeled after Neafsey’s findings; a light blue background with heavy black text. Among comments in its favor were:

- Black text on light background good
- Blue is calming in a doctor’s office
- Easy on the eyes

*Titles:*

Participants also generally agreed (5/10) that the title “Making a decision about colon cancer screening: What is the right choice for you?” was the best choice. There was some debate about whether “you” or “me,” but more participants felt that “you” fit better. Key comments included:

- “Decision” is a key word
- It tells the most about what will go on in the program
• “screening” is less intrusive than “testing”

Other comments:

Not all participants commented, but those who did were divided equally about whether the content font size was just right or a bit too small (2 votes each). One person thought both the content and title bar text were too big.

Other comments included:

• Break up the paragraphs in the content
• The touch screen is too complicated—have a mouse available too
• On the Likert questions, use a number scale instead of words (0-5, eg)
B2) **Functionality Testing**

Functionality testing took place over the course of 2 days, again at the Robert and Pearl Seymour Senior Center in Chapel Hill, NC. Participants were, again, asked to complete three tasks:

- Attempt to navigate the program using the buttons that make the program go back and forth between the pages with no assistance.
- Attempt to choose an answer to a survey question for which you would choose just ONE answer with no assistance.
- Attempt to choose answers for a survey question for which you would choose MORE THAN ONE answer with no assistance.

*Figure 5. First content screen with instructions for navigation.*
B2a) Functionality Testing Final Report

Population:

Recruitment

4 participants were recruited from the Seymour Senior Center in Chapel Hill, NC on October 1-2, 2008, with 1 man and 3 women.

Computer use breakdown:

All were computer users:
1 used a computer less than once per week.

1 used a computer 2-3 times per week.

1 used a computer once a day.

1 used a computer more than once a day.

**Title Screen:**

100% of participants felt that the length of time the title screen was programmed to show for was adequate.

**Navigation:**

100% of participants were able to navigate between screens using the Next and Back buttons with no instruction from the RA. Instructions read as follows:

One participant gave the following suggestion for the instructions:

"*Instructions were good, but don’t say 'Go to next screen' until you are ready for the person to go to the next screen. Be literal.*"

**Question Styles**

**Radio Buttons**

100% of participants were able to use the radio buttons successfully without additional instruction. 1 participant suggested that the radio buttons be a bit larger.

The majority (75%) of participants liked the first layout better than the second.

**Checkboxes**
100% of participants were able to use the checkboxes successfully without additional instruction from the RA.

50% (2) preferred the first layout for the checkbox question to the second and one did not have a preference. One preferred the second layout, which had the checkboxes on the right instead of the left.

Likert Question

100% of participants were able to answer the Likert question without additional instruction from the RA.

50% (2) preferred the second layout, shown below, to the first. One had no preference, and one preferred the first. The first layout featured a double ended arrow beneath the answer choices. Among reasons for preferring the second layout were:

- “The arrow might influence the answer”
- “The arrow is distracting”

The participant who DID like the arrow felt that it might assist someone with lower visual acuity.

Other Comments

- Font sizing is big enough, even “straining without glasses”, for one participant who self-reported very low visual acuity
- Layouts on sample screens with pictures is good
- “Touch areas are good.” The participant felt that the hit for the buttons was adequate, making them easy to use with a touch screen.
Conclusions

The major questions—whether participants in the target audience will be able to use the program at all, and whether participants in the target audience without additional verbal instruction were overwhelmingly answered. All participants were able to use all of the functionality without additional instruction.

Secondary measures in aesthetics were less firmly answered, but a majority answer still arose with all questions.

C) Next Steps

C1) Completing the program
In December, we will enroll several more participants in the functionality testing component of the Development Testing phase. It is important that we thoroughly test the program’s basic functionality early in the process because if we do not create it so that it is usable by the target audience, all else is meaningless.

Once this phase of development testing is complete, we will create a beta version for usability testing, followed iteratively by testing of an alpha version. Finally, we will test it’s use in a clinical setting as part of a larger decision aid implementation initiative.

C2) Future plans
After the testing phases of this program are complete, we will create a final version of this program, for possible integration into distribution as part of a larger decision aid dissemination study being developed in our outpatient clinic.

Future iterations of this program might include further tailoring using conjoint analysis-style questions. Conjoint analysis is a questioning technique developed in
product development and marketing that separates a product into attributes, trying to elicit what exactly is important to an individual consumer. In the case of medical treatments, conjoint-style questioning techniques can elicit what characteristics about a treatment are important to a patient—for example, if a patient has trouble swallowing pills, an injection or liquid medication might be more suitable than a typical oral treatment.
References


