A Study of the Effectiveness of UI Elements Within Various Clemson Websites

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INTRODUCTION

Motivation

In this study, we combine the findings of Jakob Nielsen with Fitt's Law by comparing the search time needed to find buttons and accomplish actions concerning Clemson's Redfern Health Center website. In the current user interface found at https://www.clemson.edu/campus-life/student-health/, some of the buttons are located down and to the far right of the page, which is generally the last place a user will look when initially scanning a web page, according to Nielsen. When compared to the header links, the target buttons are smaller which, according to Fitts' Law, will make them harder to find.

Goals

In this experiment a new user interfaced is proposed, in conjunction to the original flawed interface, where the target buttons will be one of the elements in the header menu, making it much larger, and placing it at the top left of the screen. This is done with the goas of allow the user to locate some of the buttons and accomplish the actions much more quickly and effectively.

Hypothesis

By using eye-tracking technology and recording the time taken by each participant to locate the target buttons, we intend to effectively test the hypothesis that the proposed optimized interface with the larger buttons at the top of the page would take less time to locate than the default interface currently in production. The results of this study will give insight into the effectiveness of the user interface and how it can be altered for the better.

PREVIOUS WORK

In 2006, Jakob Nielsen discovered that most users browse a web page in a predictable pattern, that of an F. They first scan across the top from left to right, and then go down across the left side and then back to the right. This means that generally speaking, the user will see an element on the lower right last. Other experiments have shown that the size and distance of an element directly impacts the user's ability to quickly locate and interact with the element. On average, the larger and closer to the user's focus an element is, the easier it will be to locate. This is commonly known as Fitts' Law (Mackenzie, 1995). The study introduced above and described below leverages these findings greatly in terms of what to expect in the data

METHODOLOGY

Experimental Procedure

The procedure of the experiment was very simple given the nature of the experiment. Subjects were first recruited via email invitation, personal invitation, or subject curiousity. The procedures for the experiment were followed according to an IRB approved script written by all members of the team. The subject was first introduced according to the script and was able to ask any questions they needed to have answered. Then the subject was given an IRB approved letter of consent to review.

After reviewing the letter of consent the participant was then asked several demographic questions about their occupation, age, class ranking, gender, and area of study. The answers to these question were collected by a third party survey technology known as Survey Monkey. This was chosen as it allows rapid processing and presentation of data collected.

Following the demographic survey, the subject was then placed in front of the eye tracker and the eye tracker was calibrated for their gaze. After the eye tracker was calibrated the subject was then allowed to begin the experiment. First the subject was shown still images from a flu shot scheduling appointment flow. The users time was collected and the eye tracking data as well. Next the subject was shown still images from a prescription refill flow. The same data was collected. In between stimuli the user was presented with written instructions to center the user's eyes and to ensure they understand what to do.

At the conclusion of the session the subject was allowed to ask any questions and was thanked and dismissed. At any point in the study, past subjects were allowed to contact the team with concerns, or questions.

Experimental Design

The study was done between-subjects such that each participant was exposed to only one group of images for each of the two tasks: scheduling a flu shot and refilling a prescription. The subjects were shown a still image and asked to locate an actionable item.

The first group was shown images with actionable items that were unchanged in size and location for the flu shot task, and were shown images with actionable items of increased size and modified location for the prescription refill task. The second group was shown images with actionable items that were increased in size and changed location for the flu shot task and were shown images with unmodified actionable items for the prescription refill task.

This 2x2 (*Task vs Location of Target Item*) study was intended to measure the effect of the size and location alterations on the time required for participants to locate the target item for each task, as well as allow the testing to stay truly random and avoid any ordering effects. Thus allowing data collected to remain valid.

The participants were timed on how quickly they were able to locate and focus on the target object. Although no timing device is visible to the subject in order to avoid distracting them from their task. Additionally, subject's gaze patterns were collected in order to understand their visual searching strategy. Following the successful location of the target item the subjects were taken to the next step of the experiment until conclusion of said experiment.

Stimuli

The stimuli presented to the subjects were simply two still images of Clemson's Redfern Health Center website. The first image shown below in Figure 1 is of the original web page. The second image found in Figure 2 is of the modified interface. Among the stimuli shown in Figures 1 and 2, the users were also shown still images of text in between being exposed to the two stimuli. This was to center the user's eyes and communicate to them further instructions for the experiment.

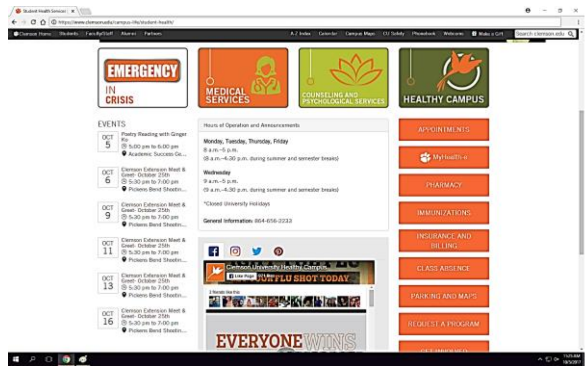

Figure 1: Unmodified Still Image of Clemson's Redfern Health Center Website

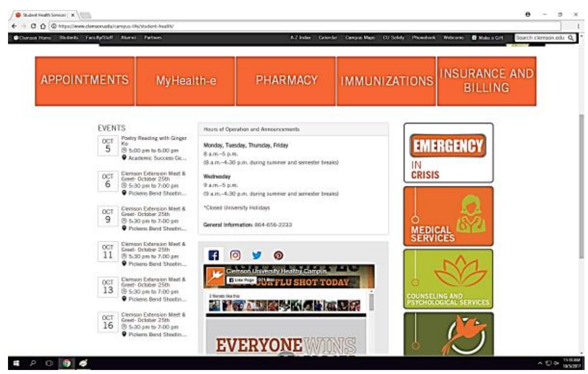

Figure 2: Modified Interface of Clemson's Redfern Health Center Website

Apparatus

Stimuli were displayed on a Dell Professional P2213 22 inch LED monitor with a 60Hz refresh rate and a screen resolution of 1680 x 1050 pixels. The display is backboned off of a NVIDIA GeForce GTX 745 adapter with 4 GB of dedicated memory. A GazePoint GP3 pupil corneal reflection eye tracker was used to collect the eye tracking data. This eye tracker has a 0.5 – 1 degree of visual angle accuracy, with a 60 Hz sampling rate, and 5 to 9 point calibration. 25 cm of horizontal and 11 cm of vertical movement are allowed as well as a ±15 cm range of depth movement.

Figure 3: Workstation Used For Testing

The tracker was mounted to the Monitor as shown in Figure 2 and calibrated using the provided Gazepoint Control Software v3.1.0 and controlled by the provided Gazepoint Analysis Software v3.1.0. The workstation used was a Dell Optiplex 9020 PC with an Intel Core I7-4790 3.6GHz / 8MB cache processor, 16GB (2 x 8GB) 1600 MHz DDR3 Non-ECC RAM, and a 3.5in 500GB 7200 RPM hard drive. The PC was equipped with the Windows 10 Enterprise 2016 Operating System.

Subjects

The subjects in the study were randomly selected from the Clemson area and recruited in conjunction with the outlined experimental procedure. The study consisted of 17 subjects in total, each with normal vision not requiring corrective eye-glass lenses or contact lenses. The majority of the subjects were aged from 18-34 years old. 27% of subjects reported having used the Clemson Redfern Health Center website prior to the experiment. The majority of the participants were computer science students of Clemson's School of Computing. No incentives were given to subjects for participation.

RESULTS

The data yielded from the experiment is summarized and presented here in a series of succinct data elements. The data collected are explained in meaning and relevance in the Discussion and Conclusions section of the paper. The first Data element to be presented here is the following table.

Task	Stimuli	Participant Completion Percentage
Schedule Prescription Refill	*Unmodified*	77.778
	Modified	42.857
Schedule Flu Shot Appointment	*Unmodified*	71.429
	Modified	100.000

Table 1: Table of Subject Task Completion Percentages

Table 1 shows the Ratios of subjects who were able to find requested elements, as per the experimental procedure. The data here are presented as a series of percentages rather than actual ratios for brevity and to broadcast significance. Regarding table 1, 77.78% and 71.43% of participants shown the unmodified interface were able to complete the tasks of scheduling a flu shot appointment and scheduling a prescription refill within 10 seconds, respectively. Although, 71.43% and 100% of participants shown the modified interface were able to complete the previously listed tasks within 10 seconds.

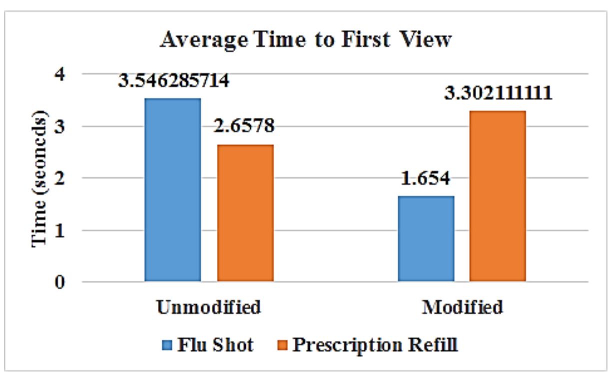

Figure 4: Chart Displaying the Average Completion Time (Time to First View) of Subjects

The next element is shown above as Figure 4 is a chart displaying the average times to find requested elements. The data here are presented as averages about all search times of all subjects tested under the following stimuli. As shown above in Figure 4, the average completion time (time to first view), for the unmodified interface was ≈ 3.55 seconds and ≈ 2.66 seconds for the two tasks scheduling a flu shot appointment and scheduling a prescription refill. The average completion time (time to first view), for the modified interface was ≈ 1.65 seconds and ≈ 3.30 seconds.

Figure 5: Sample Scanpath of Unmodified Stimuli

The next elements shown as Figures 5 and 6 are sample visual search patterns of the stimuli. The images were rendered from trials and presented here to show how a majority of the subjects scanned the stimuli in an attempt to complete the requested task in the trial.

Figure 6: Sample Scanpath of Modified Stimuli

DISCUSSION AND CONCLUSIONS

A percentage of participants were unable to complete the given tasks in the 10 seconds given to complete the task. This may be due to the confusion participants experienced by not understanding the translation of the given task of the required tab to be selected. (i.e., flu shot appointment translates to the Immunizations tab, and scheduling a prescription refill translates to the Pharmacy tab). This could have also happened due to the fact that 10 seconds may not have been enough time for some of the participants to complete the task. Visual search proficiency, as most physical qualities and proficiencies, normally varies from subject to subject

However, the focus of this experiment was primarily on the implications of size and location of elements in a user interface. The scanpaths of each participant were analyzed and shown in Figures 5 and 6. These figures show the scanpaths of a specific participant. Figure 5 shows the participant first looking at the top and then scanning and only glancing over the desired tab of “Pharmacy” before finishing by focusing on the incorrect tab. Figure 5 also shows the scanpath of a participant in the study scanning the top row of large tabs looking for the correct tab to complete the task of scheduling a prescription refill by looking at the “Pharmacy” tab. Although the tab was less obvious in the right list of tabs.

Figure 6 shows the scanpath of a participant in our study scanning the top large tabs looking for the correct tab to complete the task of scheduling a flu shot appointment by looking at the “Immunizations” tab. The participant was able to find the desired tab in a reasonable time with the scanpath data showing less confusion in where to look. Figure 6 also acts as a confirmation of Jakob Nielsen’s study as the beginnings of an F shaped pattern are beginning to form.

Regarding at the scanpaths presented in figures 5 and 6 it can be seen that in figure 5 the subject eyes wander the page in a very erratic pattern looking for affordances to guide the eye. This could be due unfamiliarity with the interface, or lack of guidance for the eyes. In figure 6 a direct flow is established that grabs the attention of the user and guides the eye to general location of the UI element. The empirical data however shows something of larger significance.

Regarding figure 4 it can be seen that the modified did offer a moderate increase in task completion time offering a 2.16 speedup in user performance for the task of scheduling a flu shot and diminishing user performance substantially for scheduling a prescription refill.

Regarding table 1, it can be seen that in the case of scheduling a flu shot lead to more users being unable to complete the task. As stated earlier, this could have been because the user was not given enough time to complete the task. This could also have been due to the fact that some of the subjects have been exposed to the original stimuli by using the publically available Redfern Heath Center website beforehand and were confused by the modifications.

Table 1 also shows that in the case of scheduling a prescription refill, the UI modifications made resulted in a 8.57% increase in user completion of the task. This coupled with the fact that 73% of subjects participating had never been exposed to the stimuli shows that the modifications provided a major benefit in terms of proficiently guiding the user to their goal in every trial, although not in a timely manner.

The conclusion based on the data is that the hypothesis established in the beginning was correct, the UI of Clemson's Redfern Health Center website could stand to benefit from the modifications presented in this study. Not only in terms of user performance, but also in terms of user experience. The modifications presented did increase performance and user experience in some areas, and decreased performance and user experience in other areas. Overall, the hypothesis was correct in the case of scheduling a flu shot, but not in the cases of scheduling a prescription refill. Also, in the case of scheduling a flu shot, the modified interface lowered the percentage of subjects who were able to complete the task. This however raised the percentage of subjects who were able to complete the task in the case of scheduling a prescription refill, where the modification increased the completion time of the task. Regarding the visual behavior collected, the modifications offered a more organized, and cued platform that guides users in their completion of the task, whereas the unmodified stimuli lead to users erratically searching until the task was complete, or the users ran out of time.

If these modifications were further built upon based on the data and theory derived from this study, and tested again in another more thorough study, a more efficient and user friendly UI could be developed to better service students in their use of Clemson's Redfern Health Center website.

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