Exploring Tangible Ways to Evaluate User Experience for Elders

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Abstract
While user experience assessment enables understanding users' perception about a product, limitations have been encountered when elders use questionnaires to evaluate user experience. In this paper we present the design process of *Aestimo*, a tangible interface to assist elderly people when evaluating the user experience of interactive prototypes. Our prototype is a simplification of the AttrakDiff questionnaire, which gives a chance to record one's overall opinion (i.e., speech) and emotions. In addition, our design uses playful interaction styles that are familiar to the elderly. In a preliminary evaluation, elderly found *Aestimo* entertaining and easy to use. As future work, we aim to explore new materials in building *Aestimo* and to perform a comprehensive evaluation with several elders.

Author Keywords
User experience design; Tangible interface; Elderly people

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous

Introduction
Elderly people may face several physical and cognitive limitations in their daily lives. Among the former, hearing impairments and visual problems can often result in difficulties

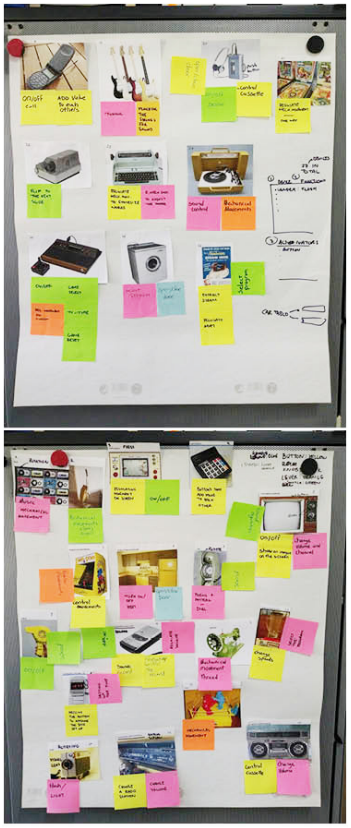

Figure 1: Electronic devices from the 1970s.

reading, especially small text [1]. Similarly, cognitive challenges are also present since there is a decrease in elders' reaction time and in their ability to solve problems [1, 6]. Therefore, it is essential to design technologies or products specifically for elders. User experience (UX) becomes a useful tool in terms of understanding the perceptions and responses resulting from the anticipated use of a product, system or service [10]. To measure UX, instruments such as questionnaires have been extensively used. One example is the AttrakDiff questionnaire[1], which is used to measure hedonic and pragmatic qualities of a product.

In the past, several difficulties have been encountered in using questionnaires to assess the user experience of older adults, e.g. they respond randomly to questions when they do not fully understand them [7]. It has also been noticed that elders are more 'cautious' in answering questions, therefore, they often refuse to answer a question or tend to frequently pick "do not know" when responding [14]. Therefore, it becomes necessary to provide support to the elderly in reporting UX.

We present *Aestimo*, a tangible interface kit that allows to measure the experience of the elder user while taking into account some of their physical and cognitive challenges. The kit is a modified version of the AttrakDiff questionnaire, which includes the evaluation of emotional dimensions, as well as recordings of elders' opinions. Our design uses interaction styles and tangible elements that are familiar to the elderly, with the goal of a playful [11], non-stressful experience. We conducted a preliminary evaluation with three elders. In the future, the results of that evaluation will be used to improve our prototype.

[1] Attrakdiff.http://attrakdiff.de/index-en.html

Related Work

In some studies, questionnaires that measure UX have been shortened to take into account the cognitive limitations (attention capacity) of participants [3]. Another approach has been to adapt the questionnaire as an interview, because older adults had problems reading and/or responding to the questions [8]. Similarly, web-based questionnaires have been used in evaluations, but elderly people did not have the knowledge to complete the questionnaire or the necessary technological equipment [7].

Tangible interfaces are more accessible and suitable for the needs of elderly people [16] and interactions that remind them of familiar devices have a high acceptance, e.g. an old fashioned radio [12] or transistor radio [17]. Actual physical contact with an interface may give elder users confidence in their abilities [5]. Therefore, we designed a tangible interface kit to report UX aimed at seniors, which can also assist researchers conduct evaluations.

Concept Design

The motivation for this interface comes from problems we found during our previous research with elderly users [15]. Researchers on several occasions had to read each question out loud, because participants could not read the question, despite having used a large font. In addition, the 7-point scale used in AttrakDiff was difficult to understand for seniors, and in their majority they only used three points on the scale (the lowest, the middle or the highest). Hence, the idea of transforming a validated instrument (AttrakDiff) to measure UX into a tangible device emerged (similar to [4]).

Buttons, Knobs and Switches

In the first phase of the design, we researched interaction styles [13, 2] of technologies that were typically in use in the seventies. We chose to look into this decade because our

Pragmatic	
Technical	Human
Complicated •	Simple
Impractical	Practical
Cumbersome	Straightforward •
Unpredictable	Predictable
Confusing •	Clearly structured
Unruly	Manageable •
Hedonic-identity	
Isolating •	Connective
Unprofessional •	Professional
Tacky	Stylish
Cheap	Premium
Alienating	Integrating
Separates me	Brings me closer •
Unpresentable	Presentable •
Hedonic-stimulation	
Conventional •	Inventive
Unimaginative	Creative
Dull •	Captivating
Undemanding	Challenging •
Ordinary	Novel
Cautious •	Bold
Conservative	Innovative •
Attraction	
Unpleasant •	Pleasant
Ugly	Attractive •
Disagreeable •	Likeable
Rejecting	Inviting
Bad	Good
Repelling	Appealing
Discouraging	Motivating •

Figure 2: Selected AttrakDiff items (marked with •).

target group, in its majority, would be familiar with how to operate those systems since at that time they were young adults. Likewise, we believe that these interaction styles will bring benefits to the elderly: (1) they will interact with the interface in a physical way, (2) they know how to operate these devices, generating little cognitive effort and feeling capable. Thus, in this first step, electronic devices of the seventies (e.g., Walkman, washing machines, typewriters) were searched online (see Figure 1). We looked into 27 electronic devices and we discovered 45 different interaction styles those devices could afford. The devices and the related interactions were compiled in one visualization using Atlas.ti [2], obtaining as a result that the interactions were commonly performed with elements such as buttons, knobs and switches.

Multimodal and Playful Interaction

We made the decision to incorporate all the interaction elements we found (buttons, knobs and switches) to make the interactions rich and playful, for two main reasons. First, because those elements are familiar to our target group and second, because they have the characteristic of giving very clear feedback to their users. For instance, when pressing a button of an old radio one can hear a strong mechanical sound - however, pressing the button may take considerable physical effort. Thus, when designing *Aestimo* we tried to combine an easy press and strong audio feedback.

Simplifying AttrakDiff questionnaire

AttrakDiff is used to understand the usability and design of an interactive product. Answers are on a scale of -3 to 3 (0=neutral). It has four dimensions: *pragmatic quality (PQ)* or the ease with which people can complete a task; *hedonic quality-stimulation (HQ-S)*, which refers to whether a product encourages the development of user skills; *hedonic quality-identity (HQ-I)* or the message that is communicated to others while using a product; and *attractiveness (ATT)* or charm of the product [9].

To simplify AttrakDiff, we decided to use a 3-point scale that by extension inspired the decision of revising the way the "questions" were formulated in the original instrument. AttrakDiff presents the positive and negative aspects of an adjective (e.g., pleasant and unpleasant) and the user has to evaluate to what extent the device was one or the other within the aforementioned scale. In our case, we reduced the 28 points of the original instrument to 16 by selecting 4 items (two positive and two negative adjectives) for each of the four dimensions (see Figure 2). Then, we transformed each adjective pair into a question, e.g. *Conservative-Innovative* became "Is the device innovative?"

Emotional Aspect and Overall Dimension

Next, we decided to enrich the evaluation by including an element that would measure emotional aspects. This decision was inspired by customer feedback stands that one can normally find in stores and airports[3]. We also decided to include one last overall feedback element aimed at gathering insights from participants that we would otherwise not have been able to receive from the questions alone.

Paper Prototyping

After the completion of the desk research, we explored different forms that our prototype could have in fulfilling the aforementioned concepts. Thus, in investigating those we used paper prototyping as a method to inspire ideas. The first two authors of this paper began creating various shapes with paper (See Figure 3), including cylindrical forms, squares, tokens, and asymmetrical pyramids. Next, the researchers experimented with those shapes to explore

[2] http://atlasti.com/

[3] https://www.happy-or-not.com/en/

Figure 3: Creating shapes and forms as a method to inspire ideas.

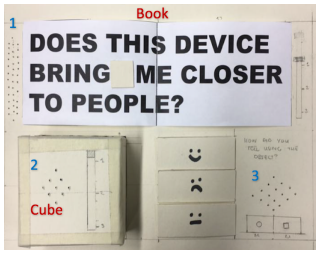

Figure 4: Paper prototype.

Figure 5: Latest version of the prototype.

forming new artifacts. The variety of shapes inspired the idea that each of them could be used as a separate artifact connected to a related task, forming an evaluation kit and adding to the playful aspect we aimed for. Thus, we tried to think each of those shapes in relation to the elements we wanted for our UX instrument: a) the AttrakDiff questionnaire, b) the emotional aspect, and c) the overall feedback. While our paper shapes were the point of departure for our design, several elements were modified in the process of designing our final prototype. Our initial design decisions are described below.

Tangible AttrakDiff

We intially decided to split AttrakDiff questions into two tangible elements, 8 questions each: a book and a cube (see Figure 4). The book would include one question on each page using a large font to ease readability. At the same time that the participants would flip a page, an embedded speaker would play the questions out loud. The cube would have an embedded speaker which would play the questions one by one after shaking it. Both elements would include a 3-point scale.

Emotional Aspect and Overall Feedback

The emotional aspect was initially imagined as tokens depicting three different faces of emotions where our users would be asked to choose and drop in a bucket-like compartment in the prototype. However, to simplify the design, we finally chose to use those three faces as voting buttons. The overall feedback would be an audio recording, with record and stop buttons reminiscent of cassette tape recorders.

After we built our first (paper) prototype, we realized it had three sound outputs (see Figure 4), which could be confusing for the users. As such, we decided to remove the cube. Also, in minimizing the sound inputs and outputs we chose to use a phone to cover the sound needs of all the elements of *Aestimo*. In addition, we changed the emotional aspect from three to four faces, offering more options to the elders. Also, we replaced the buttons with a slider. Last, when envisioning the situation of usage we realized that the shape of the prototype should change to simplify the interaction. We tried all those changes for the next version which was made in wood.

From Paper to Wood

The next step was building a wood prototype (Figure 5). In this prototype, we included engraved instructions on the surface, so *Aestimo* could be used without assistance. These instructions have large text and the user may listen to them through the phone while reading. We placed the phone handle at the front of the interface covered by a lid. We replaced the buttons of the emotional evaluation with a switch, and used a knob to evaluate the questions. Finally, the shape of the prototype was modified to add an inclined support that allows the person to better read the book.

Interaction

Here we describe how the interaction is envisioned. The user reads the instructions which lead them to open the lid of the prototype. The user picks up the phone and holds it (see Figure 6). Once the first page of the book is flipped, the corresponding question is played by the phone. After each question is read the user is invited to vote (yes, neutral, no) by using the knob at the front right of the prototype (see Figure 5).

After the completion of the book a new compartment is revealed which contains the emotional aspect and the overall feedback (see Figure 7). There, the user can find instructions once again above every element. The emotional evaluation includes a scale of four faces which invites the user

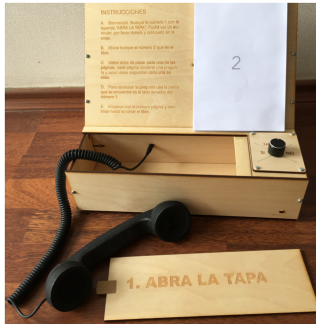

Figure 6: Phone.

Figure 7: New compartment.

Figure 8: Evaluation of *Aestimo* with elders.

to choose one of them by sliding a switch. In the last part, the overall feedback, the user has to press play and record their thoughts about the prototype and then press stop once they are done. The combination of interaction styles (knob, switch and buttons), the telephone, the book and compartments, as well as the different activities that must be performed, have the goal of creating a playful experience for elders.

Initial Observations

A preliminary evaluation of the prototype was conducted with three elders (average age: 70, SD: 10) with no cognitive disabilities. First, the participants interacted with a home blood pressure monitor. Afterwards, they had to evaluate the device using *Aestimo*. Finally, the researcher conducted a semi-structured interview to collect information about the perception that the participants had of our prototype.

In general, participants found *Aestimo* entertaining, intuitive and easy to use. They felt the instructions guided them correctly through the evaluation activities. They also indicated that they could correctly express their opinions about the device. Finally, they suggested that the emotional evaluation, which had a scale of four faces, could also include a text description.

Conclusions and Future Work

In this paper we have described the design process of *Aestimo*, a tangible interface aimed at elderly users to evaluate the user experience of interactive prototypes. *Aestimo* uses familiar interactive styles for elders and proposes a playful experience. The preliminary results are encouraging. Our next steps include an in-depth evaluation of the finished prototype. We also want to explore the use of other materials in building the external part of the prototype.

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REFERENCES

1. American Psychological Association. 2017. Older Adults health and age-related changes reality vs myth. (2017). `http://www.apa.org/pi/aging/resources/guides/myth-reality.pdf`
2. P. Cheng, A. Lucero, and J. Buur. 2016. PAUSE: Exploring Mindful Touch Interaction on Smartphones. In *Proceedings of the 20th International Academic Mindtrek Conference (AcademicMindtrek '16)*. ACM, New York, NY, USA, 184–191. `http://doi.acm.org/10.1145/2994310.2994342`
3. K. Gerling, F. Schulte, and M. Masuch. 2011. Designing and Evaluating Digital Games for Frail Elderly Persons. In *Proceedings of Conference on Advances in Computer Entertainment Technology (ACE '11)*. ACM, NY, USA, Article 62, 8 pages. `http://doi.acm.org/10.1145/2071423.2071501`
4. C. Golsteijn, S. Gallache, L. Koeman, L. Wall, S. Andberg, Y. Rogers, and L. Capra. 2015. VoxBox: A Tangible Machine That Gathers Opinions from the Public at Events. In *Proceedings of Conference on Tangible, Embedded, and Embodied Interaction (TEI '15)*. ACM, NY, USA, 201–208. `http://doi.acm.org/10.1145/2677199.2680588`
5. J. Häikiö, A. Wallin, M. Isomursu, H. Ailisto, T. Matinmikko, and T. Huomo. 2007. Touch-based User Interface for Elderly Users. In *Proceedings of Conference on Human Computer Interaction with Mobile Devices and Services (MobileHCI '07)*. ACM,

NY, USA, 289–296.
http://doi.acm.org/10.1145/1377999.1378021

6. V. Hanson. 2009. Age and Web Access: The Next Generation. In *Proceedings of Cross-Disciplinary Conference on Web Accessibililty (W4A '09)*. ACM, NY, USA, 7–15.
http://doi.acm.org/10.1145/1535654.1535658
7. M. Harjumaa and M. Isomursu. 2012. Field Work With Older Users-Challenges in Design and Evaluation of Information Systems. (01 2012).
8. M. Heerink, B. Krose, V. Evers, and B. Wielinga. 2006. Studying the acceptance of a robotic agent by elderly users. Journal of Assistive Robotics and Mechatronics, Vol. 7. 33–43.
9. J. Isleifsdottir and M. Larusdottir. 2008. Measuring the user experience of a task oriented software. In *Proceedings of Workshop on Meaningful Measures: Valid Useful User Experience Measurement*. 97–101.
10. ISO DIS 9241-210. 2010. *Ergonomics of human system interaction - part 210*. Technical Report. Inter. Organization for Standardization, Switzerland.
11. A. Lucero, E. Karapanos, J. Arrasvuori, and H. Korhonen. 2014. Playful or Gameful?: Creating Delightful User Experiences. *interactions* 21, 3 (May 2014), 34–39. http://doi.acm.org/10.1145/2590973
12. M. Nilsson, S. Johansson, and M. Håkansson. 2003. Nostalgia: An Evocative Tangible Interface for Elderly Users. In *Extended Abstracts on Human Factors in Computing Systems (CHI EA '03)*. ACM, NY, USA, 964–965.
http://doi.acm.org/10.1145/765891.766096
13. T. Oritsland and J. Buur. 2000. Taking the Best from a Company History - Designing with Interaction Styles. In *Proceedings of Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques (DIS '00)*. ACM, NY, USA, 27–38.
http://doi.acm.org/10.1145/347642.347658
14. D.C. Park and A.H. Gutchess. 2000. *Cognitive Aging and Everyday Life*. Psychology Press.
15. I. Rodríguez, G. Cajamarca, V. Herskovic, C. Fuentes, and M. Campos. 2017. Helping Elderly Users Report Pain Levels: A Study of User Experience with Mobile and Wearable Interfaces. *Mobile Information Systems* 2017 (Nov 2017), 12.
16. S. Wolfgang. 2011. Tangible Interfaces As a Chance for Higher Technology Acceptance by the Elderly. In *Proceedings Conference on Computer Systems and Technologies (CompSysTech '11)*. ACM, NY, USA, 311–316.
http://doi.acm.org/10.1145/2023607.2023660
17. M. Ziat, H. Yao, R. Schmitt, and V. Hayward. 2016. FrontPanel: Tangible User Interface for Touch-Screens Dedicated to Elderly. In *Proceedings Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '16)*. ACM, NY, USA, 3808–3811.
http://doi.acm.org/10.1145/2851581.2890266