MYNEU: A COMPLEX USABILITY PROBLEM

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ABSTRACT
myNEU is the student portal for Northeastern University. The site was built to house multiple student and administrative functions under a single sign-on. The single location was convenient, but the vast amounts of information and options negatively impacted the usability of the site. The purpose of this study is to measure the usability of myNEU against common usability design methodology to determine what frustrates users. Participants were asked to complete a series of common tasks in the portal. The number of mouse clicks, time on task, and qualitative data from think-aloud were collected. Testing showed that application efficiency is inversely correlated to participant frustration. Furthermore, efficiency is negatively impacted by the following: large quantities of information presented to the participant, inconsistent application of accelerators (selectable buttons, links, etc...), and presentation of irrelevant information to the participant from the perspective of the task itself.

Keywords: student portal; usability; think aloud; time on task; frustration; efficiency

1. INTRODUCTION

Student portals for large universities are expected (perhaps unfairly but nonetheless expected) to efficiently collect and provide large amounts of information. The student portal of Northeastern University (myNEU) will receive an update in mid to late November (as of this writing). The purpose of this study is to examine the current version of myNEU from a usability perspective, and identify some root causes of user frustration to provide suggestions for future iterations.

Usability testing, in the broad strokes, requires researchers to design a study which measures whether myNEU is: Easy to Learn, Easy to Remember, Efficient, Error Free, and Aesthetically Pleasing. This study takes a mixed methods approach to both quantify measurements of efficiency through time on task and number of clicks, and qualify our conclusions by measuring participant frustration via think aloud protocol. Our hypothesis is that efficiency inversely correlates to user frustration, which degrades the usability of myNEU. Quantitative methods follow an experimental design where participant tasks (Task 1, Task 2, Task 3) serve as independent variables. Time on task and total amount of mouse clicks serve as dependent variables that operationalize efficiency. Mixed methods were used as researchers required quantitative methods to confirm hypotheses derived from usability design analysis and qualitative methods to provide data suggesting specific solutions to user frustration.

2. BACKGROUND

myNEU was originally launched in 2006. The goal of the website was to provide, "Services ... [spanning] registration, financial management, co-op search and placement, dozens of automated administrative processes, access to the library, and access to the Northeastern online learning environment - all under a single sign-on." for students, faculty, and staff wherever users had internet access (Wier, Mickool, & Hitch, 2006). Student accounts were maintained in a database, collecting data from three separate systems, which tracked all, "discipline, cohort, status, course, registrations, and so on." Additionally, faculty and staff information including, "... role, discipline, department, course/section rosters, advising calendar, and so on" was also featured. However, given the breadth and complexity of information, usability problems occur. myNEU presents too much information at once to users, misdirects user attention via boldface and inconsistent application of color across separate forms, and presents users with irrelevant information from the perspective of the tasks being performed on respective pages.

Designers must provide efficient access to disparate information, in a consistent manner, that is also easy to understand by a large and culturally diverse population encompassing a wide range of skill levels. Northeastern University is host to a large population of international students all of whom are forced to use the myNEU website for all student related tasks. Designers must deploy site functions in a manner which can be understood universally, free of idioms, and do not use culturally specific expressions. Improving the aforementioned factors would alleviate user frustration, improve efficiency, and increase myNEU's usability overall.

Usability is defined for a system as being: Easy to Learn, Easy to Remember, Efficient, Error Free, and Aesthetically Pleasing ("aesthetically pleasing" in the sense that user satisfaction with the system is high) (Nielsen, 1994, loc 353). One technique used to achieve these ends

would be the use of “accelerators” defined as “... interface elements that allow the user to perform frequent tasks quickly, even though the same tasks can also be performed in a more general, and possibly slower, way.” (Nielsen, 1994, loc 533-534). Graphical User Interfaces providing selectable icons to the user via mouse cursor are an example of an accelerator. myNEU employs these structures for some functions but fails to be consistent in their application. This study shows that in the locations where myNEU employs accelerators user efficiency and satisfaction increases, as opposed to those locations where it does not. Standard design practice is to minimize interface complexity as much as possible:

> User interfaces should be simplified as much as possible, since every additional feature or item of information on a screen is one more thing to learn, one more thing to possibly misunderstand, and one more thing to search through when looking for the thing you want. Furthermore, interfaces should match the users' task in as natural a way as possible, such that the mapping between computer concepts and user concepts becomes as simple as possible and the users' navigation through the interface is minimized. (Nielsen, 1994)

People in general, according to Miller (1956), can only remember 7, plus or minus 2, things at any one time. Neilsen (1994) reiterates this as, “To minimize the users' memory load, the system should be based on a small number of pervasive rules that apply throughout the user interface.”. Therefore, the more information and features the user is exposed to the more likely they are to be confused by this functionality. myNEU attempts to achieve efficiency via the presentation of large amounts of functions to users on single pages. Our study shows that this practice has the opposite effect.

Standard design practice also states that the tasks people perform via a system should replicate user expectations of that task process as closely as possible. The ideal being “... to present exactly the information the user needs-and no more-at exactly the time and place where it is needed” (Nielsen, 1994). Interestingly, myNEU does utilize this design practice in some areas but not in others. This inconsistency results in user confusion and inefficiency.

People generally remember visual information as opposed to abstract ideas. For example: people remember images related to a word (like: car) rather than the definition of the word itself. Tom Kelley writes, “One more reason to put things on the wall: our memory for lists is bad, but our memory for where things are positioned around us is very good.” (Schell, 2015) People remember abstract information more easily when it is related to physical objects. This study shows the positive impact on task memorization when tasks are coupled with accelerators representing real world objects. Furthermore, when the number of accelerators used on a form (web page, etc...) are limited to a number below seven, participant efficiency and satisfaction increases.

Relating abstract tasks to real world objects allows users a point of reference that eases the cognitive load of learning a new system and remembering task processes. Pittsley & Memmot (2012) and Pegoraro (2006) use this technique in both their studies of complex educational websites. They make the point that users of such systems learn systems faster and remember tasks more often when the system more closely resembles real world objects such as file folder tabs. Designers use files folder tabs to group similar information together on separate pages which allows users efficient access to only the information that they need at that time. This design eliminates complexity and therefore user confusion/frustration. By conducting an examination of the current myNEU site’s features to identify those which are deemed difficult to

learn, difficult to remember, inefficient, error prone, or not aesthetically pleasing, we also identify those features which will be changed. The identification of these problems lead to a fundamental design methodology which will serve to inform future versions of myNEU.

3. METHODS

3.1 Researchers Role

All researchers are NEU Graduate Students and use the myNEU system on a regular basis. This fact informed researcher task selection and research design. However, our inherent bias related to the myNEU website and task selection is mitigated by our experimental design, which measures efficiency objectively via software (Morae Recorder/Morae Observer/Morae Manager).

3.2 Context

Seven NEU Graduate student participants were surveyed to request their participation in a Think Aloud protocol. Participants' sessions with myNEU were observed in the Usability Lab in Meserve Hall, at NEU, using Morae Recorder, Morae Observer, and Morae Manager software packages. Participants were allowed as much time as they wished to complete three tasks designated by the research team. Test sessions ran for nine minutes on average.

3.3 Data Collection

Think Aloud Protocol was used to collect data regarding the participants' use of myNEU. Two researchers remained in the testing room to observe, take notes, and prompt participants when needed. Two researchers remained in the control room behind a one way mirror to monitor, video, and audio record the session. Transcripts were generated of the sessions for analysis. Specifically: Think Aloud Protocol was used to operationalize participant frustration levels via coding of participant transcripts (See File B). Coding related to participant Confusion received a score of 1. Coding related to participant Frustration received scores of 2, with the exception of Frustration- Quit instances, which received a score of 3. Coding related to participant Satisfaction and/or Familiarity with tasks received scores of 0 (as these instances do not add to a participant's frustration level). Tables relating participant frustration were generated with these data.

Participants were given three tasks to complete on the myNEU site. The efficiency of each participant related to each task was operationalized by recording the participants' time on task and total number of mouse clicks used to complete the task.
These tasks were:

1. Book an Appointment with a specific Academic Advisor (Alisa Sisson, in the College of Arts, Media, and Design at NEU).
2. Locate and Report the Schedule of a Specific Course (GSND 6320 Psychology of Play) Offered in the Spring of 2018
3. Review the Participant's "Husky Card" notification preferences - Specifically: "Too Many Access Failures"

The tasks were selected as a result of researcher's analysis of the myNEU site, as it pertains to the use of real world objects to relate tasks to the participants. Task 3 is the best example of usability design concurrent with the use of real world imagery, grouping of like items, and low level of complexity (providing only the information that the user needs). Task 1 is an example of a complex task, which is presented in the most abstract way, which also does not provide users with the needed information to complete the task. Task 2 is an example of a task with which all participants should be readily familiar, as a demonstration of myNEU's degree of difficulty related to task memorization. Participants' familiarity with tasks was recorded and used to demonstrate myNEU's learnability. Errors resulting from participant misuse and website functionality were also recorded.

3.4 Materials

Usability control room workstations installed with Morae Recorder, Morae Observer, and Morae Manager software were used to measure the efficiency of each task by measuring the time spent to complete each task as well as the total amount of clicks made by each participant during each task. Time and Total Amount of Clicks serve as our Dependent Variables while the Tasks 1, 2, and 3 serve as our Independent Variables. The Morae Manager Software was used to generate all graphical data representations (see Appendix).

Participants were first given a survey to record their familiarity with the myNEU site by Researcher 1 (see File A). The survey recorded the participants' names, email addresses, and asked several questions which relate to the participants' experience level with the myNEU site. The results of these questions are used as control variables to help elaborate on all testing results, within the Discussion Section below. Participant data was then abstracted using the general descriptors: Participant 1, Participant 2, etc… Participants were asked to participate in a Think Aloud study after answering a minimum of questions which were designed to keep participants blind to the study's purpose. The final question of the first section of the survey asks the participants if they wish to participate in a Think Aloud study. If participants opt out of the study they are then presented with a number of questions related to measuring the usability of the myNEU site specifically. Those students who opted to participate in the Think Aloud study were scheduled in the Usability Lab for testing.

Researcher 2 gave each participant a briefing explaining the process and rationale behind the Think Aloud Protocol session, prior to its execution. Participants were instructed to complete basic information gathering tasks 1, 2, and 3 while performing a Think Aloud Protocol with researcher 3, within the myNEU site using their own accounts and logins (user information was promptly removed from all workstations after testing was completed). Task order was altered for each participant to eliminate order bias. Researcher 4, assisted by Researcher 1, operated Usability Lab control room workstations to record the Think Aloud session, flag the start of each task, and flag any/all visual as well as audio cues which should be coded by each researcher. Participants were then debriefed by Researcher 2 immediately following the session. The debriefing included one follow up question, which is detailed in the Discussion section.

3.5 Data Analysis

Researchers transcribed all participant video recordings. Researchers divided all participant videos into two groups. Researchers 1 & 4 transcribed and coded Participants'

1,2,3,and 4 videos. Researchers 2 and 3 transcribed participant videos 5,6, and 7. Researchers performed open coding, following a seperation strategy, on the video transcripts for their respective teams, to identify any/all emergent coding structure. Reference material provides a priori coding language which was added to via opening coding. Researchers then met to discuss and come to consensus on a concise codebook and consistent coding application methodology, which was used for all subsequent passes of each transcript. Codes were used to identify any/all trends that could be used to define user frustration. This data was cross referenced with the quantitative measures of time on task and total amount of clicks, used to measure myNEU's efficiency.

3.6 Verification

A mixed methods approach by definition employs triangulation verification. Cohen's Kappa was used for verification of qualitative methods. The team of four researchers were split into two teams of two, each of which coded the transcripts for their respective team. Kappa verification was then used by each team of 2. The Kappa Verification Score for Team 1 is 77% and Kappa Verification for Team 2 is 81%. Researcher teams then met to discuss the trends identified within their respective team's pool of participants. The results of each Team corroborated the results of the other Team.

4. RESULTS

The data generated via *quantitative* methods identifies the following trends:

- Task efficiency follows a predictable pattern, concurrent with researchers' hypothesis that task efficiency inversely correlates to participant frustration levels. (Figures 1 and 2 in Appendix)
    - Task 1 is the Least Efficient Task
        - Task 1 required the most time and mouse clicks to complete
    - Task 2 is More Efficient than Task 1
        - Task 2 required less time and less mouse clicks than Task 1
    - Task 3 was the Most Efficient Task
        - Task 3 required the least amount of time and mouse clicks to complete
- No Participants noticed an error on a web page form during Task 3 (See Discussion section for details)
- Scroll Wheel use for Task 1 was High, as participants were observed searching for relevant information.

The data generated via *qualitative* methods identifies the following trends which corroborate researchers' hypothesis that efficiency inversely correlates to participant frustration level.
(See Table 1):

- Average Participant Frustration Level for:
    - Task 1 is High
    - Task 2 is Lower than Task 1
    - Task 3 is Low

Task	Average Frustration Score
Task 1	20.9
Task 2	7.9
Task 3	2.4

Table 1: Average Frustration Score by Task

5. DISCUSSION

Stone Librande (2010 & 2013) spoke at length as to why game design teams never read lengthy design documents. Put simply, people don't like to read. User satisfaction with myNEU suffers for the same reason. A study, conducted on a selection of library websites, noted similar issues relating to "long pages" of textual information requiring users to scroll for significant amounts of time. The study noted that Researchers selected tasks on myNEU which originate on the myNEU student "Self Service" tab purposefully to illustrate the correlation between our study and Ebenezer (2003). The Self Service tab is an example of a "long page" that requires the user to scroll. Task 1 is also an example of a "long page" requiring much more scrolling on behalf of participants. Again, participants found Task 1 to be the most frustrating. These results support observations made by Stone Librande (2010 & 2013) and Ebenzer (2003). Specifically, user satisfaction increases when information is presented on only one page that frames relevant information.

While myNEU does follow many standard usability design choices, it fails to apply these concepts consistently. Ebenezer's study of library websites found similar usability problems relating to inconsistent use of format (2003). Inconsistent formats impede learning and deter users from remembering task procedures once they are learned. Researchers demonstrate myNEU's inconsistency via their selection of Tasks 1, 2, and 3. The impediment to learning is highlighted during Task 1. Participants were confused by inconsistent and misleading boldface text, highlighting irrelevant information to task completion, and the color blue being applied to non-interactive text. This is in contrast to Tasks 2 and 3 which use the color blue to highlight interactive accelerators, while also using boldface to direct user attention to relevant information.

Participants demonstrated an almost total disregard of any/all text presented on pages related to the completion of Task 1. Task 1 pages presents participants with an overwhelming amount of information regularly, most of which is unrelated to completing Task 1. While Task 1 pages do group like information into sections to decrease cognitive load, almost all accelerators within Task 1 are text based links, which participants continually overlooked. Participants almost always opted to select icons denoting real world and relatable objects over that of textual links, even when those icons were not functional. In Task 3, participants tended to click on the icon of a mobile phone to adjust the notification preferences, when the selectable radio buttons related to task completion were directly underneath the image.

Task 1 makes use of "TABs" in its organization of calendar information. Task 1's calendar is organized into Day, Week, and Month selections. However, participants almost uniformly did not recognize these selection choices since their attention was misdirected, as stated previously. This behavior is also observed in Pittsley (2012) and denoted as "banner blindness". Specifically, "banner blindness" is a phenomenon that results when efforts are taken

to make information stand out but paradoxically produce user nonrecognition. Task 1 attempts to draw user's attention by using boldfacing text and different colors to highlight important information. However, participants mistook these sections for interactive selections, which they were not. These sections directed participant attention away from calendar tabs which would have allowed participants to find relevant information quickly. This unintentional misdirection caused the participant to spend an abnormal amount of time searching for information in the wrong locations, resulting in a high level of frustration and causing several participants to give up on the task, as seen in Table 1: Average Frustration Score, reported in the Results section.

Testing highlighted some unexpected trends. Researchers asked participants to "Set the Notification Preferences for your Husky Card for Too Many Access Failures". On the web page, the option to set notification preferences for "Too Many Access Failures" is presented twice: once with a capital "M" for the word "Many" and again with a lowercase "m" for the word "many". Participants universally failed to recognize this error. We believe that this was due to researcher's prompting of participants during task direction. Our hypothesis being that participants ignored all other preference selections (and therefore did not recognize duplicate entries) since the "Too Many Access Failures" preference is the first preference listed. Participants stopped reading any other text on the page once they located the objective of the task presented to them. We theorize that participants would have noticed additional preference selections if researcher instructions were phrased more universally such as, "Review all Notification Preferences for your Husky Card". However, further testing would be needed to support this conclusion.

"Oh <*censored*>!" and "This is so frustrating!" were the reactions recorded during the experiment. Confusion arose in participants due to improper tab/window management algorithms used by the website. Confusion became evident by the participants' responses mentioned above. One noteworthy instance of improper window management technique was witnessed when a participant in the process of Task 2 opened multiple tabs. When asked to get back to myNEU central, the participant lost their way and closed 4-5 tabs in quick succession. The participant could not find their way back without researcher assistance.

6. CONCLUSION

The Central Tendency Trends of Figures 1 & 2 (in Appendix) support researchers' hypothesis that task efficiency is inversely correlational to user frustration. Figures 3 - 6 (see Appendix) provide further detail and corroboration of researchers' analysis of myNEU site functions. Specifically, those tasks which use relatable accelerators as a part of their process increase participant efficiency and satisfaction overall. Tasks employing unrelatable accelerators decrease participant efficiency and satisfaction; sometimes to the point of participants abandoning the task completely. Figures 3, 4, 7, and 8 (see Appendix) detail the total amount of mouse clicks used by participants across all tasks, logging both scroll wheel use and without scroll wheel use. Since none of the tasks required significant use of the scroll wheel, high usage denotes long periods of time searching web pages for relevant information. This trend also demonstrates participants' difficulty in learning the process associated with Task 1.

Task 1 proves inefficient mainly due to large amounts of information being presented to participants, which is also mostly irrelevant. The pages devoted to Task 1 misdirect participants' attention via boldfacing. Task 1 uses accelerators but these consist of text. Task 1 also employs inconsistent color schemes with those provided to users within the most heavily used sections of

myNEU; such as Task 2. All of the aforementioned design choices of Task 1 result in a decrease of user efficiency and therefore an increase in user frustration.

It is our recommendation that future iterations of myNEU should make extensive use of universally relatable accelerators to improve site efficiency and user satisfaction. Specifically, it is our expectation that the upcoming version of myNEU will most likely display large amounts of interactive icons compared to its current version. Furthermore, myNEU should be segmented into large amounts of specialized web pages, providing smaller amounts of information per page. This will decrease the cognitive load on users to allow faster recognition of usable information, while also decreasing the amount of time needed to learn site functions.

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APPENDIX

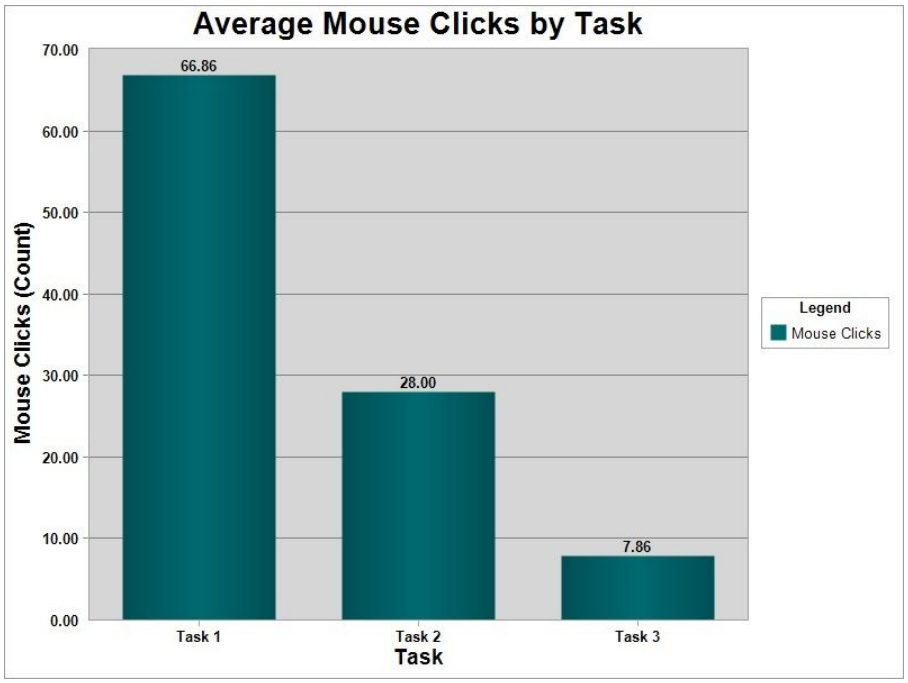

Figure 1: *The Average of the Total Amount of Mouse Clicks (Left & Right) Used to Complete Each Task Across All Participants*

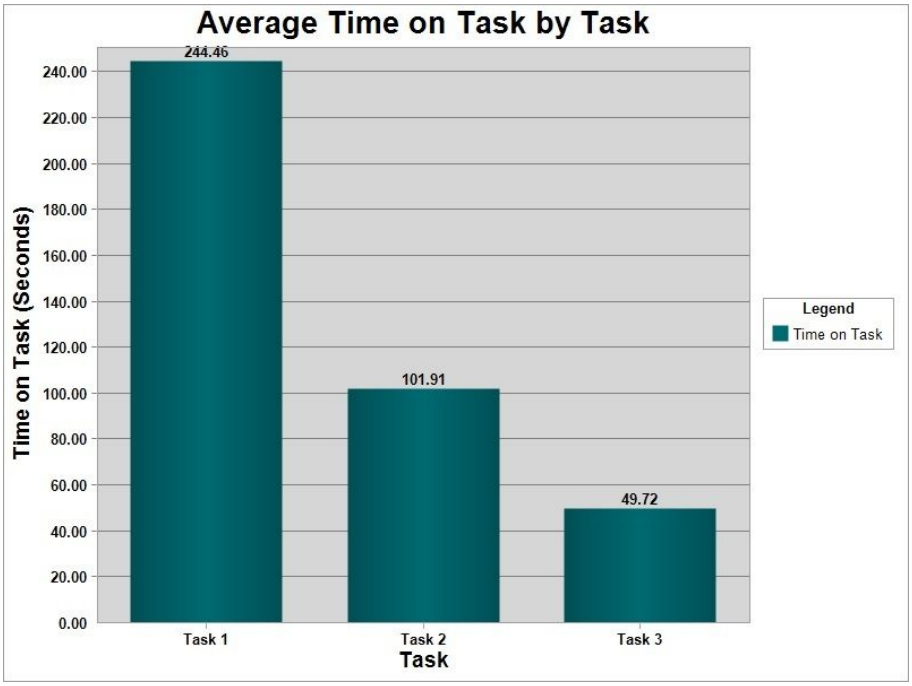

Figure 2: *The Average of the Total Amount of Time Needed to Complete Each Task Across All Participants*

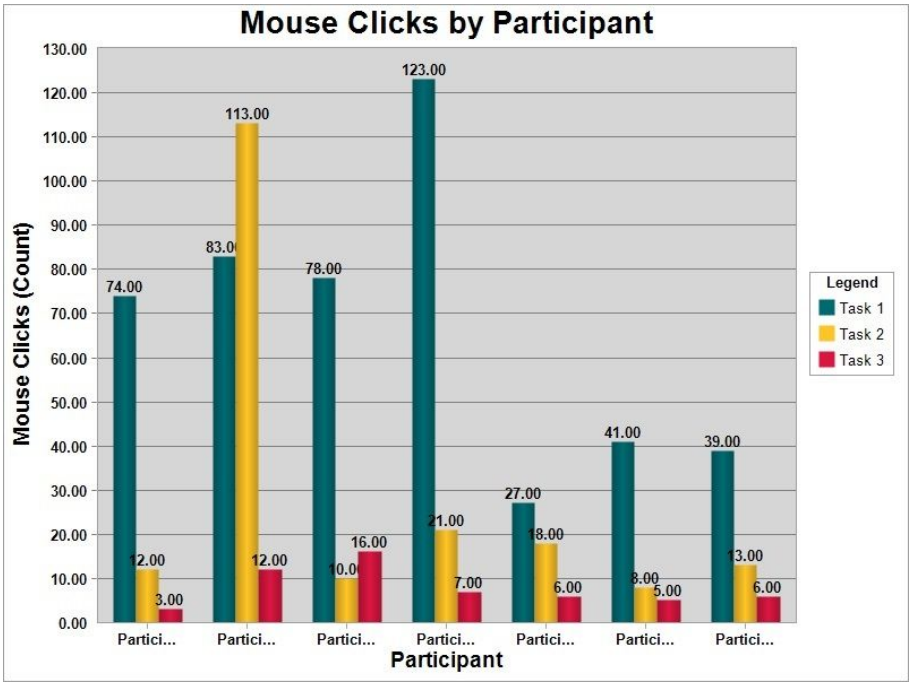

Figure 3: *The Total Amount of Mouse Clicks (Left & Right) Needed to Complete Each Task by Participants*

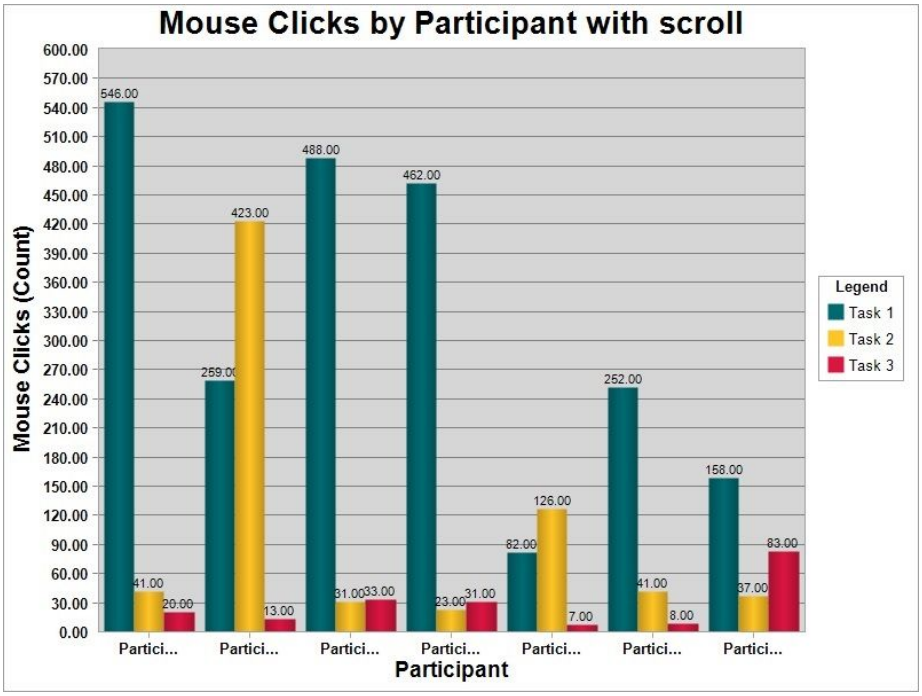

Figure 4: *The Total Amount of Mouse Clicks (Left & Right & Scroll Wheel) Needed to Complete Each Task by Participants*

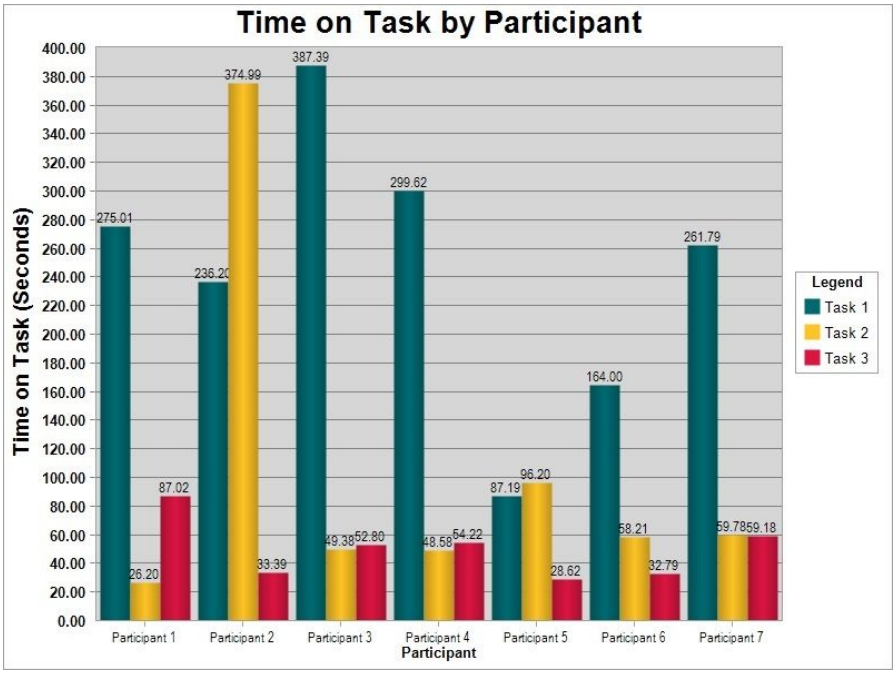

Figure 5: *The Total Amount of Time Needed to Complete Each Task by Participants*

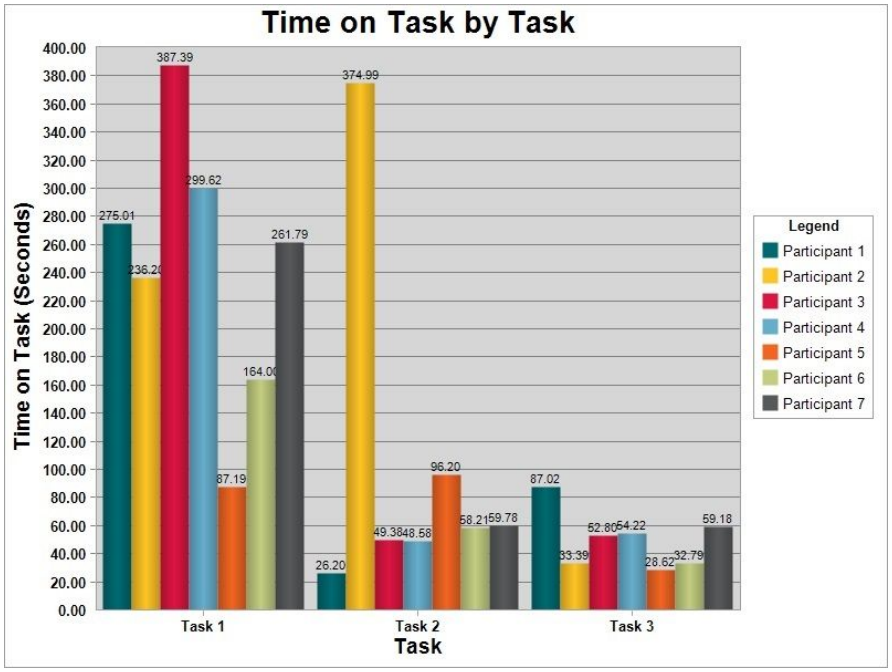

Figure 6: *The Total Amount of Time Each Participant Needed to Complete Each Task, by Task*

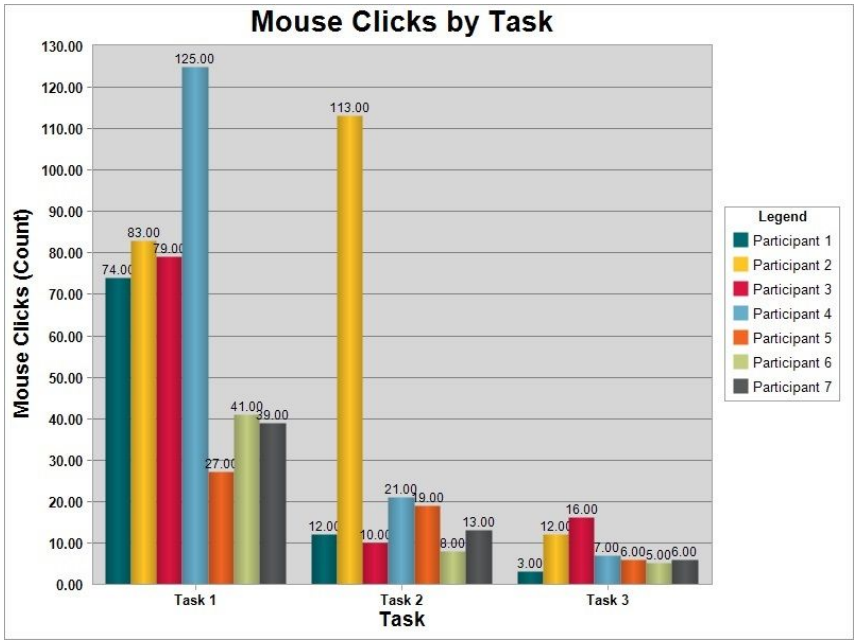

Figure 7: *The Total Amount of Mouse Clicks (Left & Right) Each Participant Needed to Complete Each Task, by Task*

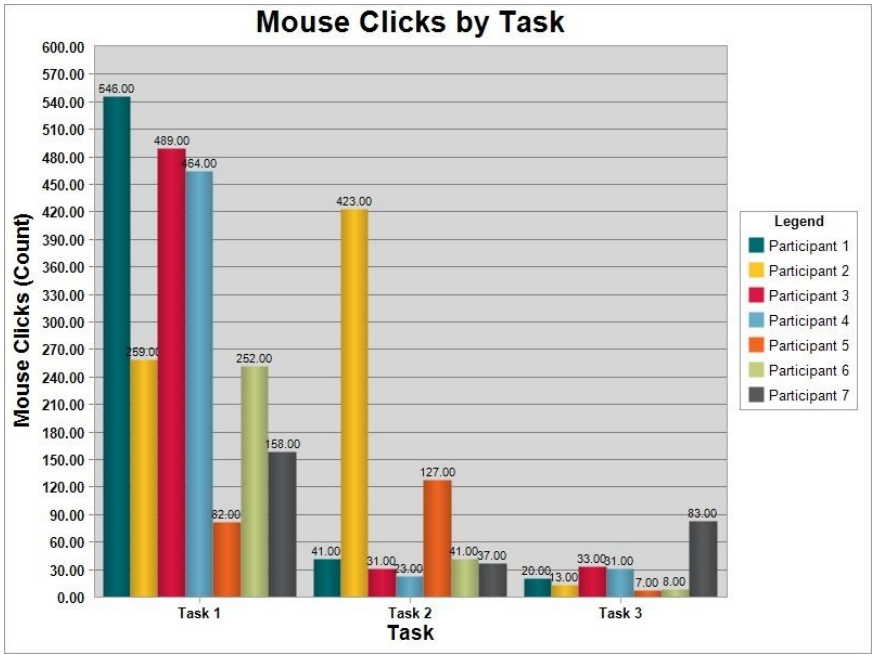

Figure 8: *The Total Amount of Mouse Clicks (Left & Right & Scroll Wheel) Each Participant Needed to Complete Each Task, by Task*