

Evaluating Differing Proportions of Text and Image Fixation During User Internet Experience

Advised by Dr. Joy Hirsch, Professor of Psychiatry,
of Comparative Medicine, and of Neuroscience and
Dr. Adam Noah, Associate Research Scientist in
Psychiatry in the Hirsch Brain Function
Laboratory

Submitted to the faculty of Cognitive Science in
partial fulfillment of the requirements for the
degree of Bachelors of Science

Yale University
April 20, 2018

Abstract

For companies that sell products directly to consumers (B2C Companies), website design has only very recently been an essential aspect of marketing, branding, and sales strategy. The true advent of the ecommerce boom did not take place until the early-to-mid 2000's with ecommerce sales eclipsing 3% of total sales globally in 2007 (Laudon and Traver 2008). Since then, more and more emphasis has been placed on finding the most effective website design strategies. Researchers have turned to user experience studies that feature tests of memory for content saliency, as well as eye-tracking studies that concentrate on real-time focus points on websites. A 2011 study by Guillame Hervet and colleagues disproved the "Banner Blindness Phenomenon," which stated that people did not pay attention to auxiliary advertisements when browsing on different websites. Backing for the phenomenon came from work done regarding memory and experience salience work done specifically by (Chatterjee 2008) and (Drèze and Hussherr 2003), but Hervet used eye tracking research to determine that subjects do indeed pay attention to auxiliary advertisements during browsing, although they may not be conscious of that fact in retrospect (Hervet 2011). This finding, namely that real-time eye-tracking research serves as a more realistic basis for what people actually look at while they are online, leads us to our study. In our study, using eye-tracking technology, we examine where subjects look while they browse through websites, as they normally would do, and while they perform tasks on different websites. We use different types of consumer-oriented websites (sites of companies that sell different kinds of products) and compare looking time statistics to gain insight pertaining to

consumer attentional focus across different markets. Mainly, we take a close look at the division that exists between subject text looking-time and image looking-time across all websites. We find a counterintuitive prevalence among looking-time trends throughout all trials, and discuss why this phenomenon persists. We focus on percentages of trial time allotted for focusing on text versus images, and why our results are surprising in that respect. We use the information we gathered from our trials to propose website design suggestions for the future regarding image vs. text distribution and placement on websites.

Contents

1. Introduction

1.1 Eye-Tracking Research on Internet Experience

1.1.1 Eye-Tracking Research on Text

1.1.2 Eye-Tracking Research on Images

1.2 Pilot Experiments and Pilot Data

1.3 Present Study

1.4 Formal List of Hypotheses

1.5 Research on Emotional Valence of Differing Markets

2. Methods

2.1 Participants

2.2 Design

2.3 Materials

2.4 Procedure

3. Results

3.1 Free Navigation Condition

3.1.1 Responses to Hypotheses in Free Navigation Condition

3.1.2 Trends Across Free Navigation Condition

3.2 Task Driven Condition

3.2.1 Responses to Hypotheses in Task Driven Condition

3.2.2 Trends Across Task Driven Condition

3.3 Overall Trends and Post-Trial Survey Data

4. Discussion

4.1 Implications of Research

4.2 Future Desired Subject Paradigms

4.3 Conclusions

Author Contributions

References

1. Introduction

1.1 Eye-Tracking Research on Internet Experience

Eye-tracking research in the realm of user web-surfing experience is not widespread. Further, this research does little more than confirm intuitive preconceptions about user experience. For example, research by Soussan Djamasbi and colleagues asserts some fundamental navigation phenomena about website viewing: 1. People often collect information by first looking at images and then scanning text; 2. The size of elements (text or images) on a page often informs users about element importance, and therefore influences the order in which elements are viewed; 3. Elements placed towards the top of a page are more likely to be looked at before those placed toward the bottom (Djamasbi et al. 2011). Furthermore, research by Borys Magdalena and colleagues sheds light on more specific phenomena when it comes to gaze fixations during user experience regarding websites. Magdalena's research and experiment focused on a mobile device-adapted website. Participants browsed through the website on mobile devices as their gaze fixation duration and fixation quantities were tracked. These quantities represented the amounts of time subjects spent looking at a specific thing. Heat maps representing the data revealed that subjects on average tend to focus more on text during user experience, and additionally, subjects tend to focus much more on the left side of a webpage as opposed to the right side (Magdalena et al. 2016).

Some other eye-tracking studies have focused on emotional responses to specific types of images or formats, and (Wang et al. 2014) featured eye-tracking data and fixation effects that resulted from looking at pictures of other people. The

study found that subjects were far more likely to fixate on images that contained people in them. Heat maps revealed that human focus was relatively evenly distributed between images and text when other human beings were present in the images. Additionally, the experimental results showed that image looking time and image engagement/emotional reaction was greatly increased among users when humans accompanied images of products. Even further, the type of product pictured influenced the valence of the effect human accompaniment had on the image of a product. Human presence greatly increased user engagement with entertainment products while it only moderately increased user engagement with utilitarian products (Wang et al. 2014). These findings inform the decision in our own experiment to use different types of product websites in our trials, as different types of products clearly prompt different fixative effects from subjects.

1.1.1 Eye-Tracking Research on Text

Some basic eye-tracking research on text comprehension and reading processes exhibit the unconscious cognitive inner machinations that occur during reading. Research conducted by (Jarodzka and Brand-Gruwel 2017) displays a saccadic pattern during reading. Their research showed that subjects fixate on words that their brains subconsciously decide need comprehension, and automatically pass by shorter words that do not command extra attentional focus like “or” and “the.” When words that do not require additional cognitive energy expenditure are come across, the brain prompts a saccade (a rapid movement of the eyes between fixation points), which moves the reader’s focus along the remainder

of the sentence (Jarodzka and Brand-Gruwel 2017). This research provides illustrative groundwork for eye-tracking research on text fixation as a whole.

(Sauman et al. 2009) provides a more applicable framework for gaze fixation on text during website navigation. As a part of their eye-tracking experiments, they included webpages that displayed different news stories, and featured highlighted/bolded words representing hyperlinks and word buttons that frequently are included on websites. These bolded words on average captured the attention of the majority of subjects (N=96). The hyperlinks had different variations, as commonly included on many websites. Hyperlinks that were portrayed through a box that contained the highlighted words “Breaking News” captured the attention of 89% of participants (Sauman et al. 2009). These results undeniably prove that textual highlights largely influence attentional focus time and gaze fixation on text, and these facts should be taken into account when looking at text looking-time data.

1.1.2 Eye-Tracking Research on Images

While most studies involving eye-tracking and websites conclude that users devote more attentional focus to text overall, other researchers slightly challenge those conclusions by defining multiple types of people, as opposed to perpetuating a generality about all internet users. One such study conducted by (Koc-Januchta, M. et al. 2017) differentiates between two types of learners: visualizers and verbalizers. The study hypothesizes that in a learning and information seeking setting, verbalizers fixate more on text while visualizers fixate more on images on websites. Eye-tracking heat maps of both visualizer and verbalizer trials revealed

that the researchers' hypotheses were correct. While trying to learn about a mechanism that was both illustrated and described with a paragraph underneath the image, visualizers devoted the majority of their focus to the illustration while verbalizers devoted the majority of their attention toward the description of the image (Koc-Januchta, M. et al. 2017). This clear variability in the human population runs contrary to many other studies in this area and could serve as an explanation for data variability among subjects.

Comparative eye-tracking research has shown that there are specific characteristics of images that draw gaze much more effectively than others. First and foremost, as many studies have proven, human images prompt the highest amount of user engagement, especially when a human face is visible (Wang et al. 2014). Additionally, humans devote extra time to images or scenes that they deem semantically informative according to foundational studies (Buswell 1935; Yarbus 1967). Even further, it is important to note that, "subsequent studies have repeatedly demonstrated that the human gaze is drawn not only to visually salient regions in terms of colour, contrast and edge orientation, but also to interesting or meaningful regions based on the viewer's knowledge (Henderson & Hollingworth 1999)" (Kano and Masaki 2009). So, human beings, when looking at pictures in general, tend to focus most on those images that feature other human beings, as well as images that they feel are semantically informative in reference to a whole concept.

1.2 Pilot Experiments and Pilot Data

Two pilot experiments preceded the study that we conducted and are detailed in this paper. These pilot experiments successfully informed most of the hypotheses formed in this paper, as well as some of the experimental design. The first pilot experiment involved observing eye-tracking trials of subjects who were told to navigate through a beef jerky company's website as well as the websites of the company's competitors. The beef jerky company was looking to remodel its own website to facilitate website visitors in purchasing a subscription from the site. To determine how to inform the company's website remodel, we had subjects look through websites of the company's competitors who already had established, successful, website subscription models. This experiment was largely subjective, as the trials of different subjects were merely observed, and empirical data was not gathered. Each subject had two minutes to freely navigate through four different websites, including the site of the beef jerky company we were assisting. We found that although we did not have fixation time statistics at our disposal, on the whole subjects spent considerably more time looking at text as opposed to images throughout the trials. We found these results to be counterintuitive, as all the websites involved contained what we deemed to be very salient images and videos. We found in our observations that many subjects blatantly disregarded many reasonably salient images or videos, as they looked for information via text fixation. Additionally, we observed that subjects were drawn to highlighted texts and texts that appeared on buttons more than other, normal text on the website.

This first pilot experiment informed our free navigation experiment design. In our study, we ran two separate conditions, one of which we deemed "free

navigation trials.” In these trials, which will be elaborated on later, subjects browsed through websites as they normally would do, without restrictions. In the aforementioned pilot study, we found that we gave subjects too much time to browse, and that an extended trial time would likely skew the data toward more text looking-time. This is most likely because once subjects have glossed over all the images on a page, they are left with nothing to do but read, and so as free navigation trials get longer, the more likely subjects are to devote extra time to reading.

The second pilot experiment involved a similar free navigation condition. In this experiment, however, subjects freely navigated through the website Essential.com, which features parallaxing. Parallaxing in website design refers to image and text movement that operates in accordance with user scrolling. This feature makes the website more dynamic and is intended to draw more attention to images and videos that are displayed. The subjects again had one minute to browse through the website, and we found that after the conclusion of trials for all subjects (N=5), that on average, subjects devoted 62.4% of browsing time to text fixation. Additionally, there was one outlier in the experiment in the form of a subject that only spent 35% of browsing time on text fixation. When this outlier is discounted, the percentage of browsing time devoted to text fixation for the subject pool jumps to an average of 67%. So, for a website that features a specific characteristic designed to funnel user focus toward images and videos, subjects still chose to fixate their gaze on text more than images on averages. When the outlier is discounted, the data displays that two thirds of the time, subjects were fixating on text while browsing.

This second pilot experiment further informed our hypotheses and our experimental design. As for experimental design, we discovered that one minute for free navigation was still too long for trials. It is possible that that extended trial time slightly skewed the results toward text fixation time percentages.

As for hypotheses, both pilot experiments informed our central hypothesis, namely that our subjects would devote more looking time toward text as opposed to images. More specifically, since both pilot experiments involved free navigation trials, the results of both experiments allowed us to be confident with our hypothesis for our free navigation trials in our study talked about in this paper. Because of this confidence, we also pushed to design a second condition that featured subjects completing navigational tasks on websites while tracking their fixations.

1.3 Present Study

In this study, we took a close look at the focus preferences of subjects across three different types of B2C websites. The B2C websites that we looked at spanned across three different types of markets (department store/clothing, food subscription service/food, and furniture). We attributed a subject's focus to be aimed at exactly one of three possible categories at all times. Those categories were text, images, or free space (neither text nor images, but anywhere else on the webpage). Unlike previous studies, we looked to establish a clear dichotomy between text looking-time and image looking-time, and did so across multiple

markets. We used two websites to represent each type of market, resulting in six different websites in total.

Subjects completed trials under two different conditions, and each subject participated in both conditions. The first condition was what we will refer to from here on out as the “Free Navigation” condition. In this condition, subjects were instructed to browse a respective website casually, as they would typically do. They were not constrained in any way in what they could click on, where they could go on the site, what they could look at, or any other related actions they could take. The free navigation condition was designed to serve as the purest form of internet-user experience, with no ultimate goal in mind. We predicted that in these trials, across all markets, subjects would devote more looking-time to text than images. Further, we hypothesized that the different types of markets would elicit different discrepancies in our overarching prediction.

We hypothesized that subjects would spend the most time looking at text during free navigation trials involving food subscription service websites. Additionally, we hypothesized that subjects would spend the least time looking at text during free navigation trials involving department stores/clothing websites, leaving furniture websites in the middle of the three market types when it comes to text looking-time. To be clear, the ultimate prediction that subjects would spend more time looking at text than images remained constant across all variable within the free navigation trials.

The second condition under which subjects completed trials is what we will refer to from here on out as the “Task Driven” condition. In this condition, subjects

were instructed to complete a task for each site they had already freely navigated. To avoid unintended priming for the free navigation trials, we ensured that each subject completed the free navigation condition before the task driven condition. We figured that exposing subjects to the websites that they were going to freely navigate before the free navigation trials would tarnish the purity of the trials. We acknowledge that exposing subjects to websites during free navigation trials before task driven trials certainly primes them for task driven trials, but we maintain that assigning randomness to website exposure order in each condition preserves the validity of the observed phenomena. In the task driven trials, all subjects were instructed to “Buy a sweater” for department store/clothing websites, “Buy a subscription” for food subscription service websites, and “Buy a couch” for furniture websites. Once subjects arrived at the necessary screen for purchase, they were instructed to stop, and then were taken to the next site. We predicted that subjects would devote more looking-time to images in this condition for both furniture and clothing websites, given the nature of the task and the expected selectivity of the subjects. We predicted that subjects would still devote more looking-time to text in this condition for food subscription service websites, given the nature of the task and absence of a need for selectivity.

Overall, we predicted different amounts of text looking-time across markets due to the nature of the different products. For food websites, which we predicted to have the highest text looking-time amounts, our hypothesis is based off the information-seeking tendencies of human beings when dealing with food. Human beings would prefer to acquire information about food through reading, hence why

restaurant menus are abundant with text and not images. Contrarily, we hypothesized furniture websites to receive the second highest text looking-time amounts on account of the excitatory valence of the product. Furniture, being a very emotionally and excitatory neutral product type, was expected to receive more image looking-time than food, but less than clothing, resulting in less text-looking time than food, but more than clothing. Lastly, clothing was expected to receive the least amount of text looking-time across subjects due to the selectivity of subjects and the nature of the product. Intuitively, clothing is a visually charged market that relies on the visual approval of consumers, and so devoting time to look at images on a clothing website perhaps holds more utility than reading about products.

An additional analysis took place across both conditions, and across markets among each condition. After data collection, we also looked at the discrepancies between data sets based on gender. We predicted that females would have a longer image looking-time for department store/clothing sites, due to higher female selectivity in clothing. For furniture and food subscription websites, we predicted results to be consistent across genders, as there is little basis for either gender to display a disproportionate preference for either food or furniture.

1.4 Formal List of Hypotheses

1. Subjects will, on the whole, spend more time fixating on text than they will on images.
2. Subjects will spend proportionally more time focused on text during task-driven trials as opposed to free navigation trials.

3. Subjects will spend different amounts of text/image looking-time across different types of product/market websites.
4. Subjects will fixate most on text during trials involving food subscription websites, fixate second most on text during trials involving furniture websites, and fixate least on text during trials involving clothing/department store websites.

1.5 Research on Emotional Valence of Differing Markets

By this point in the paper, readers have seen how some of our hypotheses rely on the assumptions that the different markets represented in the websites of our study invoke differently valenced emotions in human beings. For example, both hypotheses three and four rest on the assumption that not only will subjects experience a different emotional valence during the interaction with each different type of website, but that those different emotional valences will also cause them to look least at images of food, second least at images of furniture, and third least at images of clothing.

While there does not exist research that explicitly compares these three types of images (food, furniture, and clothing), there has been research done on how looking at differently emotionally valenced images can influence gaze duration. For example, in their 2004 study, Manuel G. Calvo and Peter J. Lang determined that images that contained other human beings would command longer durations of gaze than images without humans. They launched an experiment that measured gaze duration of subjects after exposure to neutral, emotionally negative, and

emotionally positive images. Additionally, they included a control condition in which there were no humans present; the images contained only inanimate objects. They found not only that subjects sustained gaze for longer periods of time when looking at emotionally charged photos, but also that subjects looked longer at pictures with human beings in them (Calvo and Lang 2004). In reference to our study, this informs our hypothesis that our subjects will fixate the least on text during trials involving clothing/department store websites. This is because images in those websites, unlike images in the other two variations of websites we tested in this study, contain human beings in them. The mere presence of human beings in the images on the clothing/department store websites should cause subjects to devote more attention to images during those trials than during other trials.

There exists no research on the emotional valence of images of furniture, aside from the fact that they are occasionally used as neutral images in more complex studies of emotional valence. Because of their neutrality, we expect them to receive the second most attention of our three types of website images. The images on the furniture websites won't emotionally arouse subjects either way, but the same cannot be said about the images contained in the clothing/department store websites, which will likely have a positive emotionally valenced reaction with subjects due to the presence of humans in the images.

In regard to images and descriptions of food, there has been research done concerning descriptive menus and how they lead consumers to purchase more food. Including highly descriptive menu items is a marketing tactic used by many restaurants and food services, and there is evidence to prove why it works. For

example, a 2001 study illustrated how merely changing the name of menu items to make the item more descriptive increased sales by 27% per item (Wansink et al. 2001). An experiment run by Wansink gave consumers the option to pick either a regularly labeled menu item or an altered, descriptively labeled item. The study saw consumers select the descriptive menu item 56% of the time. Additionally, customers who chose to eat the more descriptively labeled menu items consistently rated their eating experience more highly and rated the food to be of higher value than did customers who ate the regularly labeled food (Wansink et al. 2001). This study clearly demonstrates the effect that textual descriptions have on consumers when they order food. This phenomenon is likely largely part of the reason why modern-day menus feature more text than pictures, and why the food subscription websites we used in our study do the same. Evidently, humans place a large emphasis on the way they perceive food based on textual descriptions, which is why we hypothesized that subjects would spend the most time fixating on text during trials involving food subscription websites, as opposed to websites of a category.

2. Methods

2.1 Participants

16 college students, with one student having an outlying age, participated in our study. The ages of the students ranged mainly from 19-22, with the outlying age being 36 years old. The age statistics for the participants are represented as follows: ($M_{Age} = 22.13$ years; $SD_{Age} = 3.828$ years; $Median_{Age} = 22$ years). All but one of the participants are currently enrolled in undergraduate study at Yale University, with

subject one being enrolled in undergraduate study at Fordham University. Of the participants, there were five females and 11 males. The subject with the outlying age of 36 is a male. All participants completed both trial conditions in their entirety, and no exceptions were made for any subject. A total of three subjects have deficient vision, causing them to need glasses or contacts. Two of those three subjects were wearing contacts on the day of trials, making their visual deficiencies negligible. One participant had to remove his glasses on the day of trials, but his visual deficiencies did not appear to affect his performance in either experimental condition (something that will be visited again in the discussion section of this report).

2.2 Design

Our study featured two separate conditions with three different markets represented within our websites, making it a two by three study. Additionally, gender was treated as an independent variable for discussion and analysis purposes after the results were gathered. In the free navigation condition, subjects were given 30 seconds to browse through each site (order of the sites they navigated through was randomized) as they normally would. Their focus was tracked throughout each 30-second browsing period, giving us an accurate representation of focus distribution throughout an organic Internet visit.

In the task driven condition, subjects were instructed to complete a specific task, and were given an unlimited amount of time to do so. For the department store/clothing websites, subjects were instructed to “Buy a sweater.” For the furniture websites, subjects were instructed to “Buy a couch.” These could have

been any sweater or couch the subject chose. For the food subscription websites, subjects were instructed to “Buy a subscription.” Naturally, this command gave the subjects a much smaller range of options. The focus of the subjects was tracked throughout the task, and when the subjects arrived at the appropriate webpage that would enable them to purchase the item they were instructed to find, the researcher guided them to another website and task. The subjects did this for all six websites, and the order of the websites was randomized for each subject. This gave us the most accurate representation of focus distribution during the completion of a goal-driven behavior on the Internet.

The last portion of the experiment featured a survey that gauged the subjective experience of each subject. The survey asked each subject his or her subject number, gender, and age. The survey then asks the subjects about what they remember their subjective experience to have been during the trials. The survey contains multiple statements and asks each subject to rate on a scale of 1-5 the magnitude to which they agree with each statement, with a rating of 1 denoting “Completely Disagree” and a rating of 5 denoting “Completely Agree.” The statements in the survey were as follows:

- 1 I used about an even combination of text and pictures to help me navigate through the websites.
- 2 During the task trials, I used about an even combination of pictures and text to help guide me through the tasks.
- 3 During the free navigation trials, I used text more than pictures to gather information about the websites.
- 4 During the free navigation trials, I used pictures more than text to gather information about the websites.
- 5 During the task trials, I used text more than pictures to help guide me through the tasks.
- 6 During the task trials, I used pictures more than text to help guide me through the tasks.
- 7 The amount I looked at text and pictures varied based on the category of the website (the three categories were furniture, clothing, and food).
- 8 The amount I looked at text and pictures varied based on the individual websites; categories did not matter to me.

Data from the survey responses was stored via Qualtrics and was used to aid in analysis and discussion.

2.3 Materials

Very few materials were needed for the completion of this study. As just recently mentioned, the Qualtrics tool was used to conduct an online survey after the subjects satisfied both experimental conditions. The Hirsch Brain Function Lab provided computer monitors and computer equipment, and all the trials were conducted within the lab. The eye-tracking software used was the Tobii Pro x3-120, which featured a camera placed behind the subjects' heads during trials, and an eye-

tracker placed directly below the monitor during trials. The only other materials used were a stopwatch to time each trial and a chair that was modified in elevation depending on each subject's height.

2.4 Procedure

Subjects' trial appointments were scheduled nine minutes apart to ensure there were not long wait times after subjects arrived. Upon arrival to the Hirsch Brain Lab, subjects received a piece of paper that read as follows:

"Hello and thank you for volunteering to participate in my thesis study. Today, you will be looking at different websites and following instructions from the researchers. In some cases, you will be asked to simply browse through the websites as you would normally do. The researchers will tell you to "navigate like normal" or "browse like normal." The trials in which you will be doing this will last 30 seconds per website. In other cases, the researchers will also ask you to perform tasks on the websites. An example of a task might be to try and purchase a specific item from a website (without actually giving your payment information). In these cases, the researchers will explicitly instruct you to execute a specific task. Trials in which this occurs will not be timed, so do not feel the need to hurry. At the conclusion of your trials, we ask that you fill out a questionnaire about your experience. The questionnaire has already been emailed to you and will be conducted via Qualtrics Survey. Thank you for your time and willingness to participate!"

After reading this statement, subjects were taken to a separate, isolated testing room. They sat down in the test chair in front of a computer monitor with a computer mouse clearly at their disposal. As they looked at the monitor, to the right of their visual field was another monitor which displayed in real time the data being extracted from the eye-tracking software (this auxiliary monitor was displaying where the subjects were looking). After sitting down, the subjects underwent a three-point calibration process. The subjects were instructed to look at "point 1," then "point 2," and then at "point 3." Study advisor and Hirsch Brain Function Lab

Associate Research Scientist Dr. Adam Noah directed the calibration process for every trial. After calibration, the subjects were told by a researcher that the first set of trials would be the free navigation trials, and that they should “browse each website normally.” A researcher then began the trial on the eye-tracking software and instructed the subject to click on one of the six already present tabs on the computer screen. The researcher possessed a list of different randomized website orders for each subject and used that to guide the subjects through trials. At the onset of the free navigation trial, the researcher would start a stopwatch, and then instruct the subject to move on to a different website after 30 seconds had passed. This was done for each of the six websites, until all websites had been freely navigated. The researcher then stopped the trial.

After completion of the free navigation trial, the researcher went through each website and returned to the home page on each to prepare for the task driven trials. When each website had been returned to the home page, the researcher then told the subject that the next set of trials would feature tasks that needed to be completed. The researcher instructed the subject that they would be assigned a task for each website, and that they would be given an unlimited amount of time to complete each task. After giving the instructions, the researcher began the trial on the eye-tracking software and directed the subject to the first site in their specific task driven condition website sequence. As previously stated, for department store/clothing websites, subjects were instructed to “Buy a sweater.” For furniture websites, subjects were instructed to “Buy a couch.” And for food subscription websites, subjects were instructed to “Buy a subscription.” Once the subject had

completed a respective task (they had reached the proper web page for buying the item they were instructed to buy), the researcher instructed them to move to the next website and task in their sequence. After all six websites had been run through and all six tasks had been completed, the researcher concluded the trials.

After a subject completed trials for both conditions, they were told to complete a Qualtrics survey. The survey asked each subject for his or her subject number, age, and gender. The survey also asked subjects to rate on a scale of 1-5 the magnitude to which they agreed with eight different statements pertaining to their subjective experience during the trials. The specific statements and parameters of the survey have been detailed in the *design* portion of this report.

3. Results

3.1 Free Navigation Condition

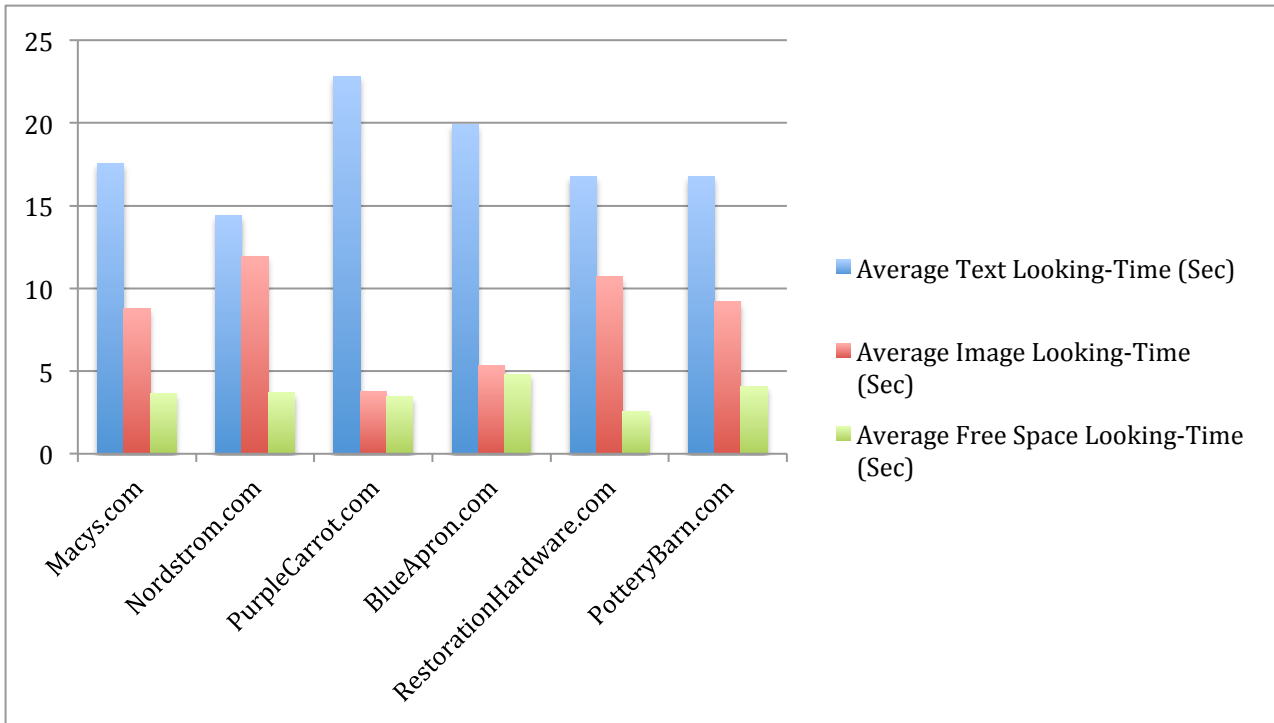
The Free Navigation condition yielded results we felt would most closely align with focus distribution during a normal, organic, web-browsing session. By giving the subjects no restriction besides the 30-second time limit, we enabled participants to act as if they typically would while navigating through websites. As previously stated, subjects were exposed to all six websites in this condition (two department store/clothing sites, two furniture sites, and two food subscription sites). The department store/clothing websites were Macys.com and Nordstrom.com. The two furniture websites were PotteryBarn.com and RestorationHardware.com. The two food subscription websites were PurpleCarrot.com and BlueApron.com. Prior to the experiment, we had

hypothesized that subjects would overall spend more time focusing on text than on images. More specifically, we predicted that subjects would spend the most time looking at text while navigating food subscription websites, the second most time looking at text while navigating furniture websites, and the third most time looking at text while navigating department store/clothing websites. A comprehensive report of our results from this condition is contained in the following sections.

For clarity, the statistics for each respective website during the free navigation trials are as follows:

Website Name	Average Text Looking-Time	Average Image Looking-Time	Average Free Space Looking-Time
Macys.com	17.56 sec (58.5%)	8.81 sec (29.4%)	3.63 sec (12.1%)
Nordstrom.com	14.38 sec (47.9%)	11.94 sec (39.8%)	3.68 sec (12.3%)
PurpleCarrot.com	22.81 sec (76%)	3.75 sec (12.5%)	3.44 sec (11.5%)
BlueApron.com	19.88 sec (66.3%)	5.31 sec (17.7%)	4.81 sec (16%)
RestorationHardware.com	16.75 sec (55.8%)	10.69 sec (35.6%)	2.56 sec (8.5%)
PotteryBarn.com	16.75 sec (55.8%)	9.19 sec (30.6 %)	4.06 sec (13.5%)

Additionally, here is the same data represented as a bar graph:



3.1.1 Responses to Hypotheses in Free Navigation Condition

Our first, and most important, hypothesis was that subjects would spend more time focusing on text as opposed to images as they freely navigated the websites. This prediction was correct, as during the free navigation condition across all sites, subjects, on average, spent 18.02 seconds per 30-second trial focusing on text and only an average of 8.15 seconds per 30-second trial focusing on images. The remainder of the average time in the trials was spent focusing on free space (neither images nor text). This means that over the course of a 30-second free browsing period where subjects were given no content restrictions or instructions, our participants devoted, on average, 60% of their 30 seconds per trial focusing on text and only 27.17% of that time period focusing on images. The remaining 12.83% of

the average trial time was devoted to gazing at free space (mostly during webpage transitions or scrolling). Given the sample size $N=16$, this finding strongly reinforces our hypothesis that our subjects would focus mostly on text while freely browsing through websites.

More specifically, our hypothesis regarding average text looking-time per website category was also correct. On average, participants spent 21.35 seconds (71.2%) looking at text during food subscription website trials, 16.75 seconds (55.8%) looking at text during furniture website trials, and 15.97 seconds (53.2%) looking at text during department store/clothing website trials. Additionally, subjects, on average, spent 4.53 seconds (15.1%) looking at images during food subscription website trials, 9.94 seconds (33.1%) looking at images during furniture website trials, and 10.38 seconds (34.6%) looking at images during department store/clothing website trials. These findings all coincide with the overarching finding and confirmed hypothesis that subjects would spend more time focusing on text than images, but to different degrees. We were correct in predicting that food subscription websites would prompt the most text looking-time, and the 4.4-second (14.67% of trial time) difference between average text looking-time during food subscription website trials and furniture website trials is statistically significant given our sample size $N=16$. However, although our hypothesis was technically correct in predicting how much text looking-time furniture websites would experience in comparison to the other two website categories, the .78-second (2.6% of trial time) difference between average text looking-time during furniture website trials and department store/clothing website trials is not statistically significant

given our sample size $N=16$. It is difficult to determine if our results would have favored our hypothesis on this matter more or less if we had a larger participant pool.

3.1.2 Trends Across Free Navigation Condition

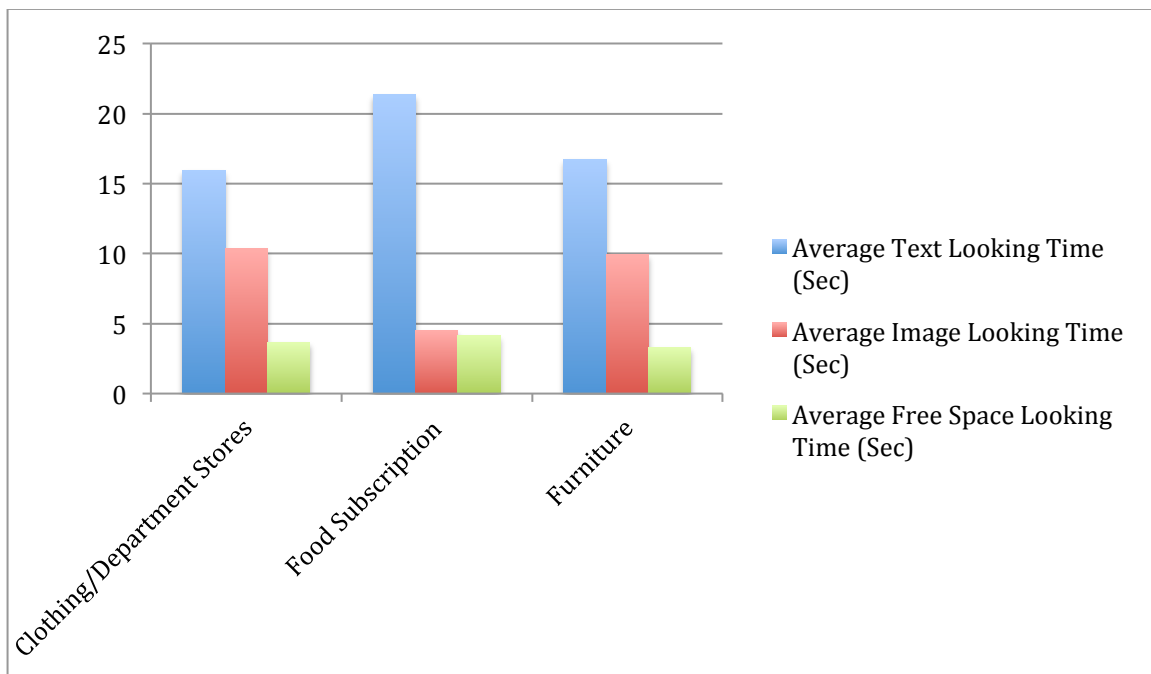
Before diving into the main two sections of trends that we want to discuss, it is important to discuss the interesting findings that can be directly seen on the above graphics. First, it was extremely surprising to find that both furniture websites had the exact same average text looking time (16.75 seconds) after 16 different trials. Perhaps what makes this result even more surprising, is that the subjective layout and formatting of the two furniture websites had the most intra-market website differences among all three markets. That is to say that PotteryBarn.com differed more from RestorationHardware.com than did BlueApron.com from PurpleCarrot.com or Nordstrom.com from Macys.com. The differences in layouts and formats likely explain the 1.5 second difference in average free space looking time between the two sites, as RestorationHardware.com has far more free space than does PotteryBarn.com.

On a similar note, it was equally surprising to see the differences in average text looking time between PurpleCarrot.com and BlueApron.com as well as between Macys.com and Nordstrom.com. Despite both pairs of websites displaying very little subjective difference in format and layout within each market category, PurpleCarrot.com warranted an average of 2.93 seconds more text fixation time than did BlueApron.com and Macys.com warranted an average of 3.18 seconds more

text fixation time than did Nordstrom.com. These findings are surprising because, as previously mentioned, Nordstrom.com and Macys.com share very similar formatting and so do PurpleCarrot.com and BlueApron.com.

Aside from the more specific aforementioned findings, there are two main areas of general trends that should be paid attention to in this condition. The first trend is one that has been commented on numerous times throughout this report, and it is the trend of differing text looking time across website market types. This trend will be illustrated even more clearly in an upcoming graphic. The second trend, which has not been discussed at nearly as much length, is the trend observed across genders, and will also be illustrated with an additional graphic.

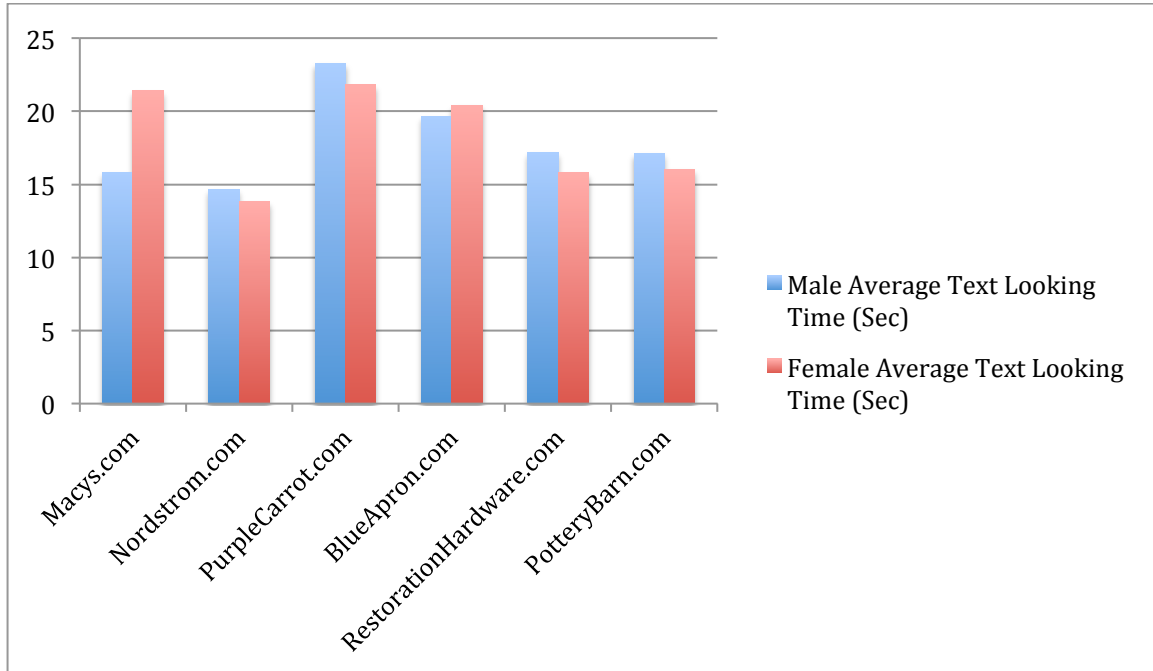
First, here is a graphic detailing the differences in looking time across website market types:



As discussed in the “addressing hypotheses” section, our original predictions regarding this trend were technically correct. We observed a significant difference

in the amount of fixation time devoted to text in the food subscription website trials compared to the furniture website trials (4.4-second (14.67% of trial time)), but not a significant difference between furniture website trials and department store website trials (.78-second (2.6% of trial time)) for the same metric. This trend suggests that humans prefer to seek out text to acquire information about food much more often than when they want to learn about furniture or clothing. This trend is not surprising, as it can be inferred that humans are able to gather more information about food by reading about the ingredients that go into a food product. The same cannot be said for furniture and clothing, and this will be discussed in more detail in the final section of the paper. Through subjective observation, we saw that subjects spent more time fixating on images of products on the clothing websites, but more time fixating on general website images on the furniture websites. That is to say subjects were more prone to browsing through product lines and scanning images with clothing websites, and much less prone to do the same thing with furniture websites. Contrarily, subjects usually browsed through furniture websites and paid attention to images on main webpages on the sites as opposed to devoting looking time to actual product line images.

The second trend that we observed in this condition occurred across genders. Here are the statistics regarding genders in this condition represented in a bar graph:



As can be seen in the above graphic, results were relatively uniform across genders, with a few notable trends. The first trend worth acknowledging is that males spent more time looking at text during trials involving both furniture websites. For RestorationHardware.com, males, on average, fixated on text for 1.38 seconds more than females did. For PotteryBarn.com, males, on average, fixated on text for 1.09 seconds more than females did. It is difficult to tell if these results and differences are statistically significant, as we do not have a large enough sample size or typical population statistics to compare these differences against. Nevertheless, this trend is worth noting. Additionally, there is a sizeable disparity between average male and female looking time during Macys.com trials. In fact, females, on average, devoted 5.58 more seconds to text fixation during Macys.com trials than males did. This difference accounts for 18.6% of total trial time and is undoubtedly statistically significant. This disparity makes the non-significant difference among genders in Nordstrom.com trials even more puzzling, though, seeing that the

subjective formats of the sites are very similar, and that both sites are in the department store/clothing market category. The differences seen among gender looking time with food subscription trials are statistically insignificant and do not warrant any extra contemplation for the researchers. We believe it is plausible that males and females feel similarly towards food, and that the differences displayed in this experiment are the product of simple subject variation.

3.2 Task Driven Condition

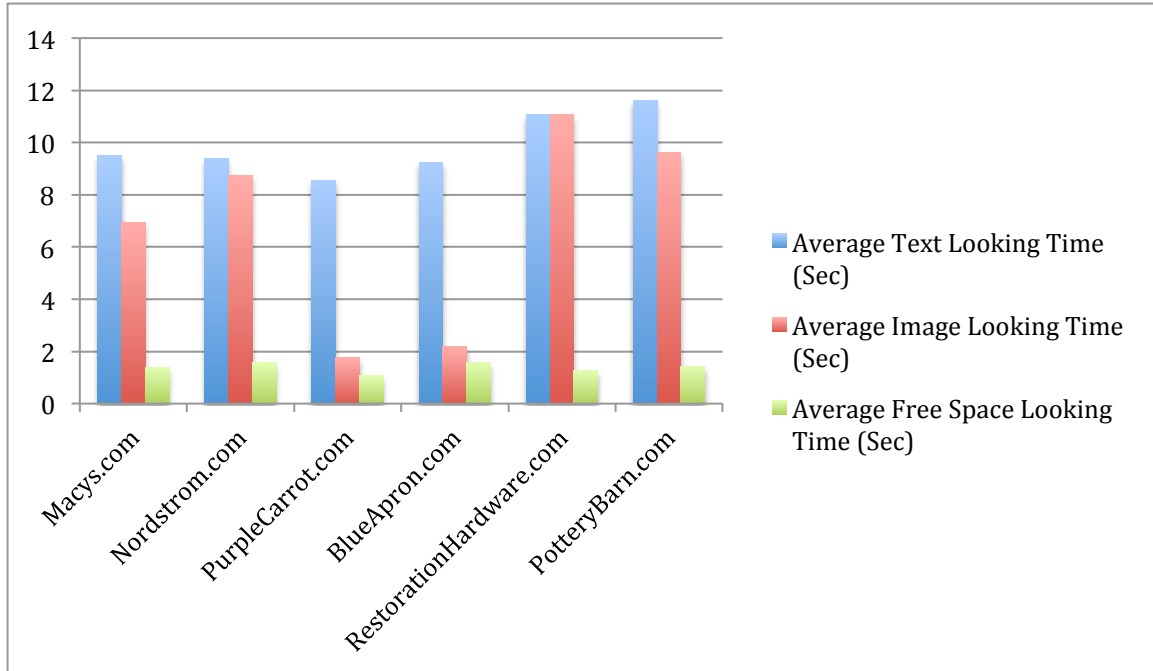
The Task Driven condition yielded results we felt would most closely align with focus distribution during a goal-oriented web-browsing session. By giving the subjects a clearly defined task with no time limit, we felt that we were able to simulate, as accurately as possible, the cognitive environment a consumer is placed in when they are looking to purchase something online. As previously stated, subjects were exposed to all six websites in this condition (two department store/clothing sites, two furniture sites, and two food subscription sites). The department store/clothing websites were Macys.com and Nordstrom.com. The two furniture websites were PotteryBarn.com and RestorationHardware.com. The two food subscription websites were PurpleCarrot.com and BlueApron.com. Prior to the experiment, we had hypothesized that subjects would overall spend more time focusing on text than on images. More specifically, we predicted that subjects would spend the most time looking at text while navigating food subscription websites, the second most time looking at text while navigating furniture websites, and the third most time looking at text while navigating department store/clothing websites.

Additionally, we hypothesized that compared to the Free Navigation Condition, subjects would devote more time to text fixation during the Task Driven Condition. We predicted that because the subjects would be intentionally trying to complete a task related to efficiently and effectively navigating through a website, they would more actively read for information than spend time looking at images. A comprehensive report of our results from this condition is contained in the following sections.

For clarity, the statistics for each respective website during the task driven trials are as follows:

Website Name	Average Text Looking-Time	Average Image Looking-Time	Average Free Space Looking-Time
Macys.com	9.5 sec (53.3%)	6.94 sec (39%)	1.38 sec (7.7%)
Nordstrom.com	9.38 sec (47.6%)	8.75 sec (44.4%)	1.56 sec (8%)
PurpleCarrot.com	8.56 sec (75.2%)	1.75 sec (15.5%)	1.06 sec (9.3%)
BlueApron.com	9.25 sec (71.2%)	2.19 sec (16.8%)	1.56 sec (12%)
RestorationHardware.com	11.06 sec (47.3%)	11.06 sec (47.3%)	1.25 sec (5.3%)
PotteryBarn.com	11.63 sec (51.3%)	9.63 sec (42.4%)	1.44 sec (6.3%)

Additionally, here is the same data represented as a bar graph:



3.2.1 Responses to Hypotheses in Task Driven Condition

In response to our first, and most important hypothesis, the Task Driven Condition confirmed our predictions. On average, subjects spent far more time fixating on text during this condition than they did fixating on images. This was especially true in the food subscription website trials, as subjects spent an average of 73.2% of their time during food subscription website trials looking at text. At this time, it would be prudent to include that this section will be using percentages almost exclusively to display differences between trials, as these trials were not subject to a controlled and constant time limit.

As for our second hypothesis, we were in fact incorrect. Our second hypothesis stated we expected subjects to proportionally devote more time to text fixation during the Task Driven Condition as opposed to the Free Navigation Condition. On average, experiment participants devoted 60.05% of looking time to

text during Free Navigation Trials, while only devoting, on average, 57.65% of looking time to text during Task Driven Trials. While the difference in these percentages may not be significant, the fact that they are similar at all makes them a significant finding in reference to our original hypotheses. We expect to know why this was the case, based on subjective observation of the trials, and that shall be discussed in later sections. Regarding our third and fourth hypotheses, we were correct in predicting that food subscription website text fixation time would proportionally be the highest, as the lower of the two looking time percentages for food subscription trials (71.2%) was still 17.9 percentage points higher than the next closest furniture or clothing website trial percentage (Macys: 53.3%). Conversely, we were incorrect in predicting that text looking time for furniture and clothing websites would significantly differ in this condition, and further, that subjects would spend more time fixating on text during furniture website trials than in clothing website trials. In the Task Driven Condition, we observed no statistically significant difference among these markets concerning percentage of text fixation time, as our subjects spent an average of 49.3% of furniture website trial time fixating on text and an average of 50.45% of clothing/department store website trial time fixating on text. The difference of 1.15 percentage points here is not significant, and for at least the purposes of this study, disproves our third and fourth hypotheses.

3.2.2 Trends Across Task Driven Condition

Unlike the Free Navigation Condition, the Task Driven Condition did not yield any acute trends or gender-based trends. There were no statistically significant variances within market groups, or across genders. The two notable trends in this condition both focus on differences across market-based categories.

The first trend we observed was clearly defined in the comparative graphic seen above, and it namely was that subjects spent significantly more time fixating on text during food subscription trials in this condition than they did in any other market category trials. As previously mentioned, subjects spent on average 73.2% of their time during the food subscription trials devoting their attention to text. This result was not surprising, given the subjective structure of the food subscription websites, as well as the previously talked about findings about food subscription website text looking time. Also, previously mentioned, we found no significant differences in text looking time between furniture and clothing/department store websites. As subjective observers of the trials, we posit that this result was because of the similar nature of the task. For both furniture website and clothing website trials, subjects were instructed to purchase a type of item that would be available on the site. The instructions were given in such a way that the subject had a wide variety of options to choose from within the category of item they were instructed to buy. For example, for clothing website trials, subjects were instructed to “buy a sweater,” which means that they could have purchased any product on the site that reasonably could be considered a sweater. Comparatively, during furniture website trials, subjects were instructed to “buy a couch,” which means they could have purchased any product on the site that reasonably could be considered a couch. In

our observations of the trials, we noticed that subjects would browse through product lines on clothing and furniture websites and choose which “sweater” or “couch” was their favorite. They would then choose to click on their selection, arriving at the webpage right before purchase, where the trial would end. Because in some of our trials these subjects went through this selection process instead of simply “purchasing” the first sweater or couch they find, the amount of total trial time subjects, on average, spent on image fixation undoubtedly increased. In the future, if we were to run this condition again, more specific instructions would likely produce different results, and those results would likely correspond with the hypotheses we stated in this study.

The second trend in this condition that we observed was the differing trial durations across website types. Because we did not place a time limit on the trials in this condition, our participants dictated how long each trial would last. When the subjects reached the correct webpage, that is, the webpage from which they would be able purchase the item they were directed to look for, the trial came to an end. Therefore, the trials varied from subject to subject, based on either the proficiency of each subject to find the item they were looking for, or the amount of time it took each subject to pick the item they wanted to “purchase.”

Food subscription websites had, by far, the shortest average trial length, with an average trial length of 12.19 seconds. Clothing/department store websites had the second shortest trial length with an average trial length of 18.76 seconds, and furniture websites had the longest trial length with an average trial length of 23.04 seconds. The likely reason behind the short trial length for the food subscription

trials is two-fold. Firstly, the food subscription websites are formatted in such a way so that consumers are streamlined toward purchasing a subscription. The sites' main function is to acquire subscriptions to their service from consumers. Our directions to our subjects during the experiment were to "purchase a subscription." So, our subjects carried out the very task that these websites are designed for. That undoubtedly led to very short trial time. Secondly, there does not exist any variety in the selection of products on the food subscription websites. Compared to the furniture and clothing websites used in this experiment, there is essentially no variety whatsoever on the food subscription websites that we used. This fact denied our subjects the option to browse through products on the food subscription websites. So, both efficient website design and a lack of selection made the task that we requested of our subjects easy to complete, resulting in very short trials. Conversely, as previously mentioned, subjects took a much longer time on average to complete the task given to them on the furniture and clothing website trials because: 1. Browsing through product lines by some subjects skewed the data, as their trials were exceptionally long and 2. There is a much larger variety of products on both the furniture and clothing websites that we used for this experiment, and the resulting website format required slightly more time for subjects to correctly execute their task.

3.3 Overall Trends and Post-Trial Survey Data

Overall trends coincided with our main hypothesis, namely that subjects would devote more of their attention to text than images both while browsing freely

in the Free Navigation Condition and while completing a task in the Task Driven Condition. Across both conditions and all trials, subjects spent, on average, 58.85% of their total trial time fixating on text, 29.86% of their total trial time fixating on images, and 11.29% of their total trial time fixating on free space.

The post-trial survey asked eight general questions about the trials. Each subject answered the survey questions upon completion of the trials. The survey was included in this experiment to gauge the degree to which subjects mispredicted the distribution of their focus during their experience with the websites. Not all the survey results display significant findings, but we will talk here about the questions and responses that illustrate a misconception of attentional focus and user experience.

In relation to the largest overarching trend, and the confirmation of our main hypothesis, the first survey statement, for which each subject needed to rate on a scale ranging from 1-5 how much they agreed/disagreed was as follows: "I used about an even combination of text and pictures to help me navigate through the websites." Based on our previous discussion of the overall results of the study, we know that the subjects should have overwhelmingly disagreed with this statement, as text fixation, on average, made up for 58.85% of trial time while image fixation, on average, made up for only 29.86% of trial time. However, over half of the subjects in the study (9/16) either answered with a 3 (neutral), 4 (mostly agree), or 5 (completely agree), and seven of those subjects either mostly agreed or completely agreed. Therefore, over half of the subject pool misperceived how their focus was

distributed throughout the trials, and for seven subjects, that misperception was especially notable.

The third statement of the survey read as follows: “During the free navigation trials, I used text more than pictures to gather information about the websites.”

Based on the data from the Free Navigation Condition, we know that subjects should have overwhelmingly agreed with this statement, as 60.05% of total trial time in that condition was, on average, devoted to text fixation. However, over half of the subjects (9/16) responded with either a 1 (completely disagreed) or a 2 (mostly disagreed). This is to say that nine subjects were completely wrong about how they attributed their focus during the Free Navigation Condition, as the average amount of subject fixation time on text was significantly higher (9.74 seconds or 32.5% of total trial time higher) than the amount of subject fixation time on images.

Apart from the two survey statements that have already been mentioned, all the responses from the subjects corresponded with the results that we saw. However, the responses to one more survey statement are worth noting. The survey statement of interest is as follows: “During the task trials, I used text more than pictures to help guide me through the tasks.” In response to this statement, twelve subjects submitted either a 4 (mostly agree) or a 5 (completely agree). Furthermore, three subjects responded with a 3 (neutral). Only one subject responded with a 1 (completely disagree), while no subjects responded with a 2 (mostly disagree). This finding is of interest to us because of the fact that our second hypothesis was incorrect. We incorrectly predicted that subjects would spend more time fixating on text proportionally in the Task Driven Condition than in the Free Navigation

Condition. While we were wrong in this prediction, our subjects overwhelmingly recalled experiencing more text fixation during the Task Driven Condition than they did regarding the Free Navigation Condition. So, while the Task Driven Condition actually saw subjects focus proportionally less on text than in the Free Navigation Condition, the subjects' survey responses suggest that the subjects perceived the opposite to be true. This finding is something that in future trials we would like to investigate further, but it also effectively illustrates how human subjective user experience during website browsing often differs from what actually took place.

4. Discussion

4.1 Implications of Research

This research can be directly utilized in the realm of B2C company website design. It is abundantly clear that human beings tend to pay more attention to text than they do images as they browse the Internet casually, or if they have a specific consumer-related goal in mind. So, what this means for web designers in the future is this: 1. If a company wants to display their products via images on their website, those images should be accompanied sparingly by text, as text detracts from focus on images. 2. The text that companies decide to include on their websites should be meaningful and add to the comprehensive experience of the consumer; their eyes will be drawn to the text, and so they should be able to acquire information from where their gaze will focus on most. 3. Companies should conduct research on the emotional reactions that their products produce among consumers, and tailor their

websites toward those reactions. 4. An easy way to get consumers to look longer and more intentionally at images on a website is to add human beings into the images. 5. Text that covers images or is highlighted in some way will be read almost immediately by the consumer and should be used only to emphasize the most important information on the website. 6. Consumers often have misperceptions about how much time they actually devote to reading as they browse websites, suggesting that much of what they read is forgettable; it would be intelligent for web designers to keep this in mind during design.

In the future, we would like to be able to take this research a step further, and make it even more applicable to the real world of marketing and web design. Future experimental designs would feature a metric by which we could measure how likely subjects are to click on certain things, and what exactly makes a human being purchase a specific item. This design would likely feature a mechanism by which we could determine a specific “price point” for a type of item. The data collected from a future experiment like this one would be able to inform companies not only where consumers look during website browsing, but what aspects of websites they engage with the most and what exactly makes a product appealing to a consumer. Finally, establishing a specific price point for different types of items in the experiment would inform businesses on what exactly they need to do during website design in order to maximize sales on specific products.

4.2 Future Desired Subject Paradigms

In the future, it would be favorable to gather more variety in our subject pool. While the subjects that participated in this study were great for analysis and provide a solid basis for this kind of research, the participant pool was relatively homogeneous overall. All the participants were college students, and all but one participant attend Yale University. While there was a subject with an outlying age (36 years old), that does not come close to fulfilling the desired age diversity for this kind of work.

There are multiple different worldviews that would be interesting to test in these types of experiments that we were unable to test here. The first, and perhaps most compelling of those worldviews, is that of a child who is not proficient in reading yet. While our results in this study have been counterintuitive and surprising to the layperson, what would be even more surprising is if the general trend of our results here were replicated among a population who currently struggles with reading. If children who are still learning how to read still had their focus gravitate toward text during website browsing, then some very concrete conclusions could be made about the nature of how human beings seek information. In the future, testing children who are still learning how to read would be a major priority, mainly because of the gravity of the potential overarching conclusions we could draw at the end of the study.

Another group of subjects that would be particularly interesting to test is the elderly. As previously mentioned, the oldest participant among our subject pool was 36 years of age. It would be very interesting to test individuals who have lived the majority of their lives without the omnipresence of the Internet. Most of these

individuals struggle with Internet use, and it would make for some captivating data if the general trends of their results matched the results we acquired in our study here. It would be expected to have some relatively technology-literate subjects in that subject pool, but it would also be reasonable to expect there to be participants in the pool who are relatively unfamiliar with Internet use. It would be interesting to see how this would affect trial results.

A glaring homogeneity that we had in our subject pool was our subjects' educational background. All but one of our subjects is currently enrolled at Yale University as an undergraduate, and the outlier in that group is currently enrolled at Fordham University, another prestigious college, as an undergraduate. This homogeneity offers a limited worldview in terms of both intellectual capability and educational experience. It would be worth our time in the future to test subjects who currently attend, or have attended lesser secondary institutions as well as those who have not attended college at all. By broadening our scope in this sense, perhaps we could get more widely applicable results. Appealing to the average person is valuable because it allows us to make broader conclusions about normal human nature and operation.

A fourth worldview that I would be curious to investigate is that of individuals from other countries/cultures. Although it is not likely, it is possible that American culture and systemic American educational systems have molded our American minds to seek information in a specific way. In our trials represented in this paper, we did not feature any subjects who were international students. Therefore, the cultural worldviews represented in our experiment were strictly

American. Like many of the other desired paradigms, gathering information about different subject variations allows us to make broader conclusions about human nature. Additionally, if we were to find different results across cultures, it could lead to a very compelling investigation into why that phenomenon exists.

4.3 Conclusions

From this experiment, we are able to confidently conclude that our human beings, on average, fixate on text more than images during casual web browsing and during consumer-related goal-oriented tasks on the Internet. Additionally, we can conclude that food subscription websites prompt more text fixation time than do furniture or clothing/department store websites.

Our major conclusion, as just mentioned, is that human beings focus on text more than they focus on images during user experience on consumer websites. This is likely because human beings prefer to seek information by reading as opposed to looking at images. We have considered that this phenomenon exists because humans potentially have the ability to perceive more visual information in quicker amount of time when they look at images as opposed to looking at text. However, this explanation is not supported by our research, as our data did not display our subjects being able to cover the entirety of an image with their focus in a short period of time, making it impossible for them to have fully digested certain images. We have also considered that our findings might be predicated on the fact that we ran an experiment in a controlled setting and installed a time limit into one of our conditions. However, our pilot data and experiments suggested that had we wanted

to skew the data even further in the direction of coinciding with our hypotheses, we could have done that by giving our subjects more time to look at each website. Instead, we employed what we thought would create the most realistic data, and that data even turned out to run contrary to some of our hypotheses.

Overall, our experiment will become one of the few experiments to set the groundwork for this type of research, and it should be referenced in the future by other researchers looking to investigate the questions revolving around effective web design further. We were able to produce sound, replicable results with a consistent dataset. This study will serve as a foundation for more research, and more potential experiments to come and advance this field.

Author Contributions

Barmore, Dr. Joy Hirsch, and Dr. Adam Noah designed the experiment together. The experiment was built off of and based on prior experiments that were designed and run by Barmore. Dr. Adam Noah assisted with running the experiment detailed in this study, and Dr. Hirsch supplied her lab and lab materials. Additionally, Dr. Adam Noah assisted in statistical analysis of the results of this experiment, while Dr. Joy Hirsch assisted in periodical qualitative analysis of work produced by Barmore. The text of the final paper was entirely contributed by Barmore, based on advice and guidance given by both Dr. Adam Noah and Dr. Joy Hirsch.

References

- BORYS, Magdalena, Monika CZWÓRNÓG, and Tomasz RATAJCZYK. "web Analytics Combined with Eye Tracking for Successful User Experience Design: A Case Study." *Applied Computer Science*, vol. 12, no. 4, 2016, pp. 96-110.
- Buswell, G. T. 1935 *How people look at pictures: a study of the psychology of perception in art*. Chicago, IL: University of Chicago Press.
- Calvo, Manuel G., and Peter J. Lang. "Gaze Patterns when Looking at Emotional Pictures: Motivationally Biased Attention." *Motivation and Emotion*, vol. 28, no. 3, 2004, pp. 221-243.
- Chatterjee, P. (2008). Are unclicked ads wasted? Enduring effects of banner and pop-up ad exposures on brand memory and attitudes. *Journal of Electronic Commerce Research: Online Advertising and Sponsored Search*, **9**, 51–61.
- Chu, Sauman, Nora Paul, and Laura Ruel. "Using Eye Tracking Technology to Examine the Effectiveness of Design Elements on News Websites." *Information Design Journal*, vol. 17, no. 1, 2009, pp. 31-43.
- Djamasbi, Soussan, et al. "Online Viewing and Aesthetic Preferences of Generation Y and the Baby Boom Generation: Testing User Web Site Experience through Eye Tracking." *International Journal of Electronic Commerce*, vol. 15, no. 4, 2011, pp. 121-158.
- Drèze, X., & Hussherr, X. F. (2003). Internet advertising: Is anybody watching? *Journal of Interactive Marketing*, **17**, 8–23.

- Henderson, J. M. & Hollingworth, A. 1999a High-level scene perception. *Annu. Rev. Psychol.* 50, 243-271. (doi: 10.1146/annurev.psych.50.1.243)
- Hervet, Guillaume, et al. "Is Banner Blindness Genuine? Eye Tracking Internet Text Advertising." *Applied Cognitive Psychology*, vol. 25, no. 5, 2011, pp. 708-716.
- Jarodzka, H., and S. Brand-Gruwel. "Tracking the Reading Eye: Towards a Model of real-world Reading." *Journal of Computer Assisted Learning*, vol. 33, no. 3, 2017, pp. 193-201.
- Kano, Fumihiro, and Masaki Tomonaga. "How Chimpanzees Look at Pictures: A Comparative Eye-Tracking Study." *Proceedings of the Royal Society B: Biological Sciences*, vol. 276, no. 1664, 2009, pp. 1949-1955.
- Koc-Januchta, M., et al. "Visualizers Versus Verbalizers: Effects of Cognitive Style on Learning with Texts and Pictures - an Eye-Tracking Study." *Computers in Human Behavior*, vol. 68, 2017, pp. 170-179.
- Laudon, Kenneth C, and Carol G Traver. "History of Ecommerce." *History of Ecommerce*, 2008, www.ecommerce-land.com/history_ecommerce.html.
- Wang, QZ, et al. "The Effect of Human Image in B2C Website Design: An Eye-Tracking Study." *Enterprise Information Systems*, vol. 8, no. 5, 2014, pp. 582-605.
- Wansink, Brian, James Painter, and Koert V. Ittersum. "Descriptive Menu Labels' Effect on Sales." *Cornell Hotel and Restaurant Administration Quarterly*, vol. 42, no. 6, 2001, pp. 68-72.

- Yarbus, A. L. 1967 Eye movements during perception of complex objects. In Eye movements and vision, pp. 171-211. New York, NY: Plenum Press.