Usability and Accessibility of E-Health Websites: Enabling Nutrition and Physical Activity Education for Blind and Low Vision Internet Users

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ABSTRACT

This chapter describes a multi-group research study of the usability evaluation and consequent results from participants' experiences with the MyPryamidTracker.gov website application. We report on a study of a sample consisting of 25 low-income participants with varied levels of vision (i.e., sighted, low vision, and blind Internet users). Usability was assessed via both objective and subjective measures. Overall, participants had significant difficulty understanding how to use the MyPyramidTracker.gov website. The chapter concludes with major recommendations pertaining to the implementation of website design elements including pathway/navigation, search, links, text chunking, and frames layout. An extensive set of actionable website design recommendations and a usability questionnaire are also provided that can be used by researchers in their future evaluations of websites and web services.

INTRODUCTION

According to the U.S. Department of Agriculture – Food and Nutrition Service's report on the "Dietary Intake and Dietary Attitudes Among Food Stamp Participants (FSP) and Other Low-Income Individuals" (USDA-FNS, 2000), additional research is needed to address FSP participants' "moderate" levels of nutrition knowledge and lack of awareness of key pieces of nutritional information. Nutrition education aimed at helping participants make more informed food choices may provide participants with the tools and strategies to improve their nutritional intake and dietary quality.

However, most websites have not been designed with accessibility in mind. In fact, an empirical study found that 98.24% of the websites representing all types of firms, large and small, B2B and B2C, and profit-seeking and not-for-profit, did not meet minimal website accessibility standards (Milliman, 2002; Souza et. al, 2001). Another study by the Disability Rights Commission (Centre for HCI Design, 2005) found that 81% of websites (1,000 websites were evaluated) failed to satisfy the most basic requirements, and that characteristics of the sites make it very difficult, if not impossible, for people with disabilities, especially blind users, to use the website's services. Sites with small fixed-size fonts and links, small button sizes, insufficient color contrast and color combinations, poorly coded data table layouts, mouse-

based and/or dynamic scripting, and lack of audio captioning are usually inaccessible for people with various disabilities (Thatcher et. al, 2003; Slatin & Rush, 2003; Swierenga et. al, 2011). Recognizing that more information and business is being conducted over the Internet, Congress mandated that the digital presence of all Federal agencies must be fully accessible in Section 508 of the Rehabilitation Act. Furthermore, the Web Content Accessibility Guidelines (WCAG) 2.0 are now the recognized standard for accessible web design and is approved as an International Organization for Standardization (ISO) standard: ISO/IEC 40500:2012. Thus, ensuring accessibility is no longer a premium or optional feature when designing websites. The benefits of meeting the guidelines are not limited to persons with disabilities, as accessible design increases product usability for everyone. Hence, our overall research questions are:

RQ1. What is the usability of e-health (nutrition and physical activity) websites when used by low-income, disabled (i.e., low vision and blind) Internet users?

RQ2. What is the impact of e-health websites on disabled Internet users' nutrition and physical activity knowledge and behaviors following a longer term exposure?

This chapter describes a multi-group research study of the usability evaluation and consequent results from participants' experiences with the MyPryamidTracker.gov website application. Specifically, we report on a study of a sample consisting of 25 low-income participants with varied levels of vision (i.e., sighted, low vision, and blind Internet users).

BACKGROUND

Usability studies have their roots as early as the 1970's with the work of "software psychology." "Software psychology dealt with the utility of a behavioural approach to understanding software design, programming, and the use of interactive systems, and to motivate and guide system developers to consider the characteristics of human beings" (Carroll, 1997). Evolving into the analysis of user requirements and the conception of Graphical User Interfaces (GUI), "usability engineering" arrived (Nielsen, 1993; Hermann & Heidmann, 2002). A later stage that would form a subset of usability engineering concentrated on interfaces and came to be known as "information visualization" (Hornbaek, et. al, 2003). The most recent exploration in the field of usability was coined "new usability" (Thomas & Macredie, 2002) or "ubiquitous usability" (Hassanein and Head, 2003). "Ubiquitous usability" is concerned with the context in which new products and services are being used. Varied situational contexts will result in emerging usability factors, making traditional approaches to usability evaluation inappropriate.

The corresponding research has produced extensive resources in the form of usability guidelines and standards for various domains. Still, research in the two areas of context of use and a user's evaluative process of usability has been limited (Venkatesh et al., 2003). The importance of these two areas emerges from their importance in yielding a reasonable analysis during a usability study (Thimbleby et al., 2001; Maguire, 2001). For example, a usability study would be of limited value if it were not to account for the following factors (Hassanein and Head, 2003), which were the core dimensions of Coursaris and Kim's (2008) contextual usability framework:
- User (e.g., prior relevant/computing experience, age, education, culture, state of motion)
- Environment (e.g. lighting, noise – music, speech, white noise)
- Task (e.g., complexity, interactivity)
- Technology (e.g., network dependability, interface design – input/output modes, size, weight, actual device vs. emulator)

The takeaway is that usability experiments need to consider both the product/artifact and the user, and be designed subject to those considerations in addition to the environmental and task-related constraints. In this study, we focus on the users' visual impairment and how it may affect website usability, as disability has received little attention: in the context of mobile usability studies, for example, only 2% of studies explored any form of user disability (Coursaris and Kim, 2008).

At a lower level of abstraction, i.e., more specifically regarding the measurement of usability, a number of approaches have been put forth by scholars (for a review, see Coursaris and Kim, 2008). For this study, usability will be measured according to standard ISO 9241 (1998), where usability is defined as, and measured in terms of:
- Efficiency: the level of resource consumed in performing tasks,
- Effectiveness: the ability of users to complete tasks using the technology, and the quality of output of those tasks,
- Satisfaction: users' subjective satisfaction to using the technology.

The ISO definition of usability was chosen for this study in part because it is the international standard (ISO-9241, 1998) of measuring usability. The use of this standard allows for consistency with other studies in the measurement of efficiency, effectiveness, and satisfaction (Brereton, 2004). Furthermore, accessibility, which addresses whether the system supports users who are relying on assistive technology such as a screen reader to perform tasks, will be assessed by coupling usability metrics along with qualitative data obtained through our post-study questionnaire. Next, we will discuss our study in detail.

METHODS
Participants
A convenient sample was recruited by means of snowball sampling. Participants were given a $100 gift card from a local merchant and a parking pass as compensation for the 90-minute lab experiment session. There were a total of 25 participants, 9 male and 16 female. From the 25 participants, 16 were blind, 4 were low-vision and 5 sighted. Participants ranged in age from 19 to 63, had a variety of educational and employment backgrounds, and all except for one indicated that they own a computer. All but one participant indicated that they were at least "a little" interested in programs that focus on diet, exercise and smoking cessation, with 15 participants stating that they were either "very" or "extremely" interested in these types of programs. The most preferred delivery method for these programs was videotapes, either in the form of CDs or DVDs. 12 participants stated that their current health status was "excellent or very good." 10 characterized their current health status as "good," 2 indicated that their current health status was "fair," and 1 called her current health status "poor."

Testing Room Setup & Equipment
The usability evaluations were conducted at the state-of-the-art Usability/Accessibility Research and Consulting space, within University Outreach and Engagement at Michigan State University, East Lansing, Michigan (see Figure 1). The facility incorporates cutting-edge technologies and multipurpose spaces within an aesthetically appealing and accessible business environment. All spaces protect the privacy of individuals and accommodate those with disabilities.

Specifically, the usability testing room is equipped with three computers; digital video, audio, and screen recording equipment; a document camera; Internet connectivity; and white boards. The space includes an adjustable height workstation, and all computers have Freedom Scientific's JAWS® for Windows and Ai Squared's ZoomText® assistive technologies for blind and low vision users. Mixing and other production equipment are used to create picture-in-a-picture output for live viewing, as well as for recording for later

analysis and reporting. Clients can observe the test activities through live video and audio feeds to a projection screen.

The following describes the hardware and relevant settings during our study: Dell Optiplex computer running Windows XP with a 17" monitor. The default screen resolution was 1024X768. The site was displayed in Internet Explorer running over a T3 Internet connection. Additionally, a set of assistive technologies was employed during the study, as follows. The screen reader participants used JAWS for Windows. Low vision users used ZoomText. Participants adjusted the settings as needed.

> > > INSERT FIGURE 1 HERE < < <

Figure 1. Michigan State University Usability/Accessibility Research and Consulting testing room setup.

Procedure

The one-on-one lab experiment sessions lasted 90 minutes for each participant, and included several components:

- Verbal overview description of study – Participants were given a description of the general nature of the study and the order of activities that were conducted in the session.
- Informed consent form for human subjects – Each participant was asked to sign the Consent Form before they participated in the study.
- Demographic questionnaire – We administered a brief pre-test questionnaire to gather background information on participants' work experience and Internet experience.
- Task scenarios performance – Participants were asked to perform seven (7) task scenarios using the MyPyramid Tracker website interface. Participants were asked to think aloud and verbalize any confusion while performing tasks, in order to identify areas of difficulty, as well as patterns and types of participant errors when performing typical search tasks.
- Post-study questionnaire – A post-study questionnaire was administered to address specific aspects of the task scenarios and obtain satisfaction ratings.
- Participants were debriefed at the end of the session and given a hard copy of the information.

Tasks

Participants were asked to complete seven tasks on the MyPyramid Tracker website:

1. Register on the MyPyramid Tracker website.
2. Add a bagel, an apple, and a cup of coffee to your daily food intake list.
3. Add the apple to your frequently used food list.
4. Find out how well your eating behavior meets the dietary guidelines.
5. Enter the following physical activities: walking for 10 minutes, doing some light housecleaning, and sitting and typing on a computer.
6. Set walking as a frequently performed activity.
7. Determine your physical activity score.

Measurement

As abovementioned, key usability goals included effectiveness, which refers to how well a system does what it is supposed to do; efficiency, or the way a system supports users in carrying out their tasks; satisfaction, which relates to the subjective responses users have to the system; and accessibility, which addresses whether the system supports users who are relying on assistive technology, such as a screen reader, to perform the tasks.

User performance data were collected during each lab experiment session, and metrics included:

- Percentage of tasks completed successfully

- Mean time to perform a particular task
- Types of errors

Qualitative measures, used both during the test and after the test, included:

- Verbal feedback during and after the session
- Participant satisfaction ratings via the post-study questionnaires
- Written feedback on the demographic and post-study questionnaires

The complete post-study questionnaire, which shows all measures used, is found in the Appendix.

RESULTS

User Performance – Objective Data

Quantitative data collected in relevance to user performance are summarized in Table 1 below:

Table 1. User Performance – Objective data.

	Tasks	User	Successful Task Completion**	Ratio of users who "gave up" to "unsuccessful task completion"	Mean Task Completion Time (mm:ss)
1	Sign-up	B*	10/16 (63%)	4/6	06:35
		L	2/4 (50%)	1/2	06:24
		S	4/5 (80%)	0/1	02:26
		O	16/25 (64%)	5/9	05:31
2	Add food item consumed	B	8/16 (50%)	5/8	09:56
		L	3/4 (75%)	0/1	06:00
		S	4/5 (80%)	0/1	04:15
		O	15/25 (60%)	5/10	07:38
3	Add food to Frequently Used Foods list	B	12/16 (75%)	2/4	03:55
		L	3/4 (75%)	1/1	00:41
		S	2/5 (40%)	2/3	00:13
		O	16/24 (67%)	5/8	03:04
4	View Nutrition Evaluation	B	13/16 (81%)	2/3	08:28
		L	2/4 (50%)	1/2	10:30
		S	4/5 (80%)	1/1	03:06
		O	19/25 (76%)	4/6	07:33
5	Add physical activity	B	6/13 (48%)	6/7	12:56
		L	1/3 (33%)	1/2	14:34
		S	3/5 (60%)	2/2	03:48
		O	10/21 (48%)	9/11	09:52
6	Add activity to Frequently Performed Activities list	B	7/12 (58%)	4/5	03:37
		L	1/3 (33%)	1/2	03:43
		S	3/5 (60%)	1/2	01:46
		O	11/20 (55%)	6/9	03:07
7	View Physical Exercise Evaluation	B	10/12 (83%)	1/2	03:55
		L	1/3 (33%)	1/2	05:22
		S	4/5 (80%)	0/1	01:47
		O	15/20 (75%)	2/5	03:31

* Blind users = B; Low-vision users = L; Sighted users = S; Overall = O
** Total n=25; Blind n=16; Low-vision n=4; Sighted n=5

User Performance – Subjective Data (Direct Observation)

In addition to the objective data collected for participants' performance, the two authors observed each participant and recorded qualitative data to offer richer insight into the users' experience. These are reported below for each task, along with a set of recommendations made by the authors.

Task 1 – Register on the MyPyramid Tracker website

- Users had difficulty properly entering height information. Many were confused by the two separate fields and the lack of preceding labels.
  - Several screen reader users entered their entire height in the first field before realizing there was a second field for inches.
  - Several participants included units with their height information, or expressed confusion that different units than expected were being applied to the numbers they entered: "You've got to make sure it tells you what the default is." "When we enter into an edit box the website should say how they want it entered."
- Screen reader users were unsure if the information at the top of the page, before registration, was necessary or relevant. As one user remarked, "I don't know whether to skip this."
- Due to ineffective feedback, several users were unaware that they had correctly completed the task, while others were unaware that they had made errors.
  - The screen reader did not read out the pop-ups explaining errors.
  - Having a pop-up indicating both successfully saved changes and unsuccessful attempts was confusing to screen reader users—they were not sure if they had made an error or not.
  - One user read over the whole form again, remarking that it "went back to the same form, so I didn't think I did it correctly. Usually it goes back to a different page, thank you for registering then go to next page or the homepage." Another noted simply: "It doesn't move you forward."

Task 1 – Recommendations

- On the homepage, the sign up and login functions were buried beneath large chunks of text, and users were accustomed to seeing these options without having to scroll. Place these options closer to the top of the page for simpler access in order to encourage users to explore, to make the page appear more interactive, and to allow blind/low vision users to more easily locate these options.
- Ensure that all fields are properly labeled and it is clear to assistive technology users what units will be used for height, weight, etc.
- The explanation provided for invalid input indicators (asterisks, in this case) was below the form in a place where screen reader users may not encounter it at all. Place this information at the top of the page; consider displaying it only when users are directed to correct the form in some way.
- Eliminate the use of pop-ups for non-error notifications and instead take users to a new page that informs them that their information has been saved, and displays a user profile with options to proceed.

Task 2 – Add a bagel, an apple, and a cup of coffee to your daily food intake list

- Users had difficulty with the search tool for adding food to the daily intake list. (See Figure 1.)
  - Many users searched for "cup of coffee," rather than just the keyword, "coffee."
  - Several people searched for two or more items at once: "bagel coffee" etc., similar to most search tools.
  - One user asked "Does spelling count?" Several people misspelled items but did not realize it, and were not given relevant results.
- Screen reader users had difficulty with almost every aspect of the process, depending on their individual skill levels with assistive technology.

- o When the search term was not exact, the list of search results was irrelevant (i.e., "cup of coffee" returns several "cupcake" items at the top of the list).
  - o When a food item was added, there was no notification; hence, users were often confused about whether or not the item had been added.
  - o The graphical "add" button and linked text both had the same function.
  - o Several users accidentally added foods to their Frequently Used Foods list, or remarked that they did not know what "Freq foods" meant.
  - o Clicking the link for a food in the links list did not add it to the daily food intake.
  - o Users were generally confused and often frustrated by the set up of the page, especially the side-by-side content areas which made it difficult to navigate between the search function and the list of added items: "It's just not very clear! How do you check it?" "Where can I hear [what I have]?" "I'm not getting where I want to be."
- Some users thought there should be a separate entry for beverages.
- Some users thought they had successfully added items when they had only heard/seen them in the list.
- "Once you clicked 'Add' it would be nice if the search box erased itself."

> > > INSERT FIGURE 2 HERE < < <

Figure 2. MyPyramid Tracker – Enter Food Item page.

Task 2 – Recommendations
- The instructions should be concise and complete. Furthermore, it should be specified that beverages are included.
- The search function should be improved. Users expect "Google" type search and results, e.g., no Boolean connectors between words, and results sorted by relevance of the search terms.
  - o Search should provide more logical results for common words and variations (verb tenses, etc.).
  - o Common units and connectors such as "cup of" should be ignored.
  - o Search should be able to provide relevant results for basic misspellings.
  - o Search field text box should automatically clear after each search.
- Users should be notified when a food has been successfully added to their daily intake list.
- Use buttons for adding to both daily intake and frequently used foods lists; eliminate hyperlink in food text.
- Consider allowing users to select a quantity immediately after selecting a food, or indicate that quantities will be selected later.

Task 3 – Add the apple to your frequently used food list
- Several participants thought that clicking "add" should allow them to add the food to the Frequently Used Foods list.
- Several users tried to add the apple from their daily intake list on the right side of the page. Some believed they had to remove the apple from the first list in order to complete the task; others were confused and accidentally removed the apple from the daily list.
- Many screen reader users missed the link to add to the Frequently Used Foods list and had to go through the page several times trying to find what they were looking for, even after reading the help for frequently used foods.
  - o Participants often didn't know what "freq" meant.
  - o One user finally closed in on the link by listening to it letter by letter.
  - o Users would sometimes click the "Frequently Used Foods" link, which simply refreshed the frame. Users had to go through the entire page again just to hear the phrase "There are currently no foods in your Frequently Used Foods list."
- Some participants used the search function again and clicked the food link itself, adding it to the daily intake list instead of frequently used foods.

- Participants were often confused by vaguely worded links such as "Frequently Used Foods List" or "Frequently Used Foods," and thought clicking those would allow them to construct the list.

> > > INSERT FIGURE 3 HERE < < <

Figure 3. MyPyramid Tracker – Frequently Used Food page.

Task 3 – Recommendations
- Instructions and labels for the frequently used foods list should be explicit and integrated into the overall page architecture. There should be a landing page for the frequently used foods list that provides clear, concise instructions as well as a search field. A clear path to the "frequent" lists, as well as the lists themselves, should be evident to all users.
- The "freq" link must be replaced with a clear, logically-worded button that will make sense to screen reader users.
- Eliminate or clarify ambiguously worded links, e.g., use "How to make a Frequently Used Foods list," rather than "Frequently Used Foods list").

Task 4 – Find out how well your eating behavior meets the dietary guidelines
- Several participants seemed unsure about how to begin the task.
  - Some looked for information on the dietary guidelines, not realizing that the guidelines would be provided as part of the sequence.
  - Participants did not associate the "add quantities" link with analyzing dietary intake. Several used the top navigation as opposed to the buttons in the content area.
  - Screen reader users had difficulty determining their location on the page and understanding when content in a frame had changed. Upon clicking the "Analyze your Food Intake" link from the global navigation, one user exclaimed: "That's what I clicked on, but it doesn't do anything!"
- Users were somewhat surprised to have to enter a quantity as part of the process: "[This] seems kind of silly – you should be able to put servings in when you select food."
- Several expressed uncertainty about the practicality of taking exact measurements in everyday life.
- A few screen reader users were confused by the abbreviations of serving units: "'Fl oz,' I wondered what that was."
- Participants were confused about the two editing fields on the quantities page: "I'm confused about what the extra edit field is. I would think the drop-down has all the serving sizes."
  - Several participants, especially screen reader users, entered information only in some or all of the drop-down menus.
  - One screen reader user skipped the drop-down menus altogether and only entered quantities.
  - One low vision participant using ZoomText scrolled over to see the second editing field and could not figure out how to indicate he drinks "way more" than 1 mug of coffee.
  - Most users who received an error message were able to determine their error and correctly enter the quantity, but several expressed confusion and/or frustration, saying things like "I thought I already did [enter a valid serving size]," or "I don't know what I'm supposed to do."
- Reaction to the results table was mixed: Some screen reader users immediately interpreted it correctly, but others had trouble. One participant could not understand the headers and was confused about whether certain numbers were recommendations; one participant said, "I don't understand what it's reading me;" another simply called it "lousy."
- Many participants had a friendly reaction to the emoticons, pointing to them as a clear indicator of how their diets measured up to the dietary guidelines and even calling them "cute."

Task 4 – Recommendations
- Provide concise instructions for quantity selections, such as, "Select a serving size using the drop-down menu and then enter the number of servings in the text field."

- The links to the other nutrition evaluations are floating at the bottom of the page. For anyone who did not read past the 2005 Dietary Guidelines description, the links would seem random and confusing. Provide a clear path and indicator of where to move next on the page after "Save and Analyze."
- Add instructions to the error message for selecting serving size versus quantity for the selected serving size.
- Eliminate abbreviations from results tables.

Task 5 – Enter the following physical activities: walking for 10 minutes, doing some light housecleaning, and sitting and typing on a computer

- One user had difficulty changing the option from "standard" to "condensed" on the physical activity landing page.
- Users had difficulty with the search and selection option for adding physical activities. There was some confusion about whether they were supposed to use one or both, as with the food selection menu.
  - o Participants would sometimes find the category of physical activity they wanted, but then move on without clicking the "Select" button.
  - o Many users were confused by the presence of the Search field after they had already selected a category from the drop-down menu.
  - o Several participants erroneously entered times in the search field, believing that once they selected an activity type they would logically enter the time.
  - o Even after an activity was successfully added, some users did not remember the steps they had taken to get to that point.
  - o Screen reader users often had difficulty using the drop-down menus and text fields on the page.
  - o Users did not intuitively understand the dynamic drop-down/selection menu system, and were often frustrated when the activity they wanted was not immediately available via drop-down or search. Some selected activities that they believed were the best available substitute, such as "aerobic, low impact."
  - o Screen reader users were caught unaware that when they selected an activity category from the drop-down, more specific choices would show up in the lower menu box. They did not realize that new information had appeared on the page.
  - o Several users commented that "Activity Description" was a strange name, or believed that it meant they were supposed to enter a description. They tried to type in the area, since it looked like a text box.
- Some users selected Physical Activity Entry or Physical Activity Information from the main navigation when they were confused or did not know what to do next.
- Some screen reader users added physical activities without knowing it.

> > > INSERT FIGURE 4 HERE < < <

Figure 4. MyPyramid Tracker – Enter Activity Type page.

Task 5 – Recommendations
- Condensed option should be considered the default option and be featured as the first option. The standard option should be renamed "Detailed" or something similar.
- Users who want to change from "condensed" to "standard" or vice versa currently have to return to login and start over after changing the date and then changing it back. They should be able to make the switch within their current session.
- Fix the search method:
  - o Until the search function can be greatly enhanced to better understand and infer a user's intent, we recommend using only the drop-down menu to sort and select physical activities.

- o Consider simplifying the categories and options available—categories like "Inactivity light" and "Inactivity quiet" or activities like "standing, talking in church" and "standing, singing in church, attending a ceremony" are too similar and could cause confusion.
- o Some choices may fit under more than one category ("meditating" should be listed under religion, but is only found under "Inactivity light").
- o Display search results similarly to food search results; eliminate text box.
- Change "Activity Description" label to "Choose from Activities List" or something similar.
- Eliminate the hyperlinked text from activities in the daily list; add a button for removal instead.
- Consider allowing users to add durations immediately after selecting an activity, or explicitly indicate that they will add durations later.

Task 6 – Set walking as a frequently performed activity
- Participants experienced many of the same issues with the search and menu functions as they did finding physical activities in Task 5.
- Some participants clicked on the link for information about frequently performed activities and expected to be able to construct a list that way.
- Many users did not know what "FPA" stood for.
- Some screen reader users accidentally or unknowingly removed activities from their daily list.
- Several participants noted the difference in the button labels for frequently performed activities and frequently used foods. They wondered why the signal for the frequently used foods was "freq" and for activities it was "FPA."
- Some users thought they had successfully added the activity to the FPA, but had only added it to their daily list of activities.
- One user noted that the "Select" button should be labeled as a button in its description.
- One user commented that removing items by accident seemed easier than adding items intentionally.

Task 6 – Recommendations
- "FPA" does not have meaning for users unless it is explained; we recommend using the entire text of "Frequently Performed Activity" whenever possible, or choosing another title such as "Frequent Activity" or "Favorite Activity."
- As with the Frequently Used Foods list, we suggest a landing page dedicated to constructing, maintaining, and viewing the FPA list. Users should be provided with, at least, a few clear pathways to access this list.
- Eliminate randomly-placed links to information about the FPA list.
- When users select a physical activity for their daily list that is not in the Frequently Performed Activities list, they should be prompted to add it to the FPA list at that point.

Task 7 – Determine your physical activity score
- A few participants clicked on "Physical Activity Information" from the top navigation instead of proceeding using buttons. There was some confusion as to how to proceed, possibly because the "Select Duration" button did not provide adequate direction.
- Some users had to enter duration twice and remarked that it seemed inconvenient.
- One participant said she thought it would work like the nutrition analysis and give recommendations for improvement.
- One user did not know for sure if the duration fields referred to daily (as opposed to weekly) times.
- A few participants entered units with their durations or were not sure what units would be used.
- On the results page, one user questioned what "METs" was.

Task 7 – Recommendations
- Ensure that fields are properly labeled.

- Explain all acronyms/abbreviations.
- Entering duration should be part of selecting the activity, rather than the first step in analyzing levels of physical activity.
- On the overall process of selecting and analyzing physical activities, provide clear, concise instructions.

User Assessment (Questionnaire)

In the post-study questionnaire (see Appendix), participants rated various aspects of the MyPyramid Tracker site as a whole. Overall, participants "slightly disagreed" that the MyPyramid Tracker website was easy to use, with an average rating of 3.8 on a scale from 1-7, where 1 was "Strongly disagree" and 7 was "Strongly agree." Assistive technology users had an especially difficult time moving through the process. When asked if the website content met their expectations, most "Somewhat agreed" or "Strongly agreed," with an average rating of 5.68, commenting that it had lots of good information.

Participants were split when asked whether the site was organized in an understandable way, rating it 4.28 with most participants either "Somewhat disagreeing" or "Somewhat agreeing." Several assistive technology users mentioned that the frames were inaccessible for them, while most people agreed that they understood the website structure better after some trial-and-error. Regarding how useful the participants found the site to be, participants overwhelming agreed that the site was either "Somewhat useful" or "Very useful," with an average rating of 4.4 on a scale of 1-5. Two participants were neutral, but no participants rated the site as "Not at all" useful or "Of little use;" however, many participants indicated that it would take time to learn the site before they would benefit from its use. And finally, when asked if they would recommend this site to colleagues and friends, most "Strongly agreed" that they would do so, with an average rating of 5.52 on a scale of 1-7.

Some participants gave recommendations for enhancing the accessibility of the site, noting that the Frequently Used Foods and Frequently Performed Activities lists were confusing, and the units and serving sizes were difficult for assistive technology users to understand. One participant recommended offering a text-only, plain HTML version of the site, while others recommended specific fixes, such as accurately labeling fields and the use of buttons instead of images. Participants also commented on the confusing nature of the search feature, and recommended something clearer for visually impaired users. Some additional comments and recommendations for the future included: "Avoid split screen" and "I would suggest updating the dietary guidelines to 2008."

These results show that while participants were enthusiastic about the MyPyramid Tracker site, they had difficulty actually using the system – especially assistive technology users. There is considerable opportunity for improvement, especially in organization and functionality.

Conclusions and Recommendations

This chapter describes the usability evaluation results involving participant reactions to the MyPryamidTracker.gov e-health website application. This evaluation was conducted at Michigan State University in one-on-one usability sessions with 25 food-stamp eligible (FSE) participants who were blind, low vision, and sighted Internet users.

Overall, participants had significant difficulty understanding how to use the MyPyramidTracker.gov website. The features of the MyPyramid Tracker website were meant to allow flexibility and specificity in order to deliver accurate healthy eating and physical activity recommendations to users. However, the complexity, design and functionality of the site present a steep learning curve and significant roadblocks for users, especially those using assistive technology. Participants had major difficulty using the search function and drop-down menus to add food or activities to their daily intake lists, and correctly using the

Frequently Used Foods and Frequently Performed Activities features. They also had significant difficulty understanding and working within the dynamic, frames-based structure of the site. The most recurrent and significant problems were common across the vision spectrum, but in every case the task completion times for blind and low vision users were longer and their success rates lower than for sighted users.

General Recommendations for All Users

Layout
- Be conscious of category convention
    - What people have experienced and will be expecting to see
    - Identify opportunities for enhancing it
- Remember eye-tracking results: The "F" shape, i.e., users look at the top and then the left for navigation menus
- Make page elements hierarchical: Menus, navigation bars, content.
- Group related items together.
- For step-by-step processes, the buttons should be ordered in a logical fashion and should first include a "back" button. Any buttons relating to forms, such as "reset," should come next, followed by the option for saving and moving forward.
- Help create page order by respecting alignment.
- Minimize scrolling, create visual links when necessary.
- Use white space to frame content areas.

Navigation
- Provide consistent global navigation across all pages.
    - Main navigation should not change from page to page
    - Secondary navigation hierarchy should remain intact
- Menu items that represent the process should be grouped together, and there should be some indication of what step the user is currently working on. Informational menu items that do not directly relate to the process should come after or be otherwise separated from the action-oriented items.
- Use link and label names that clearly and concisely indicate destination content.
- Use terms that your target audience will understand
    - Keep dropdown menus short, and avoid multi-level dropdowns
- Make links recognizable—color, underline, visited/non-visited
    - Keep non-clickable text standard
- Always warn users when a link will open a new window. Try to avoid secondary windows and pop-ups.

Content
- Use language (terms and expressions) users expect and understand.
- Provide information based on their needs and expectations.
- Break large paragraphs into smaller chunks and cut out extraneous information and improve readability.
- Use headings to separate and identify topics.
- Fully spell out acronyms.
- Avoid italic type as it is more difficult to read.
- Anticipate accessibility elements
    - Paragraph headings, meaningful link phrases (no "click here")
    - Table formats (captions, concise/descriptive headings), Form formats (sections, concise/descriptive labels)
    - Site map

Forms
- Use consistent format throughout page and site.
- Follow convention: Labels precede input fields, checkboxes and radio buttons precede labels.
- Imagine a conversation with person filling in form.
- Lead users through the form with logical steps.
- Ask only for what is needed.
- Use sensible labels to minimize explanations.
- Clearly indicate what is required.
- Include "key", i.e., "*" means required.
- Make accessible: Include * in label (all), describe as required or mandatory in tool tip (PDF)
- Provide help at point of input (with label, on focus).
- Use flexible input fields when possible.

Interactive Components
- Decide if an interactive component is really necessary – no matter how helpful, it will add complexity.
- Simplify interactive components – have them perform only necessary tasks.
- Imagine
    - How should it work using only the keyboard?
    - How can I explain it to someone who can't see it?

Additional Recommendations for Users who are Blind Using Screen Reader Adaptive Technology

- Ensure headings are used to identify sections and subsections so that screen reader users can easily scan pages that contain large amounts of information.
- Provide accurate and descriptive alternative text for all graphics and non-text content.
- Provide a link to the homepage at the top and bottom of all pages.
- Tag PDF files for accessibility so that they render properly with assistive technology.
- Provide a site map to help users understand site organization and content.
- Make sure that drop-down menus work with the "Enter" key, which is the expected behavior for screen reader users.
- Ensure that all form fields and radio buttons have labels that are descriptive and associated with input fields.

In summary, there are several areas in which MyPyramid Tracker could be improved based on the results of this study. Beyond these redesign recommendations, a major takeaway should be the promise MyPyramid Tracker offers to blind and low-vision SNAP eligible users to improve their nutrition and physical activity lifestyle choices. This outcome will be achieved once the system becomes easier to use, more useful in educating users in low-level information that can be easily implemented, and promote the continued use of the system by making the experience more personal.

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KEY TERMS AND DEFINITIONS

Usability:	The efficiency, effectiveness, and user satisfaction with a system
Efficiency:	The level of resources consumed during a specified task
Effectiveness:	The ability to complete a task, and the quality of that output
Satisfaction:	The subjective assessment of a user's experience with the system
Performance:	The efficiency and effectiveness associated with a user's interaction with a system
Accessibility:	The degree to which the system supports users who are relying on assistive technology to perform tasks
Context of Use:	The user, task, technology, and environment characteristics in a specified use setting

Appendix – Usability Study Questionnaire

This questionnaire contains items regarding your overall impressions of the MyPyramid Tracker website.

1. Overall, the MyPyramid Tracker website was easy-to-use.

| Strongly disagree | Somewhat disagree | Slightly disagree | Neither agree nor disagree | Slightly agree | Somewhat agree | Strongly agree |

   Why? _____

2. The content of the MyPyramid Tracker website met my expectations.

| Strongly disagree | Somewhat disagree | Slightly disagree | Neither agree nor disagree | Slightly agree | Somewhat agree | Strongly agree |

   Why? _____

3. Overall, it was easy to understand the organization of the MyPyramid Tracker website screens, especially the menu levels and the flow of the screens.

| Strongly disagree | Somewhat disagree | Slightly disagree | Neither agree nor disagree | Slightly agree | Somewhat agree | Strongly agree |

   Why? _____

4. How useful do you find the MyPyramid Tracker website to be?

   Not at all   Of little use   Neutral   Somewhat useful   Very useful

   Why? _____

5. I would recommend the MyPyramid Tracker website to my colleagues and friends.

| Strongly disagree | Somewhat disagree | Slightly disagree | Neither agree nor disagree | Slightly agree | Somewhat agree | Strongly agree |

   Why? _____

6. What recommendations do you have for improving the accessibility of the site?

   _____

7. Additional comments and/or recommendations for future enhancements:

   _____