

# Usability Assessment for Caregiver Behavior Analysis Using Gaming Technology

Student Researcher: Alexandra C. Oliver

Advisors: Tanvi Banerjee, Ph.D. (Department of Computer Science & Engineering), Jennifer Hughes, Ph.D. (Department of Social Work), Noah Schroeder, Ph.D. (Department of Leadership Studies in Education & Organizations)

Wright State University

Department of Computer Science and Engineering

## Abstract

The proposed research focuses on developing a mobile application for Android systems that will detect changes in behavior and activity patterns of those who are primary caregivers for dementia patients. This application will be used to detect fluctuation in the behavior and the task performance of the caregivers as a measure of caregiver stress. By detecting these changes in behavior, the goal is to analyze the effects of caregiving to evaluate caregiver burnout. A usability study was conducted for this application to find the optimal design factors and features that benefit the target user: the caregiver.

The purpose of this research project is to develop a revised and expanded version of the application based on the results of a prior small-scale usability study [1], and then conduct a more in-depth and in-situ usability study of the revised application. Primary caregivers of dementia patients were the target of the data collection. This data will be used for the continuing design and development of the application. In short, the original application included a word-scramble game and an established caregiver stress scale survey [2]. Based on the results of the prior usability study, a basic reminder functionality was added, improvements occurred to the user interface, and development occurred for a reward system to incentivize the daily use of the application.

## Objectives

The application, titled the Caregiver Assessment using Serious gaming Technology (CAST), assesses the feasibility of using gaming technology to assess task performance and stress levels of caregivers for dementia patients. For both version 1.0 and 2.0, the application was developed in Android Studio to remain consistent between testing periods and lessen the opportunity for unexpected variables to arise during the research process. The objective of this study is to evaluate the participant's experience and test the application for usability, feasibility, and interest levels from the participants.

During the first usability study for CAST 1.0, a small sample of caregivers were given CAST 1.0 to assess during the Research and Science Night event organized by Alzheimer's Association Miami Valley in November of 2017. During the study, participants gave feedback on the application and shared how the project could be altered to better accommodate them as well as other caregivers regarding ease of use, reoccurring use, and their overall interest in the application itself [1]. From these responses, one main concern centered on the difficulty of viewing the font and reading the text in the application. Legibility proved to be an issue in other regards concerning the color and contrast in CAST 1.0 with items such as the buttons, text, and boldness of text. A reward system was also requested to encourage the use of the application and some voiced complaints on the complex design of the application and noted their desire for the navigation across the app to be more straightforward and simplified [1]. These reoccurring issues became the focus of the updates for CAST 2.0, as well as other features that could benefit the caregivers based on their comments and concerns from the first trial.

## **Methodology Used**

As with the prior study, the research method for CAST 2.0 continued the focus on qualitative data collected from individual use and evaluation. The prototype of CAST 2.0 was presented to a sample of caregivers at the Miami Valley Alzheimer's Association Research and Science Night in November of 2017. Ten caregiver participants were shown the application and were asked a series of questions regarding their opinions on features shown and were also asked for their overall thoughts on the application as well as other feedback that they felt could aid in improving the project. Using a verbal interview format, we collected the data and the caregiver's responses were recorded and later transcribed after the completion of the event. NVivo software was used to analyze the collected data.

## **Results Obtained**

Four main aspects of CAST 2.0 remained the focus of the study with the caregiver participants. A "Reminders" section of the application was a new addition for CAST 2.0 as seen in Figure 1. The purpose of this feature is for the caregiver to easily set reminders for appointments or medication within the app to keep the information in a centralized location. The alarm within this feature works in the same way as the alarm for any phone. The sampled group responses proved positive and focused on the helpful aspects of having an aid for reminders of smaller caliber appointments and miscellaneous reminders.

One of the main features of the application is the included word scramble game shown in Figure 2. The word scramble game is a central point in the data collection to aid in the determination of the levels of caregiver stress from the user. The purpose of the game is to track user task performance over time regarding the time that they spend on each question, as well as their responses to words of different difficulty levels. This is done using artificial intelligence to compare the caregiver's performance across the days in which they use the application. Changes in behavior can be detected by analyzing the differences in their performance with the game.

The word scramble was updated for clarity as well as improved to provide a more straightforward interaction with the caregiver while providing clear feedback on the correctness of their response. The alterations to this area of the application include the feedback to the caregiver to remind them if they skipped the question or if their response was correct or incorrect before they rated the difficulty of the question. The elements of the section were also structured differently in CAST 2.0 to make the purpose and goal clearer by underlining the area in which they were to insert their answer and making the buttons for interaction larger and easier to use (given that most of our users were of age 65 and above). Responses from the demo ranged greatly from the caregivers. Some enjoyed the addition of the game and other did not feel that the inclusion of it was necessary or that it was not something that most would enjoy. The clarity of instruction also seemed to be lacking for some participants.

The other large addition to CAST 2.0 is a reward system requested from study with version 1.0. The reward or incentive system's goal is to encourage continued use of the application as well as to allow the caregiver to gain a sense of fulfillment while participating in the repetitive tasks that do not give immediate feedback. As seen in Figure 3, the reward or incentive is delivered in the form of a fact-providing system. Every few questions that the caregiver responds to, they are provided with an interesting fact that relates to caregivers, Alzheimer's, and dementia. Caregiver participants stated that the incentives were encouraging and an interesting addition to the game phase though some recommended that the facts stay more focused on the caregivers themselves to make them feel that the focus of the application remains on them.

The final change that occurred for updated application regarded the overall appearance and ease of use for CAST. Based on the feedback from the first trial, this was a major request from caregivers to increase the ease of use of the system. Edits were made throughout the application regarding the appearance and ease of use by altering font sizes, colors, and the sizes of elements such as the sizes and text to increase readability throughout as seen in Figure 4. The design in the various areas within the app were simplified for better understanding and the colors of buttons as well as fonts were changed to create a higher contrast against the background color. The screen size on each page was also maximized rather than leaving empty areas on the screen as shown in Figure 5. Font sizes were also enlarged to better accommodate those that would have difficulty reading the text. The caregiver participants in the second trial felt that these changes within CAST 2.0 gave the application a “newer” feel and that it felt more colorful and modern. The caregivers that were able to compare the two versions pointed out that it was easier to read text in CAST 2.0.

### **Analysis of Results and Future Work**

In conclusion, the majority of the caregiver participants of the CAST 2.0 application usability study found the application to be an interesting concept and stated that once the application became fully deployed, they could see themselves using it routinely to aid them in evaluating the quality of their lives. Regarding the altered design and features, most participants felt that the game was interesting, but the difficulty level may be too high for the average user. The consensus regarding the reminders feature centered on the usefulness of an addition for those that easily forget medicine or appointments or those they prefer to keep caregiver related information centralized. The suggestions that were received for the reminders section of the application showed that more customizations and options should be available for the reminders. In response to the other addition of the incentives, participants relayed that they would encourage them to continue playing and the facts are interesting to read while using the application. Concerning the overall appearance and feel of the application, most participants felt that version 2.0 of CAST holds a more modern and “newer” look and it is easier to read the text throughout the various sections of the application.

As this is an ongoing study, the feedback received through the usability studies allow for the continuation to make changes to optimize the design of the application to allow for both adequate and efficient data collection, while maintaining a user-friendly interface for the caregiver. Such an interface would not only enable the caregiver to use it, but also encourage the caregiver to want to use the system routinely. The future outlook of this continuing study allows for the continuing optimization of the design and functionality of the application. Other than the feedback regarding the displayed features, caregiver participants also voiced other suggestions that could further improve CAST. Additions that are currently being integrated into the project include a setting menu to allow for customization per the desires of the caregiver such as the font size. An additional game is under development to allow a choice for those that feel that the word scramble game is too challenging or would prefer another option. Help interactions will be added through the application so the caregivers can easily access instructions features at any time. Upon the completion of these additions, a usability study will be conducted to ensure that the changes progress the application. This study is built on an existing NIH funded project (#1K01LM012439) titled “Managing Dementia through a Multisensory Smart Phone Application to Support Aging in Place.”

### **Figures/Charts**



Figure 1: Reminder Screen - CAST 2.0 (New Addition)

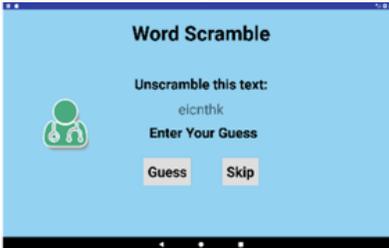
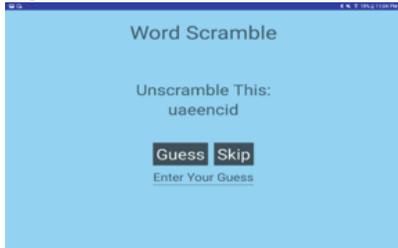


Figure 2: Word Scramble Game CAST 1.0 (left) CAST 2.0 (Middle and Right)

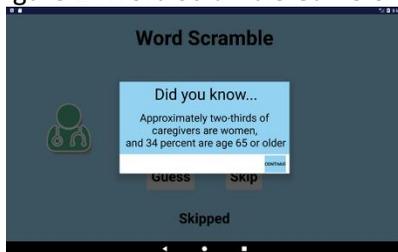


Figure 3: Incentive Fact - CAST 2.0 (New Addition)

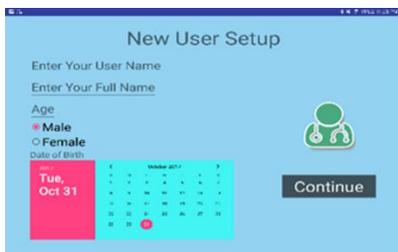


Figure 4: New User Setup Screen CAST 1.0 (left) CAST 2.0 (Right)

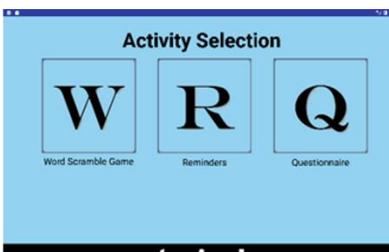
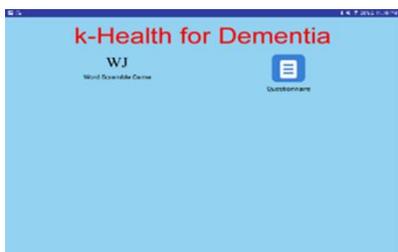


Figure 5: Activity Selection Screen CAST 1.0 (left) CAST 2.0 (Right)

### Acknowledgments and References

1. Hughes, J. C., Banerjee, T., Goodman, G., & Lawhorne, L. (2017). A Preliminary Qualitative Analysis on the Feasibility of Using Gaming Technology in Caregiver Assessment. *Journal of Technology in Human Services*, 1-16.
2. Zarit, S. H., Reever, K. E., & Bach-Peterson, J. (1980). Relatives of the impaired elderly: correlates of feelings of burden. *The gerontologist*, 20(6), 649-655.