Quantitative Analysis of Gaze Over Computer Specifications

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ABSTRACT

This paper presents a study on which aspects play the largest role in deciding which computer to purchase. We hypothesized that processor speed, RAM, and hard drive capacity would be the deciding factors for our participants when deciding on which computer they preferred. In order to test this, we recruited 12 Clemson students of the undergraduate or graduate level all with normal or corrected to normal vision and tracked their eye movements with a Gazepoint eye tracker. Each participant was shown an image with the same data as the rest, but in a different configuration to eliminate positional bias. Based on the data collected from the eye trackers, we can see which aspect participants looked at the most while they were making their decision.

KEYWORDS

Eye tracking, Computer Specifications

ACM Reference Format:
Kylon Tyner, Bhavik Suthar, Nicholas Stephens, and Pierre Karaffa. 2017. Quantitative Analysis of Gaze Over Computer Specifications.

INTRODUCTION

Computer specifications play an important role in any consumer's purchase decision when buying a new computer. In this study, we aimed to figure out which specifications were most important to students specializing in computer-related fields using eye-tracking technologies. By tracking participants' eye gaze while viewing computer specifications, we gained some insight on this matter. Current manufacturer websites tend to list processor speed, storage space, and RAM as the top three specifications. This study was designed to determine if these three are really the most important to consumers and, if they are not, which specifications would be more appealing to potential buyers.

BACKGROUND

The question of what people find important concerning the specifications of their computers has long been a question on the minds of those in a position to present them. The purpose of our study is to find which specifications people from different schools of study fixate on. This study will be helpful for a company that wishes to present a computer to a certain audience to present the specifications that particular audience finds most important. A study by Duchowski and Best used eye fixation on a rotary interface to enter a PIN code. They found that the rotary interface worked better than the grid-based design which focused on dwell time. They also found that this eliminated the screen center-bias where the test subjects would default their gaze to the center of the screen (Best and Duchowski, 2016). To alleviate the problem inherent with the grid layout we decided to go with a dial layout where the subject will look at a dot initially and can quickly see the specification that they desire. Upon looking at this specification they will then see the disparity between the three choices. This will also help us reduce any confounding in our study where the subject may gaze at the lower part of the specification making it ambiguous as to which specification is being gazed at. A paper that we used in consideration while making the stimulus was the *Burke, et. al.*

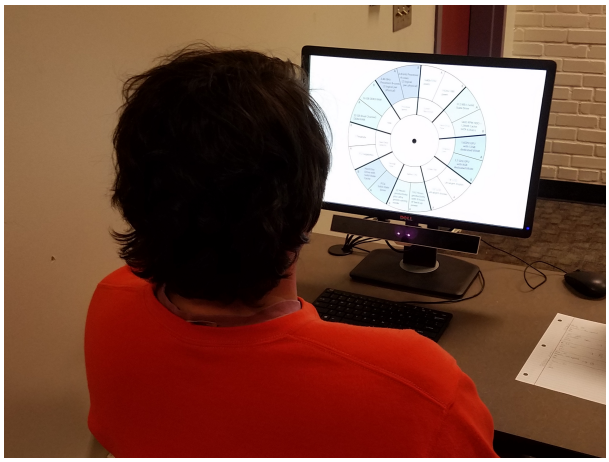

Figure 1: Image of the study setup. Displayed on-screen is the chart that each participant was shown during the experiment.

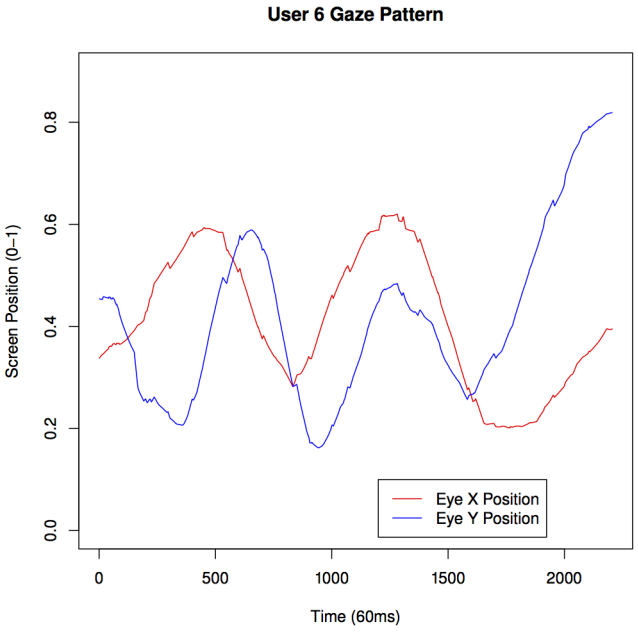

Figure 2: Shown is a line graph that plots participant gaze against time.

paper which discussed how distractions were directly related to what the participant would fixate on (2005). We made sure not to use any bright colors by keeping everything in the stimulus a black, white, or gray color. This way none of the elements overpowers the other, thereby removing confoundment of users being drawn to an element based on its color.

In order to figure out participants' interests in certain sections of an informational chart, we are using Delaitre's concept of the nearest neighbor index (NNI). This index ranges from values less than 1 to greater than 1. Values greater than 1 indicate fixations are uniformly distributed while values equal to 1 indicate fixations that are randomly distributed. Any values that are less than one mean the fixations were clustered together (Delaitre, 2011). In this study we are looking for groups of fixations that are clustered together in different sections of our chart.

METHOD

Participants

Twelve clemson undergraduate or graduate students were recruited for this study. All the participants had normal or corrected to normal vision.

Apparatus

The tracking of eye movements of participants was done using a Gazepoint GP3 eye tracker with the visual angle accuracy of 0.5-1 degree, 9 point calibration, with 60Hz sampling rate. Dell Professional P2213, 22" LED monitor with 60Hz refresh rate was used to display the stimuli. The screen resolution of the monitor used was 1680x1050 and participants were 22 inches away from the display.

Stimulus

The stimulus we used was a computer specification sheet with a circular design rather than the traditional grid layout. We formatted it this way to make tracking the eye movements of our participants easier. In the center there is a 'safe zone' where participants can look and no data will be collected. Having this allows for there to be a neutral spot for participants to look to rest their eyes.

Experimental Design

The purpose of this study was to see which aspects of computer performance students care the most about and which ones most affect their purchases. We hypothesized that processor speed, RAM, and hard drive capacity were the overall favorites amongst the participants and that each person would look to those sections when making their decision. We performed an observational study with a between subjects design in which we presented participants with a computer specification sheet with a circular design instead of the traditional grid design. We presented the stimuli this way in order to make tracking the eye movements of the participants easier.

Procedures

Prior to performing our experiment, participants were asked if they had any questions before starting. They were read a short informational letter then asked to answer some questions regarding their demographic. The eye trackers were then calibrated to the current participant using a 9-point calibration to ensure accuracy and precision during the experiment, also making sure that each person was the appropriate distance from the screen (approximately 22 inches). After all of the preparations were complete, the experiment began. We showed participants a sample image similar to the chart they would be viewing and explained what they would be doing. We told participants that they would be looking at an image containing information on 2 computers, then choosing which computer (A or B) they preferred, assuming similar price. After finishing data collection, we then looked to see where each participant looked while making their decision. In looking at this, we were able to see which aspect of computer performance each participant cared the most about.

RESULTS

The data that we collected was exported from Gazepoint Analysis for us to examine in depth for statistical significance of any kind. One thing we noticed while analyzing our data was that participants looked at our chart in a clock-like manner. This is shown when the participants' eye position is plotted against time. As you can see from Figure 2, when plotted with time, both the x and y coordinates of the participant's gaze appear to have a wave pattern resembling a sinusoidal curve. This pattern indicates that participants' gazes changed in a circular manner, following our circular chart. This is also shown by the definition of a circle: Y = sin(degrees) and X = cos(degrees) will produce a circle for degrees 0-360. The resulting

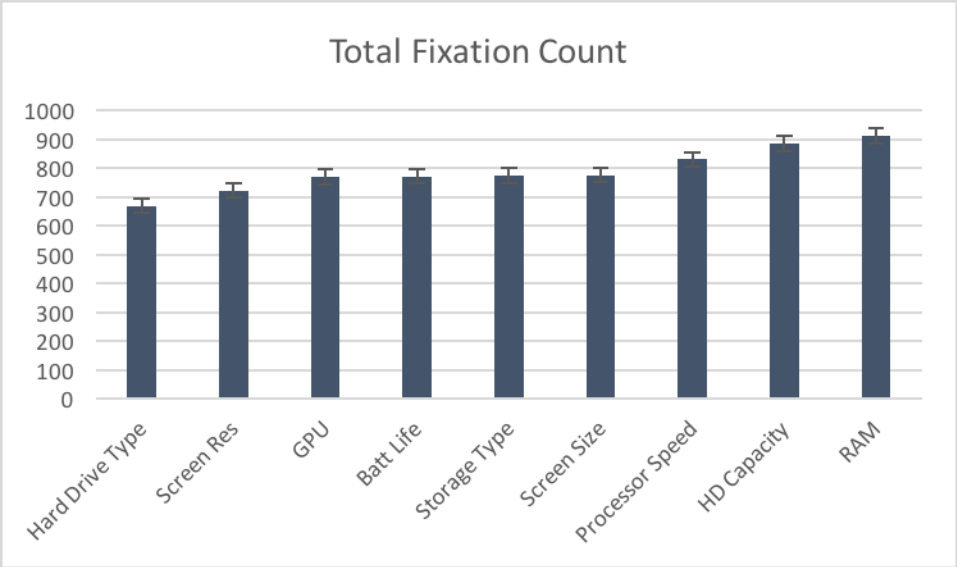

Figure 3: Shown is a bar graph that shows each data section's total fixation count.

graph was created by averaging the gaze data by 150 points to left and right in order to achieve a smoother curve.

As shown in Figure 3, RAM, hard drive capacity, and battery life were fixated upon the longest during data collection. RAM totaled 394.919 seconds of fixation, hard drive capacity had 382.8946 seconds, and battery life had 361.1437 seconds with a standard error of 10.38916539. This only partly supports our hypothesis, as we anticipated RAM, processor speed, and hard drive capacity would be the most vital to students. Interestingly enough, processor speed did actually beat battery life the total number of fixations with 831 fixations over battery life's 772 (RAM and hard drive capacity came in the same order with 912 and 886 respectively; standard error of 25.33978963).

DISCUSSION

Originally, we thought that the results we derived from this experiment did not support our hypothesis that RAM, processor speed, and hard drive capacity were the three most pivotal aspects of computer performance. As shown in Figure 4, we found that the graphics card, storage type, and battery life contained more densely packed gazes. This density indicates multiple participants focused on these sections during data collection, however, this density does not directly reflect higher fixation duration or fixation count. It is these aspects that actually show which sections were studied most often and for longer periods of time. As stated previously, when statistically analyzed, our data indicated that RAM, hard drive capacity, and battery life were the most studied sections.

Upon further examination, we also noticed multiple participants looked back and forth between storage type and hard drive type. This is more than likely due to the fact that these categories are fairly similar, which could have caused confusion during the experiment. We believe that these changes in gaze were simply that, and had nothing to do with the decision that participants made. Therefore, we are also to believe that a percentage of the fixations on the hard drive type and storage type sections occurred because participants were trying to make distinctions between the two.

Based on our observations, if we were to perform this experiment again, we would change the layout of the stimulus. One change that we would make, based on the study by *Clement et. al.* where they found that the human brain is limited in its capacity to perceive stimuli, would be to omit either the hard drive type or storage type sections as it evidently caused confusion during data collection, thus skewing our data (2013). Another change we would make would be to alter the orientation of the sections to eliminate directional bias. This would also show us whether participants look at a section

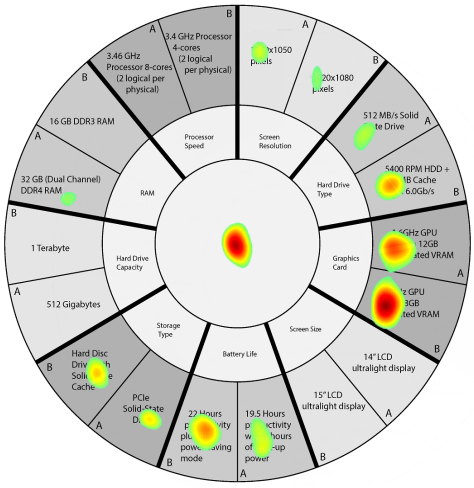

Figure 4: Shown is a heat map over the stimulus. This is an average map of all participants with outliers filtered out.

for it's content or naturally look to it because of its position. One thing that would make this method even more effective would be to completely scramble the sections and rotate the display to also insure that certain sections are not harder or easier to read next to one another. Something else we would consider would be changing the color of the display to all white as opposed to the shades of gray that we currently have for each section.

CONCLUSION

From performing this study, we have found strong evidence for the fact that the three most desirable specifications for students when purchasing a new computer are RAM, hard drive capacity, and battery life. The students that participated in our study had longer dwell times on these three sections when viewing the provided chart. This is further confirmed by the statistical analysis of our data:

$$x_8^2 = 58.504, p < 0.001$$

This extremely low p-value illustrates the fact that the data we compiled has strong evidence in favor of the fact that participants look at the computer specification that they see as most desirable when purchasing a new computer.

ACKNOWLEDGMENTS

The authors would like to thank Dr. Andrew Duchowski for assisting in experimental design and facilitating the IRB approval process.

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