Examining the Effect of Automated Health Explanations on Older Adults' Attitudes Toward Medication Information

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ABSTRACT
In a non-clinical setting, understanding health information can be a challenge for consumers, but for some, such as older adults, a more complex health history can make this task more difficult. For some tasks such as deciding on appropriate medications, misjudgments about information can place consumers at risk. Research suggests that using technology to communicate and disseminate health information can improve understanding and lead to improved health outcomes. In this paper, we examine the impact of automatically generated explanations of medical terms on older adults' attitudes toward medication information.

We conducted an experiment with 21 older adults where we asked them to complete tasks using medication texts that included and did not include medical terms augmented with consumer-based explanations. We collected data about their attitudes, understanding, and satisfaction with the use of both types of medication texts. We found that the inclusion of the explanations improved participants' attitudes about the difficulty of using the text to complete medication information seeking tasks. Participants also preferred and found more helpful the medication information that included the explanations. Results suggest that automatically generated explanations of medical terms may be useful for encouraging positive attitudes about the difficulty, helpfulness, and satisfaction with the use of medication information among older adults.

CCS Concepts
• Human-centered computing ~ Empirical studies in HCI • Applied computing ~ Consumer health

Keywords
HCI; User Interface Design; Consumer Health Information; Consumer Decision Support; Information Seeking; Over-the-Counter Drugs; Older Adults

Effectively communicating health information to consumers is a huge public health concern [3, 30]. In a non-clinical setting, consumers often rely on clear, easy to understand health information to make important personal health decisions. In some cases, tasks such as choosing an appropriate over-the-counter (OTC) medication become the primary responsibility of the consumer. For example, when choosing non-prescription medications, a consumer, caregiver, or another vested party may need to take on the role that a healthcare provider might perform in a clinical setting (e.g. administer medication, order medication, determine potential interactions). It becomes the responsibility of the consumer to seek understanding of the medication information, the benefits and risks, how the medication may or may not fit into his existing regimen, and how the medication may affect his overall health. This is usually done with little or no healthcare provider oversight [1, 2, 10]. For some individuals, such as those 65 years of age or older, this task is made more complex due to factors related to the natural process of aging.

Despite efforts to help patients better engage with their medication information, challenges with communicating health information still exist and may pose safety risks to consumers [1, 2, 10]. However, over the past decade advances in technology have provided new opportunities and mediums for disseminating and communicating health information. Coupling effective communication with health information technology is thought to improve the consumer experience irrespective of computer skills, and may lead to improved health outcomes [1, 15, 33]. As such, researchers in Human-Computer Interaction and Health Informatics have explored ways of designing computer-based interventions that can assist individuals with different aspects of their medication regimen [4, 9, 16, 19, 21, 26, 29, 32, 38, 39, 44, 45]. They have found that understanding user concerns is an important aspect for addressing some of the challenges users face when engaging with medication information and for improving the medication management experience.

In this paper, we address the challenge of complex medical terminology, which has been highlighted in literature as one of the barriers individuals face when engaging with medication information [25, 31, 41, 44]. We conducted an experiment with 21 older adults (65 years or older) to better understand the potential for automatically generated explanations of medical terms to motivate, facilitate, and support positive interactions with medication information. We asked participants to complete tasks using medication text that both included and did not include medication terms that were augmented with consumer-friendly explanations. During the experiment, we asked participants to complete questions about their attitudes, understanding, and satisfaction with the use of each type of medication text (augmented vs. not augmented). We found that by using text that included explanations, participants' attitudes about how difficult it would be to use the text significantly improved. Participants also believed that the text that included the explanations was more helpful to their effort of completing the medication tasks and were more satisfied with the text that included the explanations.

1. RELATED WORK
In this section, we provide an overview of the risks associated with the misunderstanding of medication information, the barriers and challenges consumers face when selecting appropriate medication and current work that aims to address this challenge.

PervasiveHealth 2016, May 16-19, Cancun, Mexico

DOI 10.4108/eai.16-5-2016.2263312

We then present a discussion of automatic text simplification and its potential to address the challenge of complex medical text.

1.1 Medication and Patient Safety

Thousands die or are injured each year as a result of medication interactions [10, 14]. Medication interactions are one of the main causes of adverse drug events (ADEs). Although legislation exists that provides guidance for accurate and easy-to-read labeling for medication, ADEs due to medication still occur [40]. Older adults or individuals 65 years and older are potentially at higher risk of ADEs due to several factors. Unlike prescription medication, OTC medication can be purchased at will by a consumer and requires the consumer to facilitate the process of determining if the medication is appropriate given their health history[2, 10]. Older adults account for nearly 40% of all OTC medication use, use twice as many OTC medications compared to prescription medications and on average, take between 6 and 9 medications concurrently [14, 35]. Older adults are also at higher risk for chronic illness, placing them at increased risk of drug-disease interactions and tend to have lower health literacy levels compared to other age groups, meaning that older adults may find it more challenging to "understand and act upon health information" [30]. Therefore, the OTC decision-making can become daunting and complex task for older adults [1, 25, 29].

1.2 Assisting with Medication Text

Currently, the medication label or Drug Facts Label is the primary source for communicating OTC medication information [40]. The purpose of the label is to orchestrate a complex set of behaviors by the consumer [6]. Most consumers who decide to read the label use only the label to make his or her decision and many do not read the label at all [6, 8]. Several studies have identified barriers to communicating OTC medication information through a print medium and have suggested improvements for making medication information more useful and useable by different populations [6, 21, 27, 36]. However, print mediums still have limitations and some researchers believe that technology may useful for addressing some of the limitations of print-based text [1, 15, 18].

To date, researchers have explored ways of designing computer-based medication interventions that can assist various populations with different aspects of their medication management regimen including: scheduling, ordering, compliance or adherence, concordance and/or medication education (in-hospital or at home) [4, 9, 16, 19, 21, 26, 29, 32, 38, 39, 44, 45]. For example, Wilcox and colleagues examined the use of in-hospital displays to provide hospital patients with information regarding their hospital care through their stay [44]. Neafsey and colleagues examined the impact of an interactive educational intervention to help active older users understand OTC medications and alcohol interactions [29]. Bickmore and colleagues examined how dialog systems can be used to educate patients about post-hospital care regimen [4]. In this paper, we explore automated explanation of medical terms and their effect on older adult's attitudes toward medication text.

1.3 Simplifying Complex Health Text

Simplifying text is one way to reduce the complexity of text. Several groups have emphasized the importance of the role of simplified text for helping consumers better understand health information [7, 31, 41]. The Plain Language Act of 2010 requires federal agencies to use "clear communication that the public can understand and use" [42]. In natural language processing, researchers have created techniques for simplifying health information automatically using various translators. This approach, known as text simplification, takes a sentence in a document, runs it through a technique, identifies "difficult terms", and systematically replaces the terms with synonyms and/or explanations until the sentence has been simplified [37]. This process is repeated until all sentences in the document have been simplified. Difficult terms and the level of simplicity needed is often defined by the designer and often evaluated through readability testing [5, 11, 20]. However, few studies, evaluate the technique directly with users.

This study examines the effect of automated consumer-friendly explanations directly with older adult users. Instead of readability, we focus on attitudes, because attitudes can impact behavior and intention to complete a task. In Fogg's behavioral model, he addresses three components that impact whether an individual performs a behavior: motivation, ability, and a trigger [13]. He asserts that all three components must be considered in order to persuade an individual to complete a task. We focus on motivating users by reducing the "pain" of task completion by making the task easier and saving them time, physical effort, and brain cycles.

2. INTERACTIVE PROTOTYPE

We built an interactive prototype in order to examine older adults attitudes toward medication text. The prototype's interface provided alternative consumer-based terms or phrases for medical terms that appeared in a medication text (See Figure 1). The prototype worked by querying a medication text from a dedicated medication database, parsing the text to identify difficult terms and then augmenting the difficult terms with consumer-friendly alternatives (See Figure 2). To identify difficult terms, we created a controlled vocabulary database using terms and definitions from the Plain Language Health Thesaurus and Medline Plus [28]. Any term appearing in the controlled vocabulary was considered difficult and was augmented with its corresponding definition in the translated version of the text. Augmentation was chosen in lieu of replacement for two reasons. First, because of the nature of the domain being studied, it was important not to alter the text in any way that would change the meaning of the text. Second, for lexical simplification where there is a 1-1 match of terms, the challenge of restructuring sentences is minimized. In the past, researchers have addressed sentence restructuring through a manual review of the text after the simplification has been completed [20, 24]. However, one of the design goals for this type of tool is that it is flexible enough to be used in a system "in the wild" where manual review would be cumbersome and inconvenient. Augmenting the original text with an consumer-friendly alternative is one approach that removes the need for manual review and several researchers have found this approach to be useful [23, 44].

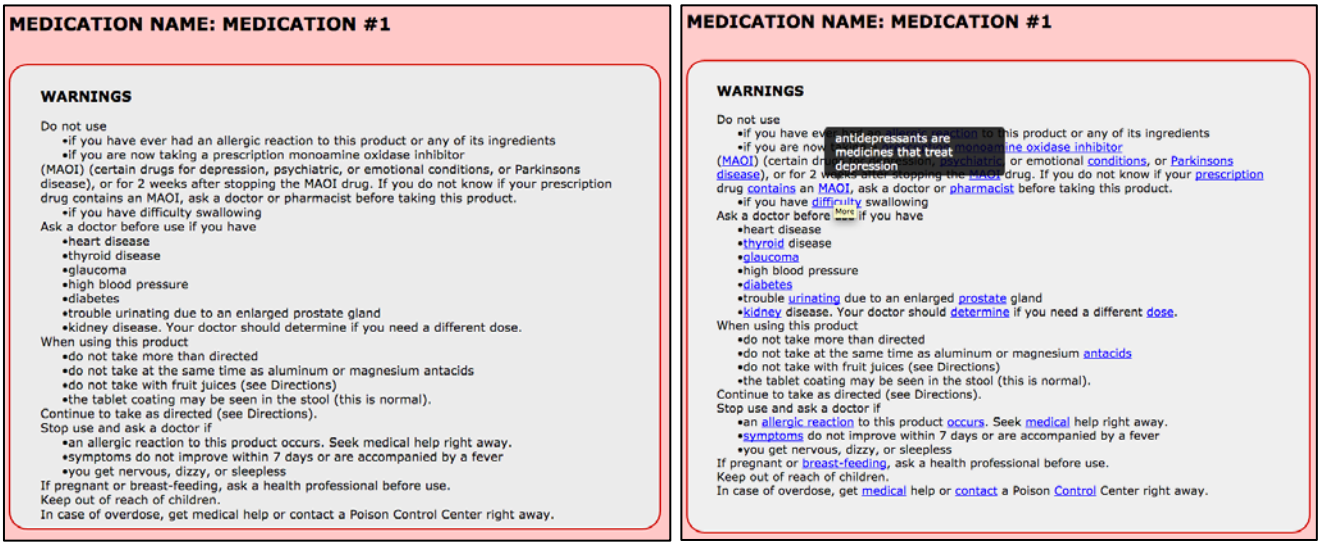

Figure 1. Screenshots of the Prototype's Interface with and without the automated explanations of medical terms

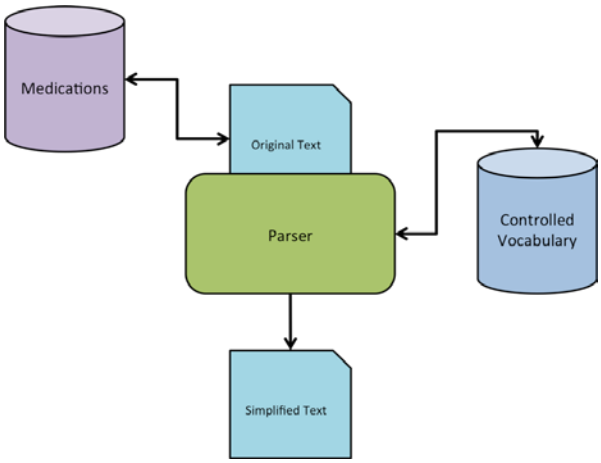

Figure 2. System diagram of prototype

3. METHODS

The goal of this study was to examine the effect of automated consumer-friendly explanations of medical terms on older adults engagement and attitudes toward over-the-counter medication text. To better understand the effect of the explanations on participants' attitudes, we explored the following questions:

- RQ1: Does the inclusion of automated explanations of medical terms evoke more positive attitudes toward medication information compared to text without explanations?
- RQ2: Are participants better able to recognize over-the-counter medication risks when provided with automated explanations of medical terms compared to text without explanations?
- RQ3: Does the inclusion of automated explanations of medical terms increase task completion time compared to text without explanations?
- RQ4: Are participants more satisfied with medication text that includes automatic explanations of medical terms compared to text without explanations?

3.1 Participants and Study Location

Older adults were purposefully recruited from two organizations within the local community that cater to those older than 50. Participants of the study were required to be 65 years of age or older and have experience purchasing their own OTC medication in the past year. The lead researcher met with directors of the two organizations to discuss the details of the study and the requirements for volunteering. The directors of the organization made first contact with potential participants through email, flyers, or verbal announcement. Interested parties were asked to contact the lead researcher if they wanted to volunteer. Before the scheduled meeting time, each participant was contacted and informed that the study would take place on a laptop computer and that they should bring any assistive devices (e.g. corrective lenses) they would normally need when using a computer.

Twenty-one older adults volunteered for the study. Approximately 62% of the participants were female (N=13) and all but three participants were retired (N=18). All participants selected English as their primary language. Participants' ages ranged from 64 – 90 (mean ~ 73 years, SD ~ 8 years). All participants were familiar with purchasing or taking over-the-counter medication. All but 3 participants (N = 18) used a laptop or desktop computer at least 3 or more times a week and only six of the 21 used the Internet to search OTC medication information.

Participants had on average a REALM score of approximately 6 (SD ~ 2). However, eighteen of the participants had a REALM score of 7, the highest score possible on the REALM test, meaning that they should not have much trouble understanding health information.

3.2 Materials

The prototype was presented to each participant on a 13" laptop computer. Participants were given the option to use the laptop's tackpad or an external mouse when completing the study. In addition, before the study begin, if needed, the laptop's screen was adjusted to the participant's desired reading comfort.

Before the experiment, participants were asked to complete a demographic survey to capture demographic information and a computer use survey to capture their use and comfort level with computers and other computing devices. The participants were then administered a verbal health literacy test - REALM[17] to gauge how well they may be able to understand health information.

During the study, participants were asked to complete a total of four questionnaires per medication text. All data collection tools were piloted for readability and understandability before the study commenced. We explain each questionnaire below.

3.2.1 Pre-Post Experiment Survey

The pre-survey included three questions that asked participants to rate their perception of the information before using it to complete any tasks (See Table 1). They were asked to rate each question using a 7-point Likert scale. The perceived difficulty measured their perception of the information based on first glance. To measure confidence and control, we used questions discussed by Kraft for measuring percieved behavior control [22]. Both confidence and control measure participants' initial beliefs about their ability to use the information to find risks and warning. Confidence focuses on their belief in how easy or hard the task would be and control focuses on their belief that they could perform the task if they wanted to. After participants completed a comprehension survey, they were again asked to rate the difficulty for each medication text on a 7-point Likert scale.

Table 1. Pre-Post Experiment Questions

Measure	Question	Likert-Rating
Difficulty (D)	The information is …	1 (Very Difficulty) to 7 (Very Easy)
Confidence (CF)	Finding risks and warnings using this information would be …	1 (Very Difficulty) to 7 (Very Easy)
Control (CT)	If I wanted to, I could find risks and warnings using this information …	1(Strongly Agree) to 7(Strongly Disagree)

3.2.2 Comprehension: Recognition of Risks and Warnings

During the study, participants were also asked three comprehension questions for each medication. For the purpose of this study, only recognition was evaluated as it is the comprehension tasks that is most closey related to the task of purchasing over-the-counter medication [6]. These questions were designed using the Food and Drug Administration Comprehension Testing Guide [43]. Each question was developed by taking information directly from the warnings section of each of the medications (See Figure 3). For example, if the medication said to consult a physician if you had diabetes, the question asked participants if a fictional person with diabetes could or could not take the medication.

1. Kate has sugar diabetes. Is it okay or not okay for her to take this drug?
   a. It is okay
   b. It is not okay
   c. I don't know

   Why did you say that?

Figure 3. Example question from comprehension survey

3.2.3 Participant Observation

During the experiment, as the participant completed the recognition questions, a structured coding form was also used to record observational data [34]. We recorded whether or not the participant made use of supplemental materials provided to help them answer comprehension questions. We also recorded task completion time. Time to complete comprehension questions was recorded as the time interval beginning when the participant turned the questions over and began answering the questions to the time when participants completed the comprehension questions and returned them to the researcher. This information was used to provide additional insight on the difficulty of the medication information and shortcomings of the technique.

3.2.4 Debriefing Questionnaire

After completing the experiment, participants were asked to complete a final questionnaire where they were asked to choose the type of medication text they preferred and found more helpful. They were also asked to discuss their preferences and to provide feedback on how we can improve the prototype.

3.3 Data Collection

Institutional Review Board (IRB) approval was obtained before data was collected. Upon arrival to the study location, participants were greeted and asked to complete the background survey and the computer use survey. Next, the participant was administered the REALM test. After completing the REALM test, participants were given a demonstration of how to use the prototype. The demo included a short paragraph about a storybook character and within that paragraph certain terms were highlighted to indicate that an explanation of the term was available. The participants were asked to interact with the prototype to familarize themselves with the explanation feature and were told that they may see something similar in the experiment. The study began once the participant interacted with the prototype and verbally indicated that they were ready to begin.

During the study, each participant received four different medication texts as treatments (See Table 2). Each of the four medications had an augmented and a non-augmented version. The four medications presented included a medication for upset stomach, a cold medicine, an allergy medication, and a pain reliever. These medications were purposely chosen to provide variety and representation of the most widely used oral over-the-counter medications. Apart from these categories, the medication texts were also chosen to meet the criteria that each was approximately at an 8th grade reading level, the average reading level of adults in the United States. Reading level for the text was calculated using the Flesch-Kincaid grade level test which provides a numerical score (e.g. 8th) indicating that the text should be easily read by an individual at that United States grade level [12]. Texts had grade level scores of 7.2 & 7.3, and 7.9 & 7.9, respectively (See Table 2). All documents also had a Flesh-Kincaid reading ease score of approximately 60, which suggests the documents, should be easy to read for 13-15 year olds.

Counterbalancing of treatments between participants was used to reduce carryover effects due to practice or fatigue. Medications were grouped based on the similarity of their grade level score so that each participant received one medication text that included explanations and one that did not at each approximate grade level. However, each text was different within each group to reduce learning effects. The dataset included a total of 84 observations from the 21 participants.

Table 2. Experiment Design

		Method of Delivery (W)	
		Translated	Not Translated
Grade Level of Text (W)	7.2 & 7.3	N = 21	N = 21
	7.9 & 7.9	N = 21	N = 21

In the experiment, a participant was presented with a medication text, he or she was first asked to rate the difficulty of the text (D) and his or her belief that he or she could use the information to find risks and warnings (CF, CT) based on their initial interactions with the information. Once the participant completed this set of questions, the researcher presented the participant with the set of recognition questions corresponding to the text being were viewed. The set of questions was presented face down to the participant and the participant was asked to turn the questions over and begin answering the questions when ready. Task completion time was collected manually using a handheld stopwatch and recorded on the observational coding sheet. After completing the comprehension questions, the participant was asked again to rate his or her perception about the difficulty of the information used to complete the recognition questions (D). This process was repeated for all four medication text that the participants viewed. At the end of the experiment, the participant was asked to revisit the types of information (augmented vs. not augmented) used in the experiment and identify which type of information he or she preferred and found more helpful, and to provide any additional feedback about the experience. Participants were paid $15 for their time.

4. RESULTS

Below, we present the findings of our experiment. We compare the measures from the augmented text with the non-augmented text. Participants' ratings for confidence, control, and difficulty were grouped in categories of positive (ratings of 5, 6, or 7), neutral (4) and negative (1, 2, or 3). The proportion of observations in which ratings changed from positive to negative (or vice versa) across treatment was analyzed for each dependent variable.

4.1.1 Confidence (CF)

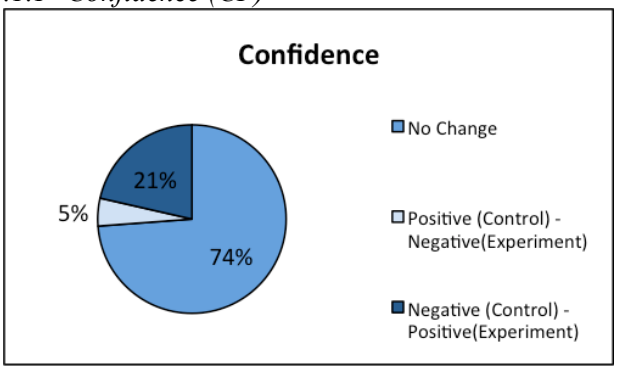

Figure 4. Participants' perception of how difficult it would be for them to use the medication text

When asked about their perception of how difficult it would be for them to use the medication text, more participants reported positive attitudes when using the augmented medication text. Of the 42-paired observations included in the dataset, thirty-one observations (74%) showed no change across treatment groups. Nine observations (21%) moved from negative when participants were presented with non-augmented text to positive when presented with augmented text. Two observations (5%) moved from negative when presented with the augmented text to positive when presented with the non-augmented text information. The McNemar's test for changes was used to test for differences in proportions and to analyze the nominal, paired data. The results provide sufficient evidence (df=1, N = 42) that participants' perceptions about the how easy it would be for them to use the information to find risk and warnings differed significantly between the two treatments (P ~ .0348). Participants were more likely to report positive beliefs about their confidence when presented with the augmented text compared to the non-augmented text.

4.1.2 Control (CT)

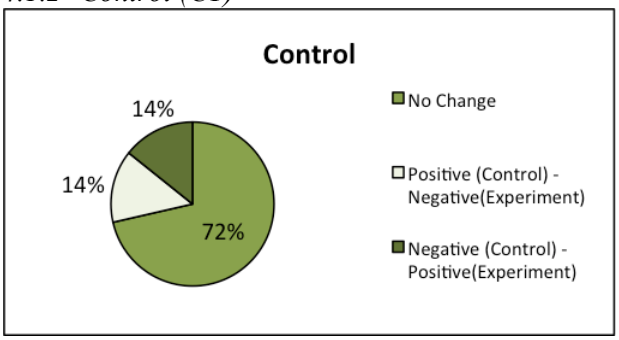

Figure 5. Participants' perception of their ability to use the text to complete medication information-seeking tasks

Participants' beliefs of their ability to use the text to complete medication information did not change significantly across treatment. The data set included forty-two paired observations (See Figure 5). Thirty observations (72%) showed no change across treatments. Six observations (14%) showed a change from positive to negative and six (14%) showed a change of negative to positive. Results of McNemar's test did not provide sufficient evidence (df=1, N = 42) that participants' attitudes about their ability to use the information to find risk and warnings significantly differed between the two treatments (P ~ 1).

4.1.3 Perceived Difficulty vs. Actual Difficulty

Fifty percent of responses about perceived difficulty were positive when interacting with the augmented medication text compared to 38% of responses for the non-augmented text. When examining whether the augmented text had any effect on actual difficulty, the Wilcoxon Signed Rank Test indicated a significant improvement in the proportion of participants whose ratings improved from negative to positive beliefs about difficulty when interacting with the texts that included explanations of terms (W = -87.5, P ~ 0.0049). However, a similar trend was observed for the texts that did not include explanations, which suggests that in either case, participants felt that the information was less difficult after using it to complete the medication tasks.

4.1.4 Recognition Tasks

To calculate the number of errors made by participants, we tallied the questions that the participants answered incorrectly and questions for which the participants did not know the answer. Across treatments participants made a total of 68 errors, which yielded an error rate of .26984. Participants made a total of 34 errors for each treatment. Therefore, the number of errors did not differ across treatments (W = -1.5, P ~ 0.5393).

4.1.5 Task Completion Time

We recorded task completion time for each of the four tasks the participants completed throughout the study. The average task completion time for participants when using the augmented medication text was 3 minutes/8 seconds (185.03 seconds). The average task completion time for participants when using the non-augmented medication text was slightly higher at 3 minutes/19 seconds, an increase of 11 seconds. However, the Wilcoxon Signed Rank Test suggests that there is not sufficient evidence (W = 5.5, P ~ 0.4721) to support that there was a significant effect of treatment for increasing or decreasing task completion time. This

suggests, that the simplified version did not increase or decrease the time taken to complete the comprehension tasks.

4.2 User Satisfaction

At the end of the experiment, participants were asked to discuss which version of the information (augmented vs. non-augmented) they preferred using and found more helpful when completing the comprehension tasks. Participant's responses to these questions were coded to fit in one of three categories 1) Experiment (augmented version) 2) Control (non-augmented version) or 3) Neutral (no strong preference). Nineteen participants responded to both questions and two did not provide a response to either question. Sixty-eight percent of participants expressed that they preferred using the medication text that included automated explanations, 26% were in favor of texts without explanations, and 6% were neutral. When asked to elaborate on why they preferred the simplified text, nearly all participants commented that they liked having the additional information available when and if they needed it. One participant stated, *"[I prefer the one with] The pop-ups, because it provides additional information in layman's terms"*. Another stated, *"[I prefer the one] With the links because the links provide sources of further information"*. Participants also found the augmented text useful for unfamiliar terms. One participant stated when asked why she preferred the augmented text, *"I like the highlighting because there were words unfamiliar to me."*

Comments from the five participants who preferred the non-augmented medication text were more varied. One participant felt that not having the automated explanations forces a person to focus more on the warnings instead of the highlights. He stated, "*I prefer the non highlighted version because I think it makes you focus more on the warnings. Otherwise you tend to skim the warnings."* Another felt that the explanations were not necessary and similar to the previous participant's statement encouraged people to skim the information. A third participant felt that the explanations made the information too complicated.

When asked which version of the information they thought were more helpful, sixty-eight percent of participants expressed that they felt that using the information that included simplified explanations was more helpful, 26% were in favor of the non-simplified information, and 6% were neutral. When asked why they felt the simplified text was more helpful, once again, nearly all responses alluded to having simplified information available when needed. For example, one participant provided the following explanation of why the explanations were more helpful, "*I understand the terms, but I understand that many might not, so giving more information about terms such as anticoagulant would be helpful if that term needs to be used. Why not just say blood thinners (warfarin + genereco)."* Of the 26% that found the non-simplified text more helpful, responses were related to the complexity that the explanations added to the interface. One participant stated, *"I found the highlights annoying"*.

To determine if the observed frequencies for satisfaction deviated significantly from the expected frequencies a One-Way Chi-Square Classification was conducted (See Table 3). Based on the Chi-Square reference table, a X^2 of 5.99 or greater is needed for X^2 to be significant at the .05 level. Therefore, a result of X^2 of 11.80, suggests that there is enough evidence to reject the hypothesis that the results of the study could have happened by sampling error alone and the deviations between the observed and expected frequencies are significant.

Table 3. Result of One-Way Chi Square Test

Outcomes	O	E	$(F_o - F_e)$	$(F_o - F_e)^2$	$(F_o - F_e)^2 / F_e$
Experiment	13	6.33	6.67	44.49	7.03
Control	5	6.33	-1.33	1.77	.28
Neutral	1	6.33	-5.33	28.41	4.49
	19	19			X^2 =11.80

df = 3 – 1 = 2

4.3 Summary

Overall, these results suggest that participants' beliefs about the difficulty of the medication text and their ability to complete tasks using the medication text did not differ significantly between treatments, however, inclusion of the automated explanations positively effected their perception of the difficulty of the recognition task. Using the augmented medication text did not significantly increase or decrease task completion time. Additionally, participants were more satisfied with the augmented medication text and found the text that included the automated explanations more helpful. However, participants experienced the same error rates on recognition questions regardless of whether the medication text included explanations or not.

5. SUGGESTIONS FOR IMPROVEMENT

At the end of the experiment, participants were asked to provide feedback on how to improve the prototype as well as to discuss their overall experience. Generally, participants were satisfied with their interaction with the prototype, however several comments suggest the need for more personalized support and view of medication text. Five participants commented on the formatting of the text itself. Minimal formatting was used purposefully to place emphasis on the text for the purpose of the experiment. However, participants felt that better formatting in addition to the augmented explanations would be more helpful. Similarly, three participants suggested that the prototype provides more guidance on what information is most important. One participant discussed how she would like the prototype to place emphasis on things relevant to her condition. She stated, "*The tool-tips need to be more informative than in the samples. Also it should be organized in a more concise way. For instance, I know I am taking med for HBP, so it would be easier if I could look at all the warnings/risks for BP meds in one place."* Additionally, two participants mentioned that there were some terms they felt should be augmented that were not (such as salicylates). One stated, *"Maybe more in depth definitions the one that most needed an explanation to me is "salicylates" as an example."*

6. DISCUSSION AND CONCLUSIONS

In its current state, results suggest that the prototype evaluated shows promise as a method for providing simplified OTC medication information to the older adult population. Participants' perceptions of the difficulty of medication information seeking tasks improved significantly from negative to positive when provided with OTC medication information augmented by the automated explanations compared to information not augmented. Although there was no evidence that the tool improved comprehension of the OTC information, the findings suggests that knowing that additional support is available and at hand may improve consumers confidence in being able to use the information to make a decision.

A significant proportion of the participants also preferred using the medication text with automated explanations compared to text

that did not provide explanations. Many of the participants eluded that they liked having additional information at hand and that this was the reason for their preference. For similar reasons, participants also found the text with automated explanations more helpful than text that did not provide explanations when completing comprehension tasks. Again, while there was no evidence that the tool improved comprehension, participants both favored having the additional support of consumer-friendly terms and phrases compared to having no support at all. Therefore, findings suggest that having additional support available may also be more helpful to consumers and may also improve how they engage with medication text.

The goal of the study was to understand the effect of automated explanations of medical terms on older adults' attitudes toward medication text. Results suggest that with more research and further improvement, the technique is a feasible option for providing simplified OTC medication information to older adults. For example, one encouraging finding is that the presence of the technique did not increase or decrease task completion time. This suggests at minumum the automated explanations did not make the decision-making task more complex by increasing the time it takes to navigate the text. However, more ideally the tool would decrease decision-making time while also improving comprehension. Future studies will focus on how to improve this technique or combine it with other design techniques in order to improve decision-making time and comprehension of medication information.

7. LIMITATIONS AND FUTURE WORK

Participants in the study were purposefully recruited and although participants ranged in age, education level, and familiarity with OTC medications, most participants had very high health-literacy levels. This may have impacted the study results as at this level, participants are expected to easily understand and act upon health information. Participants' responses were varied however results may not be generalizable to a group of participants with more varied health literacy levels. In the future, a different recruitment method will be employed to ensure that the sample includes participants with more diverse health-literacy levels. In addition, more participants will be needed to detect significance differences at the .05 level based on the differences observed in this study.

8. ACKNOWLEDGEMENTS

We would like to thank the organizations and participants who helped to make this research possible. We would also like to thank the Social Science Research Council Mellon-Mays Graduate Initiatives Program for funding parts of this research.

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