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Online Viewing and Aesthetic Preferences of Generation Y and Baby Boomers: Testing User Website Experience through Eye Tracking

Baby Boomers, the generation born between 1946 and 1964, and Generation Y, born in 1977 to 1990, form two important groups of online users in terms of numbers and economic impact. Understanding their web preferences is of great importance to companies, in particular because literature suggests that these generations may differ in how they view web pages and in what they find visually pleasing. To this end, a laboratory experiment examined users' reactions to a set of homepages. Users' reactions were captured using self report measures and eye tracking, which recorded fixations. Overall, both generations reported similar aesthetic preferences, and both generations preferred pages that had images and little text. However, the two generations also displayed differing online viewing behavior and preferences. For instance, eye tracking data revealed that Baby Boomers had significantly more fixations and that their fixations covered more of the pages (e.g., headers, main body, sidebars) than Generation Y. In addition, Baby Boomers reported a significantly higher tolerance for having more web components on a page. These results suggest that Generation Y users, as opposed to Baby Boomers, will be more likely to miss key information if a web page fails to present that information using a limited number of clear focal points that are located above the fold. The relationship observed between viewing behavior and visual appeal supports the importance of aesthetics in usability research. Moreover, this research suggests that companies targeting either generation could benefit from being mindful of the visual appeal of their websites.

KEYWORDS: Aesthetic Preference, Visual Appeal, Viewing Pattern, Web Design, Fixation, Generation Y, Millennials, Baby Boomers, User Experience, Eye Tracking

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“...in the new computing user experience is the steel structure that frames the building...The challenge for technology developers is to more deeply understand what you, the user, want.”
(Ben Shneiderman, *Leonardo's Laptop: Human Needs and the New Computing Technologies*, p. 2 and 27)

INTRODUCTION

The World Wide Web assumes a central role in many aspects of modern life, and is essential to business, e-commerce, healthcare, government, and education [27,51,53, p. 59,69]. Such a vast expansion creates the need for innovation in website design in order to stay competitive, draw users, and, subsequently, increase revenue. However, this is a challenging endeavor because, with the growth of information technology, users no longer expect a minimum of functionality or basic usability. Rather, the competition is shifting towards user experience because creating a positive user experience is now an essential part of technology design [59]. This is particularly true for websites, which have become an accepted and expected communication channel [61]. The continual growth of online marketing and e-commerce sales [36,38,65,66] indicates the need to compete in an “increasingly crowded market” [58]. This growth also suggests that companies can greatly benefit from paying careful attention to their users’ experience with their websites. Given the importance of user experience in the information technology market, our research examines similarities and differences in web preferences and viewing behavior between two different yet important groups of users – both in terms of numbers and economic impact – Baby Boomers and Generation Y [23,25,52,67].

Baby Boomers, aged 46 to 64, not only account for 33% of the US adult population and 35% of the adult Internet population [25], but they are the largest generation in the US with 78 million people [23,62], and constitute a very large spending power of over \$2 trillion [52]. In addition to the sheer

number and spending power of Baby Boomers, many of those in the Baby Boomer generation work past retirement age [22], and this consequently means that employers and retailers need to consider Baby Boomer user preferences in their web design. At the other end of the spectrum, Generation Y, aged 19 to 33, accounts for 26% of the US adult population and 30% of the total online adult population [25]. This generation forms another large group of users with more than 70 million people. Generation Y constitutes substantial spending power as it earns approximately \$211 billion and spends about \$172 billion annually [23,67]. In addition to the number and spending power of Generation Y, research shows that this generation is very reliant on the Internet and is becoming more prevalent in the workforce [23]. Consequently, employers and retailers are particularly interested in Generation Y and need to consider their user preferences in their web design [23].

While both these generational populations are important in terms of economic power and size, it is unclear if the two generations engage in similar types of viewing behavior and have similar aesthetic reactions to web pages. Research suggests that generational differences in attitudes and world view typically stem from experiencing different major events in the younger, more formative years of childhood [2,55,60]. Both Baby Boomers and Generation Y experienced major technological advances—Baby Boomers grew up with television and Generation Y with the Internet [60]. While both of these advances facilitated experiencing a global world during the formative years for the two generations, the access and experience that these technologies provided of that global world was significantly different for each generation. For example, unlike the television, the Internet provided a 24 X 7, fast-paced, two-way connection with the global world [46] that facilitated instantaneous response and encouraged multitasking [17]. As a result of this formative experience, Generation Y typically exhibits a shorter attention span [46], greater sense of immediacy, and is more prone to boredom than Baby Boomers [60].

In this paper, we argue that Baby Boomers and Generation Y, due to their differences in certain tendencies (e.g., sense of immediacy), may not experience the same web page in the same way. Given that Baby Boomers and Generation Y constitute a large proportion of online users and bring with them a large economic power, their reactions to different website designs and innovations can have important implications for companies. Research shows that user experience significantly influences a user's willingness to revisit a web page and purchase products from a website [34]. Thus, underrating the nuances that may exist in the way a website is experienced by Baby Boomers and Generation Y can have significant implications on the profit margin of a company that targets one or both generations.

Given these implications, we set out to compare and contrast user experience of the two generations when viewing a set of home pages. Using past research, we argue that generational differences are likely to affect two important aspects of user experience: viewing behavior (how a page is viewed) and aesthetic reactions (how a page is visually experienced). In addition, we explore the relationship between viewing behavior and aesthetic reactions, as well as the influence generation has on this relationship. For companies that target Baby Boomers and Generation Y, our research may provide insight for improving the visual appeal and overall effectiveness of their homepages for these two important user groups. Additionally, the relationship between users' viewing behavior and their aesthetic perception of a page may be of particular interest, as companies can utilize this information in deciding where and how to place elements on their web pages.

LITERATURE REVIEW

This paper focuses on two aspects of user experience: viewing behavior and aesthetic reactions.

Viewing behavior refers to how a user looks at a web page [13]. Because users' viewing behavior indicates to what parts of the page they attend, it can be particularly helpful in understanding whether

the information provided on a web page is communicated effectively [13]. Aesthetic reactions encompass users' visual experience of stimuli. Past research shows that aesthetic reactions can form as early as within the first 50 milliseconds of viewing a stimulus. This first impression influences users' subsequent experiences of the stimulus [32]. Thus, understanding viewing behavior and aesthetic reactions can help companies improve users' experience of their web page.

In the following sections, we provide a brief review of user experience literature that examines viewing behavior and aesthetic reactions. Next, we discuss the literature that explains why and how Generations Y's behavior differs from Baby Boomers' behavior. Using this literature, we present our argument explaining how generational differences can affect the viewing behavior and aesthetic reactions of Generation Y and Baby Boomers.

Viewing Behavior

Viewing behavior, or how a user looks at a web page, plays an important role in how successfully information on a web page is communicated to that user. Guiding users in viewing a page can improve the communication and thus a user's experience with a web page. One way to guide users in viewing a page is by providing visual hierarchy, cueing users to the order in which they should view the information on the page [16]. This can be achieved through the selection of elements and their attributes, such as size and location [16]. For example, the placement of images or graphics on a page can affect the order in which page elements are viewed [16]. People often collect information by first scanning images, then reading text [3,16]. Similarly, the size of elements on a page can affect the order in which they are viewed – large items are typically perceived as more important and thus are more likely to be viewed before smaller objects [16]. Finally, the location of an element is a key factor in determining its place within the viewing order. For example, users perceive elements placed at the

top of a page as more important and attend to them first [3,16]. Thus, by carefully selecting both web elements and their attributes, designers can manipulate the visual hierarchy of a page and, consequently, the viewing behavior of users to more effectively communicate information [16].

The choice of attributes and arrangement of elements on a page not only affects how a user views a web page, but these web components also contribute to how a user reacts to a page [8,14]. In the following section, we provide a brief review of the literature that explains why designers should consider users' aesthetic reactions to their web pages. .

Aesthetic Reactions

Research shows that users' aesthetic reaction to a web page plays a key role in their experiences with the page and can influence their behavior—for better or for worse. More specifically, research shows that aesthetic reactions influence the evaluation and enjoyment of a website [32]. An appealing web design can be particularly important in attracting web-surfing users [50]. Aesthetic reactions, which are contributing factors in determining the quality of a website, are shown to be a good predictors of whether users purchase items or intend to return to a website [34]. Interestingly, even if a website has major usability issues, users are likely to “forgive” these flaws in the site, but only when they find the site aesthetically appealing [31]. For instance, one study found that if users rated a site as visually appealing prior to using it, their perceived value of the website remained constant, even if they were unable to complete half of their assigned tasks [31]. These findings, in combination with user statements (e.g., “if it looks pleasant, I just trust it”), suggest that aesthetic reactions may also be linked with users' trust of a website [26]. Supporting this view, a recent study shows that there is a strong positive correlation between a user's rating of trust in the informational content of a page and the user's rating for visual appeal of the page [15].

The research on aesthetic reactions and the ramifications it has on users' opinions, judgments, and behaviors coincide with research on the confirmation bias (or halo effect) in social psychology [32,44]. Research on the confirmation bias shows that individuals seek information that confirms their pre-existing beliefs – whether positive or negative [9,28,41]. Thus, how a site is initially judged (i.e., either positively or negatively) predicts how it will be viewed in the future, regardless of experiences with the website that are contrary to the initial judgment (e.g., if a website is initially perceived to be negative, subsequent positive experiences are less likely to change the negative perception of the site) [32]. Thus, companies can benefit from designing aesthetically pleasing web pages.

There are two main general approaches to investigating aesthetic reaction [30]. One approach argues that aesthetic experience is best understood when the complete stimuli is evaluated. This approach examines a users' subjective appraisal of the web page as a whole; a Gestalt-like approach [29]. The other approach argues that aesthetic responses are best understood when reactions to the isolated elements of an object are studied; a bottom-up or interactive approach; [63]. This approach examines the effect of individual web components on users' experiences and perceptions [30]. In this study, we employ both approaches. We investigate users' aesthetic experience of the whole page by collecting their subjective ratings of the overall appeal of a set of web pages. We also collect information about their reactions to parts or components of a page by collecting a set of self reported ratings for preferences for parts (e.g., images, amount of text, etc.). Additionally, we use the eye-tracking data to examine fixations, which reveal what areas of the page were attended to by the users. We use this data to examine whether there are generational differences in viewing behavior and aesthetic reactions between Baby Boomers and Generation Y.

Generation, Viewing Behavior, and Aesthetic Reactions

Research shows that generational differences are rooted in common events that are experienced during the formative years of one's childhood [2]. These experiences affect the generation's attitude and

behavior toward stimuli [55]. In this paper, we are concerned with how generational differences between Baby Boomers and Generation Y influence the way they view a page or react to it.

Generation and Viewing Behavior

Studies show that cognitive effort plays an important role in how information systems are used [11]. In particular, there is ample evidence that people often use their information systems in a way to reduce their cognitive effort [57]. Thus, paying attention to users' cognitive effort while they are in the process of viewing a page may be particularly helpful in better understanding their behavior. The degree to which users are willing to expend effort when viewing a page is likely to impact their viewing behavior, and, therefore, their experience as web users.

One factor that may affect the degree to which a user is willing to expend effort when viewing a page is the user's generation, which is shaped by social markers experienced during childhood [60]. These common events experienced by a generation have a significant impact on the world view, attitudes, and behavior of that generation [55,60].

In this study, we are particularly interested in the different generational experiences of Baby Boomers and Generation Y. Both Baby Boomers and Generation Y grew up with major technological breakthroughs that facilitated globalization [60]: for Baby Boomers, it was the advent of the television, while for Generation Y it was the introduction and proliferation of the Internet [55]. While both of these were major breakthroughs for their time periods, the nature and scope of the technology and subsequent globalization was significantly different; the rate of change and advancement in globalization for Generation Y was much higher than for Baby Boomers [60]. Because of the Internet, Generation Y's experience of a global world during their formative years was very different from Baby Boomer's experience of a global world when they were growing up. Online communities made it

possible for Generation Y to conveniently connect to peers and friends regardless of geographical location and/or time of the day [1,60]. Such a convenient and continuous connection to peers and friends was not available to Baby Boomers during their childhood. The experience of maturing in a constantly connected world not only created the experience of globalization at a more personal level but also facilitated an accelerating rate of change that was not experienced by prior generations [55,60]. As a result, compared to Baby Boomers, Generation Y has a different sense of immediacy and, to this young generation, “instantaneous response is the only meaningful time frame” [60, p. 7]. Rather than causing Generation Y to feel overwhelmed or slow, the constant stimulus has caused them to have a shorter attention span [46], exhibit less patience, and feel easily bored [60]. The heightened sense of immediacy of Generation Y is likely to affect the degree to which this generation is willing to expend effort when processing information. Consequently, the two generations are likely to have different viewing behaviors. In addition, it is possible that the two generations also have different aesthetic reactions when viewing a web page.

Generation and Aesthetic Reactions

In the previous section, we explained why generational differences between Baby Boomers and Generation Y may influence their viewing behavior. In this section, we argue that generational differences are also likely to affect Baby Boomer and Generation Y users’ aesthetic reactions. Aesthetic reaction in our study refers to a user’s aesthetic experience of a website. In the following paragraphs, we explain why and how generational differences between Baby Boomers and Generation Y may affect their aesthetic reactions to isolated elements of a page (e.g., their preferences for web elements such as texts and images), as well as their overall perception of the visual appeal of a web page.

Web Preferences. As mentioned previously, because Generation Y grew up with a technology that provides rich, flexible, and interactive communication, this generation tends to have a greater sense of immediacy than Baby Boomers, who did not grow up with this technology. Additionally, most Baby Boomers read books for both entertainment and information when growing up [21,56]. Generation Y, on the other hand, had access to the Internet for the same needs [45]. The shift from books toward electronic media had a particularly significant effect on the reading habits of the two generations [21,56]. This argument is also supported by reports indicating that Generation Y does not like to read text [21,45,56], finds reading blocks of text boring [48], and avoids textual-information [20,43]. In contrast, Baby Boomers, who tend to be avid book readers [24], do not shy away from reading text-based information and, in fact, they are often willing to re-read textual passages if there is a need to do so [39]. This difference between the two generations is likely to affect their preference for the amount of textual information that is provided on a web page.

Differences in sense of immediacy and patience are likely to be reflected in the generations' preferences for web components (i.e., web elements such as images, menus, links, etc.) that can facilitate faster and less arduous communication. For example, generational differences are likely to be apparent in the preferences of the two generations for density of information on a web page. Pages that are less densely populated (i.e., have fewer web components on them) are likely to be more favored by Generation Y than by Baby Boomers. According to the model of visual hierarchy [16], viewing a web page consists of 1) finding points of entry to the web page and 2) scanning for information around those entry points. Because having fewer web components makes it easier to find points of entry, "impatient" Generation Y would be more likely to show preference for web pages with fewer web components. Using similar logic, it is likely that images would be more preferred by Generation Y than by Baby Boomers because they are often focal points and, therefore, easily found entry points [16]. Additionally, images on a page are likely to be more favored by Generation Y than by Baby

Boomers because the younger generation favors image-based communication over text-based communication [4,68].

Visual Appeal. Users' reactions to parts of a stimulus are likely to affect users' overall aesthetic experience of that stimulus [30]. Thus, one's preferences for individual components or characteristics of a web page are likely to affect how one experiences the overall aesthetics of a web page. By natural extension, this means that differing web preferences of Generation Y and Baby Boomers are likely to affect how they would evaluate the overall appeal of a page. One potential example is the preference for an image-based versus text-based method of information display. Literature suggests that younger users are not necessarily fond of reading text [43], while older users tend to read a great deal of text [5]. Research looking at attention paid to warning labels on cigarette and alcohol advertisements found that, while teenagers fixated longest on an advertisement with a cartoon character image, approximately one-quarter of the participants never even glanced at the textual information [20]. Based on these findings, the younger generation (Generation Y) may find web pages that include images more appealing than older generations (Baby Boomers).

In addition to differences like the one described above, personal attributes, such as education and cultural experiences, have been shown to affect visual preferences [7,10,33]. A user's aesthetic interaction with an artifact is influenced by the user's cognitive structure. One's cognitive structure is formed by one's experiences throughout his or her life [33]. Thus, according to this argument, social markers shaping generational differences are likely to affect a user's aesthetic experience. One's cognitive structure can also be influenced by information it receives. Consequently, information that is received through education can play a significant role in a user's aesthetic experience [33]. Because technological advances have played a much greater role in the education of Generation Y than the

education of Baby Boomers [40], the two generations may be affected by education differently. Thus, the two generations may have different aesthetic reactions when experiencing the same stimuli.

RESEARCH QUESTIONS AND MODEL

The user experience literature on viewing behavior shows that page design plays an important role in how a page is viewed by users [16]. The user experience literature on visual appeal provides ample evidence that the aesthetic perception of a web page has a significant impact on users' interaction with that web page, as well as users' intention to revisit the page [35]. While both areas of literature advance our understanding of user behavior, neither examines the possible effects of generation on its actors' behaviors and reactions. Moreover, while research indicates that generational differences can affect behavior and aesthetic experience [33,55,60], little research has examined possible links between generation, viewing behavior, and visual appeal. In this paper, we address this gap by conducting a laboratory experiment. In addition to self report measures, we capture users' eye movements. This approach allows us to extend prior research in several ways. First, it expands prior research by examining the effect of generation on viewing behavior and visual appeal. Additionally, it extends prior research on viewing behavior and aesthetic reactions by testing whether user fixations are correlated with their visual appeal. Finally, it expands prior research by examining whether generation can impact the relationship between fixation and visual aesthetics. A visual representation of previous work and of how our research extends this previous work is displayed in Figure 1.

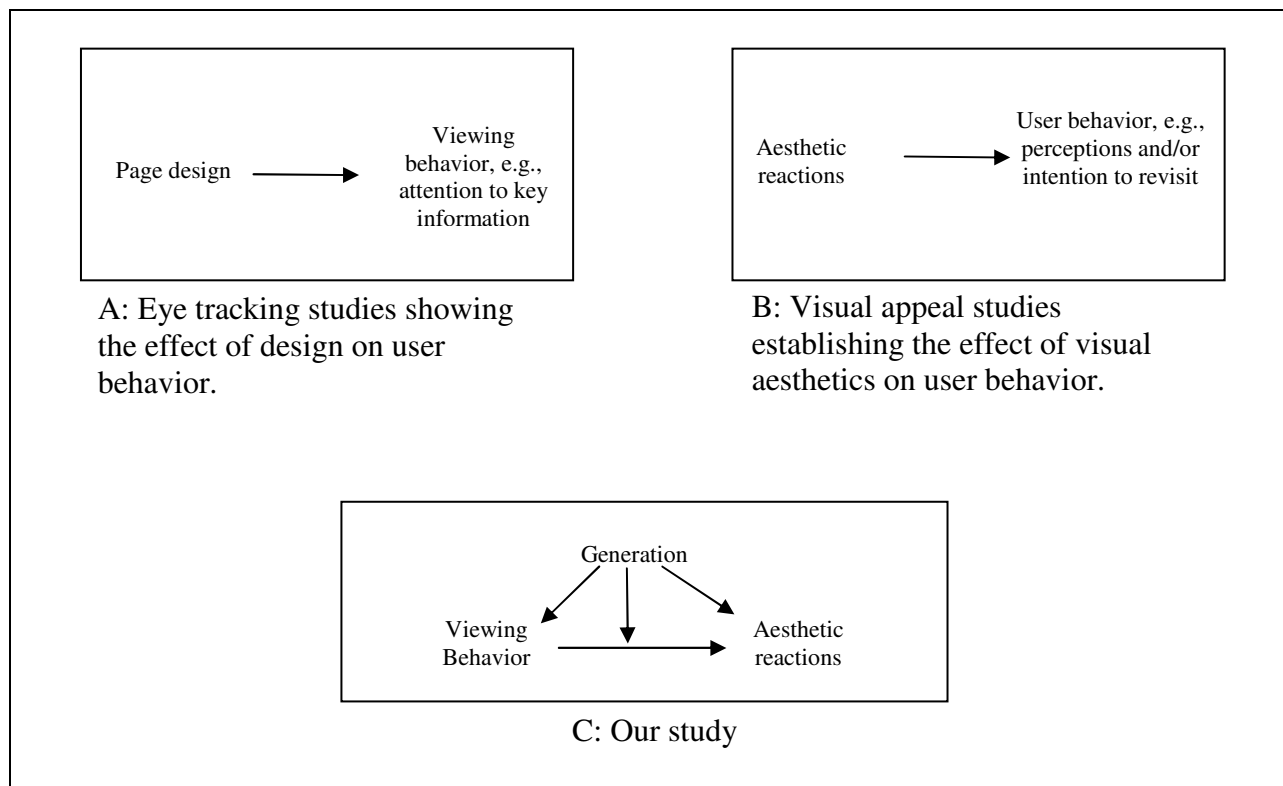


Figure 1: Visual representation of previous eye tracking and visual appeal studies as well as our study linking and extending these previous studies.

In this paper, we investigate three research questions:

1. Do generational differences influence viewing behavior?
2. Do generational differences influence aesthetic reactions?
3. Is there a relationship between a user's visual appeal rating of a page and his or her fixations, and, if so, is that relationship influenced by generation?

Using past research as a theoretical foundation, we formulated several hypotheses to test the above research questions. The first two research questions stem directly from past theories and research findings; whereas, the third research question is exploratory in nature. These research questions and their respective hypotheses are illustrated in the research model in Figure 2.

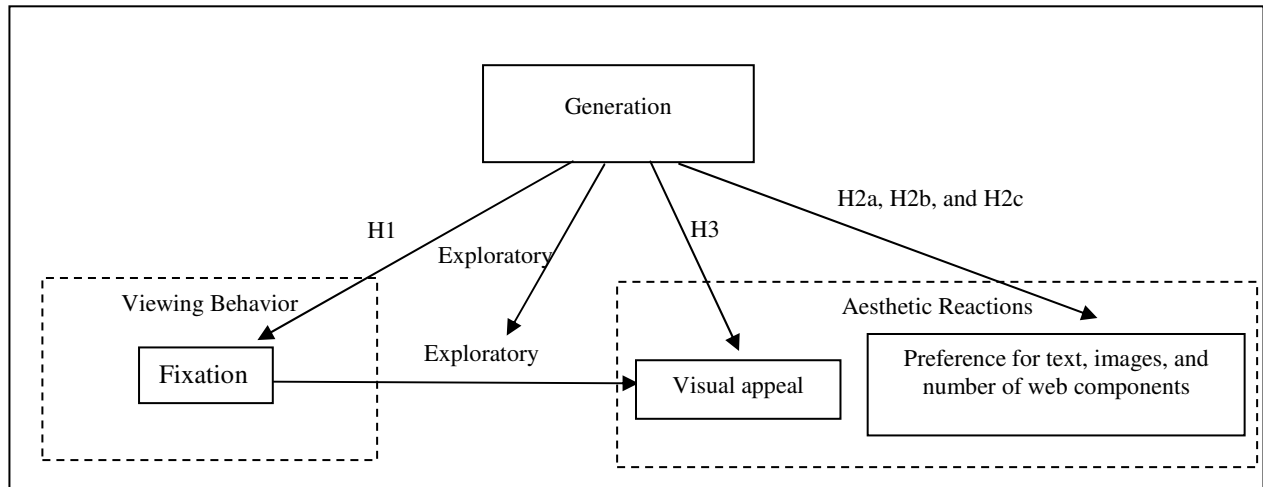


Figure 2: Research Model

Hypotheses

The user experience literature on viewing behavior shows that page design plays an important role in how a page is viewed by users [16]. In addition, the user experience literature shows that aesthetic reactions influence the evaluation and enjoyment of a website [32] and also predict whether the site will attract users [50]. However, it is unclear whether generational differences between Baby Boomers and Generation Y affect viewing behavior and aesthetic reactions.

Do Generational Differences Influence Viewing Behavior?

Because cognitive effort has an impact on how information systems are used [11], it is likely to play a role in how web pages are viewed. In other words, the degree to which a user is willing to expend effort to view a page is likely to impact his or her viewing behavior.

Both empirical research and popular culture suggest that Generation Y and Baby Boomers differ in their sense of immediacy and patience [48,60]. This difference is attributed to the two generations'

differing experiences during maturation; in particular, Baby Boomers were not exposed to the rate of change and advancement that the Internet provided Generation Y [33]. From a technological perspective, Generation Y has matured in a fast-paced world that facilitated instantaneous response and encouraged multitasking [17]. Because Generation Y has grown up in such an environment, this generation tends to have a shorter attention span and tends to be less patient than Baby Boomers, who, as they were growing up, did not have access to the technologies that were available to the younger generation [18,19,48]. Recent studies provide evidence that lend further support to this argument. Empirical evidence shows that older users do indeed exhibit a more patient approach to viewing a page than younger users [5]. For instance, older users read almost all the text that appears on a screen [46], tend to carefully weigh the consequences before clicking links [46], and are more tolerant of usability issues if they believe the technology is beneficial [43]. Younger users, on the other hand, dislike reading [41], often click on a links without hesitation when looking for information [5], and tend to be less forgiving if a technology does not meet their expectations [1].

Given the different formative experiences that Baby Boomers and Generation Y had, and given the past research looking at the impact of formative experiences on attitudes and world view [2,55,60], we predict that generational differences will be reflected in viewing behavior. More specifically, we hypothesize that Baby Boomers will exhibit more patience and expend more effort when viewing web pages than Generation Y, and we predict that these differences will manifest themselves in the fixation count and fixation patterns of the two generations. Thus, we expect that Baby Boomers will have more fixations and will fixate over more area on web pages than Generation Y. For the current study, fixation count reflects the number of times that a user looks at a piece of information and thus represents a users' effort in processing that information [15]. Fixation pattern reflects the areas of the page that received fixation. Because fixations represent attention, a larger area of fixation indicates a higher level of effort expended on viewing the page.

H1a) Baby Boomers will have a higher fixation count than Generation Y when viewing a page.

H1b) Compared to Generation Y, Baby Boomer's fixation will cover a larger area of the page.

Do generational differences influence aesthetic reactions?

One potentially important factor contributing to aesthetic reactions may be common developmental experiences. For example, the experience of a major shift away from the print media and towards the electronic media for entertainment as well as information during the formative years of Generation Y is likely to have influenced the aesthetic reactions of the younger generation [45, 33]. Computers now provide a rich medium for communication that does not need to rely on textual information.

Consequently, research shows that Generation Y, who grew up with this rich medium, often ignores textual information [43,56], while Baby Boomers, who grew up with much more textual media sources and reading books, do not [5,24]. Thus, it is likely that generational differences affect preference for text-based web pages. Therefore, we assert:

H2a) Generation Y, compared to Baby Boomers, will show significantly less preference for large amounts of text on a web page.

Another potentially important factor related to aesthetic reactions is cognitive effort. As discussed previously, research shows that generational differences originate from common events that are experienced during the formative years of one's childhood [29], and that these events influence a generation's world view, attitudes, and behaviors [30,33]. Both Baby Boomers and Generation Y grew up with major technological advances [33]. Baby Boomers grew up with television and Generation Y with the Internet. Both of these advances were truly remarkable for their time; however, they provided different common experiences during the formative years of their respective generations. While television provided entertainment and created an ability to access information faster than was

previously possible, the Internet provided Generation Y with a much more fast-paced, connected, and global world that facilitated instantaneous response [17]. As a result of this formative experience, Generation Y has developed an acute sense of immediacy [60, p. 7]. The constant access to stimuli has caused this generation to have a shorter attention span [46], exhibit less patience, and feel bored easily [60].

Given that Generation Y has been socialized to have a more heightened sense of immediacy than Baby Boomers [39, 53, 54], the two generations are likely to differ in the degree to which they are willing to expend effort and, consequently, the way they view a page. The difference in willingness to expend effort is also evident in Generation Y's preference for image based information, which can facilitate faster and less effortful communication [68]. Thus we hypothesize:

H2b) Generation Y, compared to Baby Boomers, will exhibit more preference for images on a web page.

A third factor that may influence aesthetic reactions is the presence of useful points of entry on a web page. Viewing a web page effectively requires a user to find useful points of entry to the web page [16]. These points are then used to scan for information around them. Finding useful points of entry to a page is less effortful if the page has fewer elements. Because Generation Y has grown up with a technology that facilitates instantaneous response, this generation has a stronger sense of immediacy, a pressing need for quick access to information, and a greater desire for efficient communication in comparison to Baby Boomers [39, 53, 54]. Thus, we predict that Generation Y will have a greater preference for web pages that have fewer web components than Baby Boomers because these pages offer faster, more efficient, and less effortful viewing process. In other words, we predict that:

H2c) Generation Y, compared to Baby Boomers, will show significantly less preference for large amount of web components on a web page.

Based on the past research, we predicted above that generational differences are likely to affect users' aesthetic reactions to individual components on a web page. The differences in preference for individual components on a web page are also likely to influence the overall aesthetic experience of the web page. For example, a preference for an image-based or text-based method of information display is likely to affect how appealing a user perceives a web page to be. Generation Y users, who typically do not like to read, are likely to find a page with large amount of textual information less appealing than Baby Boomers, who typically attend to textual information. Similarly, differences in preference for image-based communication are likely to affect how appealing Baby Boomers and Generation Y users would find web pages that provide more image-based information. Likewise, users who favor web pages with fewer web components will likely have a different aesthetic experience when viewing a page than users who favor having numerous web components. These examples illustrate that having differing web preferences is likely to affect how appealing a page is to Generation Y and Baby Boomers.

In addition to differences in preference for individual components, the two generations may also exhibit different overall aesthetic reactions to stimuli because they grew up with significantly different cultural and educational backgrounds. The Internet provided Generation Y with an elaborately interconnected global world that not only influenced this generation's social interactions but also affected its educational environment. Cultural and educational experiences affect one's cognitive structure, which in turn influences one's aesthetic evaluation of stimuli [33]. Hence the two generations may exhibit different overall aesthetic reactions to web pages because their cognitive structure was shaped by experiencing significantly different cultural and educational settings. Thus we predict that:

H3) *Generation Y and Baby Boomers will differ in how they rate the visual appeal of web pages.*

Is there a relationship between a user's visual appeal rating of a page and his or her fixations, and, if so, is that relationship influenced by generation?

The last research question addressed by our study is exploratory and focuses on the possibility of a relationship between users' visual appeal ratings and their fixations and that generation may influence such a relationship. User experience studies tend to study users reactions either by focusing on fixations or by focusing on perception of visual appeal. Recent investigations, however, provide evidence that examining fixations may help predict how users would rate the appeal of a page. For example, the results of a recent eye-tracking study suggest that what is captured in Generation Y's first fixation on a page may have an important impact on how appealing the page is rated [14]. When a main large image was placed in the center of a page, where Generation Y users' first fixations occurred, the page was rated as more appealing. Because pages with a large main image have a distinct visual hierarchy, these results suggest that prominent visual structures may be inherently more appealing to Generation Y users. One way to provide more insight into this possibility is to examine the relationship between fixation count on a page and the visual appeal ratings that it receives. Because viewing different visual designs results in different number of fixations [13], examining the relationship between fixations and visual appeal can provide insight about users' reactions to various types of visual designs of a page.

Generation Y's attraction to pages that require fewer fixations (less cognitive effort) during viewing can be explained by their strong sense of immediacy. But would the same be true for Baby Boomers, who tend to be more patient than their younger counterparts? To investigate this possibility, we

examined whether it is possible to predict how a user would rate the visual appeal of a page by looking at the user's fixations. We also examined whether generation can influence the relationship between fixations on a page and visual appeal rating of the page. To distinguish the exploratory nature of these investigations from those that are driven by hypotheses, these relationships are marked as exploratory in our research model (Figure 2).

METHOD

Participants and Design

Fifty-nine employees (34 female; 25 male) of one company participated in the experiment. Thirty-three of the participants were Generation Y (born 1997-1990), and 26 participants were Baby Boomers (born 1946-1964). The participants came from several departments (e.g., human resources, administration, design, building maintenance) and various businesses owned by the parent company (e.g., finance, real estate, culinary). Participants were recruited from postings on the company's internal website and daily corporate emails, and were offered a \$20 gift check as an incentive for participating. Due to the limited capacity of the eye tracking lab, all participants were not able to complete the eye tracking portion of the study. Of the 59 respondents, 22 people, evenly split between Baby Boomers and Generation Y, were randomly selected to participate in the eye tracking. This experiment utilized a mixed design. All participants viewed the same 9 web pages; however, half the participants were Generation Y and half the participants were Baby Boomers.

Materials

Web pages Used

To choose a suitable set of pages for the laboratory experiment, the aesthetic reactions of 325 users (122 male; 203 female) to 50 web pages were collected via an online study. More specifically, participants looked at each web page, and indicated how appealing they found the website to be on a 5-

point Likert scale (1 = Not at all appealing; 5 = Very appealing). These web pages were randomly selected from the top 100 retail websites as rated by ForeSeeResults, an independent company that evaluates websites based on customer data. Because home pages are often the point of entry to a website, we focused on this type of web page. Additionally, we used one genre of websites, retail websites, which is often used in visual appeal research [30,35]. Based on the visual appeal ratings for each of the 50 pretested web pages, we divided the pages into three different categories: a) most appealing, b) neutral rating, and c) least appealing. From these categories, we selected the three most appealing pages (see Figure 3, Figure 4, and Figure 5) and the three least appealing pages (see Figure 6, Figure 7, Figure 8). Additionally, three web pages in the neutral category were randomly selected for inclusion as filler pages. Thus, from the 50 pretested web pages, a total of 9 web pages were selected for use in the current experiment.

Measures

Viewing Behavior: Fixation Count and Fixation Area. One way to collect information about viewing behavior is by tracking a user's number of fixations, or gazes that are longer than 300 milliseconds [12]. Because fixations are reliable indicators of attention and are linked to intense cognitive processing, they serve as a suitable indicator of effort [47,64]. To track users' number of fixations, we used the Tobii 1750 eye tracker. This eye tracker improves on prior technologies by being completely unobtrusive because this model utilizes infrared sensors within the monitor to detect the infrared light that is reflected off the eyes of the participants. This allows the eye tracker to interpolate the position of the pupil. Previous technologies required conspicuous head gear that interfered with the natural user experience. Using the eye tracker, we recorded users' fixations or gazes lasting at least 300 milliseconds. Using this data, we calculated fixation count, or the number of fixations, for each user on each page.

In addition to fixation count, we also examined fixation area to determine cognitive effort used in viewing the pages. To do so, we generated heat maps for each page. This was done by aggregating the number of fixation counts across participants for each page (see Figures 3 to Figure 8 for examples). Typically in heat maps, areas that receive the highest number of fixations are indicated in red, with yellow and green indicating lesser numbers of fixations. Areas with no color indicate they were not fixated upon. Because the heat maps in this article are rendered in black and white, colors in the heat maps displayed in Figures 3 to Figure 8 are shown as shades of grey: red is shown in dark grey, yellow in light grey, and green in medium grey. The heat maps were then used to calculate the fixation area, or the areas of the page that were covered by fixations. The larger the fixation area on a page, the more attention was given to the page and thus the more effort was expended by the users to view the page. Thus, for each page and for each group of users, the percentage of area that were covered by fixation (shown in the images as shades of grey) was calculated by dividing the number of pixels in the fixation areas by the total number of pixels in the heat maps. These percentages were then compared to examine group differences in cognitive effort.

Aesthetic Reaction: Web Preference and Visual Appeal. Aesthetic reaction was measured for the parts of the web pages, as well as holistically. We captured reactions to the parts of the pages in two ways. We asked the participants to complete a survey that measured their preferences for various web characteristics on web pages in general. Using a 5-point Likert scale (1 = Not At All; 5 = Very Much), participants indicated the extent to which they preferred web pages that had: a) images, b) a large amount of text, and c) a great number of web components (i.e., links, images, menus, etc). This survey allowed us to capture reactions that were not limited to the pages used in our study. Additionally, we used the eye-tracker to examine how participants attended to parts of the pages used in our study. This allowed us to capture an objective measure of user attention to the parts of the web pages that were used in our study.

Users' overall aesthetic reaction to the web pages was also measured. After viewing each web page, participants indicated how visually appealing the page was on a 5-point Likert-type scale (1 = Not At All Appealing; 5 = Very Appealing). Furthermore, after viewing all 9 pages, participants rank-ordered them and selected their most and least favorite pages. This provided a relative measurement of aesthetic reaction and favorability.

Procedure

The experiment was conducted in the two usability labs of the company from which the participants were recruited. Both rooms had the same setting; however, the eye tracking monitor was only available in one of the rooms. Upon arrival, each participant was randomly assigned to one of the laboratories. For the participants in the eye-tracking lab, they first needed to engage in a brief calibration procedure that lasted about 15 seconds. All participants, regardless of room, viewed each of the 9 web pages one at a time. The order in which the pages were displayed was randomized to prevent order effects. After viewing each page, participants rated it in terms of visual appeal on a 5-point Likert scale (1 = Not At All; 5 = Very Appealing). For these ratings, participants were asked to disregard their preference for the content on the page, but rather focus the rating on the aesthetics of the web page. After viewing all nine pages, participants completed a final questionnaire that assessed their demographic information, their preferences for various web characteristics (e.g., images, amount of text on a page, amount of web components on a page), their rankings of the pages they found to be the most appealing and least appealing, and indicated how important it is for a web page to be visually appealing.

RESULTS

A comparison of the visual appeal ratings and responses to the post-survey showed no significant differences between the participants who completed the eye tracking (n=22) and those that did not (n=37). Based on the similarity between the two groups, we combined the data for those in the eye tracking lab and those in the other lab for the analyses of the self-reported data (i.e., visual appeal and the post-survey). Thus, the analyses reflect the data for all participants. The only exception is for the eye-tracking analyses, which are based only on the participants whose eyes were tracked during the experiment.

Viewing Behavior

Fixation Count

Research shows that fixation onto a stimulus requires substantial cognitive processing [47,64].

Applying this finding to our research, then, the number of times a user gazed onto an area of a page for longer than 300ms (or a user's fixation count) can be considered an index of the user's cognitive effort [13]. We predicted that Baby Boomers would expend more cognitive effort, as indicated by a higher fixation count, when viewing the web pages than Generation Y (Hypothesis 1a). To test this prediction, a between-participants t-test of fixation count was used with Generation as the between-participants factor. As predicted, the t-test ($t(20)=2.0, p = 0.03$, one-tailed) showed that Baby Boomers ($M = 166.07$) had a significantly longer fixation count than Generation Y ($M = 130.15$). The effect size was large ($r = 0.39$) [6]. This result supports H1a (see Table 1).

***** Insert Table 1 here *****

Fixation Area

In addition to fixation count, we also looked at fixation area, or where on a page participants looked. The fixation area data shows to which parts of a page users attended, and supplements the fixation count data by providing an additional measure of cognitive effort (or attention). A larger area of fixation indicates a higher level of effort expended to view the page. To examine fixation area across users, a heat map for each page was generated (Figures 3 to Figure 8). We predicted that Baby Boomers would expend more cognitive effort examining the web pages than would Generation Y. More specifically, we predicted that Baby Boomers, compared to Generation Y, would attend to more areas on the web pages; that is, their fixations would cover a larger portion or area of the page (H1b). First, we examined the heat maps for the pages deemed the least appealing. For these pages (see Figures 6, 7, and 8), the heat maps showed the predicted differences between the two generations: Baby Boomers' fixation pattern covered 42% of these pages, while Generation Y's fixation pattern covered an average 28%. The test of difference in proportions (Table 2) showed that this difference was significant ($z = 2.08, p = 0.02$, one-tailed). The significant difference in the area covered by fixation in the heat maps for the least appealing pages supports Hypothesis 1b. However, on the most appealing pages, there was only a tendency for the Baby Boomers' fixation to cover a larger area than Generation Y's fixation (Baby Boomers= 55%; Generation Y= 48%); these differences were not significant ($z = 0.99, p = 0.20$, one-tailed). Thus, these results support H1b for the least appealing pages, but not the most appealing pages.

***** Insert Table 2 here *****

Aesthetic Reactions

We predicted that, compared to Baby Boomers, Generation Y would prefer less text on web pages (Hypothesis 2a). We also predicted that Generation Y would prefer faster and less effortful communication in comparison to Baby Boomers, and that this would be manifested in a higher preference for pages that contained more images (Hypothesis 2b) and fewer web components (Hypothesis 2c). In addition to differences in preference for particular parts or components of web pages, we also argued that the two generations would differ in how they evaluate the overall appeal of a web page. Specifically, we predicted that Generation Y and Baby Boomers would differ in terms of which web pages they deemed visually appealing (Hypothesis 3).

Web Preferences

To examine if there were generational differences in preference for amount of text, images, and number of web components on a page, between-participants t-tests with Generation as a between-participants factor were conducted. Contrary to our predictions, we found that both generations disliked having a great deal of textual information on a web page, with the average rating for this item being 2.06 and 2.16 for Generation Y and Baby Boomers respectively (see Table 3). Likewise, contrary to our predictions, we found that both generations equally preferred images on web pages. Both generations reported a high degree of preference for images, with the average rating for this item being 4 on a 5-point scale for both generations (see Table 3). As we expected, however, there were generational differences in preference for the number of web components. While, overall, the means indicate a preference for fewer web components on a page, Generation Y preferred significantly fewer web components ($M=2.27$) than Baby Boomers ($M=2.72$, $t(56)=1.80$, $p\text{-one tailed}= 0.04$) (see Table 3). The effect size for this preference was small ($r=0.23$). These results support H2c, but not H2a and H2b.

***** Insert Table 3 here*****

In addition to the examination of our hypotheses, we conducted an exploratory visual analysis of the heat maps to determine whether general preferences for parts of the page were reflected in the fixation patterns on the pages used in our study. The heat maps showed that, while the two generations had highly similar fixation patterns on the most appealing pages (Figures 3 to 5), their fixation patterns were different on the least appealing pages (Figures 6 to 8). The heat maps for the least appealing pages (Figures 6 to 8) indicate that Generation Y had fewer fixations on the text that was located below the fold of the page. The heat map on the right side of Figure 8 shows that Generation Y looked at some of the images below the fold, as evidenced by the medium grey color on those images, but gave little - if any - attention to the text below the fold. Baby Boomers, on the other hand, had far more fixations on the text below the fold on this web page, as evidenced by the more prevalent and darker grey on the image on the left side of Figure 8. Similarly, the pages in Figures 6 and 7 received few fixations from Generation Y on the text below the fold, while Baby Boomers again had far more fixation on these page areas.

One major difference between the two sets of pages that were rated as most and least appealing was that the latter set of pages had many more web components than the former set of pages. On the pages that had fewer web components (Figure 3, 4, and 5), almost all web elements were fixated upon. While Baby Boomers' fixation covered more area than Generation Y's fixation, the difference was not significant. On the pages that had more web components (Figure 6, 7, and 8), Baby Boomers' fixation covered significantly more web elements compared to Generation Y, indicating that a smaller portion of these pages received fixation from Generation Y. The difference in the fixation patterns between the two generations on the most and least appealing pages may be because Generation Y has less

tolerance for having too many web components on a page, as suggested by the results of the post-survey, in which Generation Y indicated a lower preference than Baby Boomers for web pages that contain a large number of web components (Table 3). Additionally, the heat maps suggest that the two generations' attention to text and images may have been moderated by their location. When placed above the fold, both generations attended to images and text equally. Below the fold, however, Generation Y's few fixations tended to be on images rather than text.

Visual Appeal

To examine overall visual appeal, a between-participants t-test on the visual appeal ratings of the web pages viewed with Generation as a between-participants factor was conducted. Contrary to our predictions, there was no significant difference between the two generations on their visual appeal ratings of the web pages viewed (see Table 4).

In addition, as part of the post-survey, participants indicated how important visual appeal of a web page was to them (1 = Not at all important; 5 = Very important). Both Baby Boomers ($M = 4.37$) and Generation Y ($M = 4.38$) rated visual appeal as highly important, and a between-participants t-test showed no significant generation difference in this rating (Table 5).

***** Insert Table 4, and 5 here*****

***** Insert Figures 3-8 here*****

Exploratory Analyses

The third research question in our study was exploratory. This research question was concerned with a possible relationship between fixation and visual appeal rating, as well as possible influence of generation on that relationship.

When viewing the most and least appealing pages identified by study participants, we noticed that the pages that users found most appealing consistently contained prominent focal points that were centrally located. Because these pages also had fewer web components, the focal points were easily detectable. These characteristics, which research suggests reduce the amount of cognitive effort required to view a web page [16], were noticeably absent in the least appealing pages. This suggests that visual designs that require less cognitive effort to find entry points may be more pleasing to users, as evidenced by the higher ratings for the pages with centrally located, prominent focal points and fewer web components.

To examine such a possibility, we conducted several exploratory analyses. First, we investigated the amount of effort expended by users when viewing the most appealing and least appealing pages. To measure cognitive effort, we relied on the eye tracking data and specifically looked at the number of times a user fixated on an area on a web page, or their fixation count. For this analysis, a paired sample t-test was conducted with level of visual appeal (most vs. least) as the within-participants factor. The analysis showed that users had a significantly higher fixation count when viewing the least appealing pages ($M = 158.57$) than when viewing the most appealing pages ($M = 137.65$, $t(21) = 2.46$, $p = 0.02$). These results suggest that viewing the least appealing pages required users to expend more cognitive effort than viewing the most appealing pages (Table 6).

***** Insert Table 6 here *****

Given that the above analysis showed that the fixation count was significantly different between the most and least appealing pages, we conducted another analysis to further explore the relationship between fixation count and visual appeal. To do so, we created a binary variable of page category: appealing or unappealing. We then conducted a regression analysis to examine the effects of fixation count and page category on visual appeal. The regression analysis showed that fixation count ($\beta = -0.52$)

and page category ($\beta=-1.42$) each had a significant negative main effect on visual appeal ($p= 0.011$ and $p= 0.000$ respectively). Moreover, a significant interaction between fixation count and page category on visual appeal emerged ($\beta=0.97, p= 0.028$). The higher fixation count a page had, the less appealing it was rated; however, this negative effect was much stronger for the most appealing pages (see Table 7 and Figure 9). The fixation count, page category, and the interaction between the two variables accounted for 52 percent of the variance in the visual appeal ratings (Table 7). Additionally, the effect size for fixation count, page category, and their interaction on visual appeal was large ($f^2 = 1.10$) [6].

***** Insert Table 7 and Figure 9 here*****

Next, we used a stepwise regression to examine whether generation and its interaction with the fixation count and/or page category also influenced users' visual appeal rating. The results did not show a main effect for generation, but rather showed a three way interaction for generation, fixation count, and page category. The effect size of fixation count ($\beta=-0.34$), page category ($\beta=-0.86$), and their three way interaction with generation ($\beta=0.49$) on visual appeal was also large ($f^2 = 1.50$) [6]. The variables in the model accounted for 60 percent of variance in the visual appeal ratings. These results, which are shown in Table 8 and Figures 10 and 11, indicate that, for Generation Y, visual appeal was negatively affected by fixation count regardless of the page's visual appeal. For Baby Boomers, however, the negative effect of fixation count on visual appeal was much stronger for the pages that were most appealing.

***** Insert Table 8 and Figure 10, and 11 here*****

DISCUSSION

Past research shows that a user's viewing behavior when visiting a web page and the aesthetic visual appeal of that web page are important factors that influence and predict users' perceptions, evaluations, enjoyment, and purchasing decisions, as well as to what areas of a web page users attend [31,34,42,50,54]. However, research has yet to examine whether generational differences impact the viewing behavior and visual appeal preferences of users. This current research set out to fill in this gap in the literature by examining generational differences in viewing behavior and aesthetic reactions to web pages. Because generational differences influence a user's sense of immediacy [56,60], we argued that generational differences are likely to affect willingness to expend cognitive effort and, consequently, may influence viewing behavior. Because past experiences affect aesthetic reactions [49], we argued that the shared experiences that shaped generational differences are also likely to impact the two generations' aesthetic preferences. Thus, we hypothesized that a user's generation would affect his or her viewing behavior and aesthetic reactions.

Viewing Behavior. Using an eye-tracker, we examined the viewing behavior of Generation Y and Baby Boomer users. In particular, we looked at fixation count, or the number of times a user gazed at an area of a page for longer than 300ms. The analyses showed that, as predicted, Baby Boomers had significantly more fixations than Generation Y, suggesting that Baby Boomers exerted a higher level of cognitive effort in their overall viewing of the content of a web page. Looking at heat maps of users' fixations, which indicate where users fixated, we again found that the area covered by Baby Boomers' fixation was significantly larger than area of the page covered by Generation Y's fixation. The heat maps also showed that Baby Boomers were more likely to view the entire page, and scroll down the page. These differences were especially pronounced for the pages that were categorized as being the least appealing. On these pages in particular, Baby Boomers' fixation spanned across the entire page, even when scrolling was required, whereas Generation Y mainly fixated on focal points

above the fold and did not scroll. These results suggest that Generation Y users, as opposed to Baby Boomers, will be more likely to miss key information if a web page fails to present that information using a limited number of clear focal points that are located above the fold. Additionally, the heat maps suggest that the two generations' attention to text and images may have been moderated by their location. Both generations fixated on images and text equally above the fold but, below the fold, Generation Y tended to fixate on images rather than text.

Together, the above results support our hypotheses regarding viewing behavior and show that Baby Boomers exerted more cognitive effort than Generation Y to view the web pages in our study. These results are consistent with the literature that suggests that, compared to Baby Boomers, Generation Y is less patient and has a shorter attention span [46,60].

Aesthetic Reactions. We examined aesthetic reactions by testing possible differences in general preferences for certain elements of web pages, as well as overall reactions to a set of web pages. As expected, Generation Y exhibited less tolerance for having a large number of elements or components on a page. Contrary to our expectations, however, the self-reported preference for images and amount of text were similar, such that both generations preferred images and disliked large amounts of textual information on web pages. While these results support previous research indicating that Generation Y dislikes reading text, they do not align with past research showing that older users often read large amounts of text [5,43]. One explanation is that, though Baby Boomers may read text more than Generation Y, they may not like it. This interpretation is aligned with the heat maps, which show that Baby Boomers had more fixations on text than Generation Y (e.g., Figures 6 to 8), and the results of the survey, which indicated that Baby Boomers disliked reading large blocks of text.

Contrary to our hypotheses, there were no significant differences between Generation Y and Baby Boomers' visual appeal ratings of the retail web pages. A high-level view of the visual appeal findings suggest that users' overall impressions of web pages alone may not be sensitive enough for detecting subtle nuances in aesthetic reactions between the two generations. For example, we predicted that Generation Y would have less tolerance for a high number of web components than Baby Boomers. In the post-survey, Generation Y reported that they disliked having a large number of web components on pages, and this rating was significantly lower than the rating of Baby Boomers. This was a general preference, not specific to the pages that they viewed in the study. The viewing behavior of the two generations for the set of least appealing pages in our study was aligned with this self-reported general preference. The least appealing pages in our study clearly included more components on them than the most appealing pages, and on this set of pages, Generation Y's area of fixation was significantly smaller than that of Baby Boomers. On the most appealing pages, the fixation areas of the two generations were not significantly different. These results are aligned with the argument that Generation Y has less tolerance for web pages that are densely populated. However, when looking at the visual appeal rating for the least appealing pages, there was no significant difference between the two generations' ratings. Generation Y did not find those pages that had more web components significantly less appealing than the Baby Boomers did. This suggests that a combination of subjective and objective measures may be needed to refine and/or interpret subtle differences in holistic measures of visual appeal. The use of objective measures of eye-movements (e.g., fixation count and pattern) may be particularly helpful in providing a more comprehensive picture of user experience.

In addition, our research extended past research by investigating how fixation count and page category (appealing or unappealing) was related to visual appeal. This exploratory analysis showed that both types of users had a higher fixation count on the least appealing pages. What these results suggest is that the least appealing pages required more cognitive effort during viewing than the pages that were

rated as most appealing. One way to explain this behavior is by paying attention to the notable differences in the visual hierarchy of the most and least appealing pages [16]. A web page consists of a set of visual components which, through their attributes (e.g., size, color, location, image based information), define a hierarchy for scanning a page [16]. The exploratory comparison of the most and least appealing pages shows that the visual hierarchy of the two sets of pages differ significantly in these attributes and, consequently, in the order by which they prompt users to view the page. More specifically, the visual hierarchy of the least appealing pages is less prominent than the visual hierarchy of the most appealing pages. Because prominent visual hierarchies facilitate effective entry points to a page, they can reduce a user's cognitive effort in viewing the page.

The most appealing pages (shown in Figures 3, 4, and 5) have a centrally located prominent focal point, a feature that is noticeably absent from the least appealing pages (shown in Figures 6, 7, and 8). Such a prominent visual structure can minimize user effort by drawing attention to the center of the page. The pages in Figures 3 and 4, the two most appealing pages to both generations, utilize a similar method of creating a main focal point in the center of their pages. They both use a large main image and bright, large text on a dark background, bringing the center of the page to the forefront of the user experience. Similarly, the page displayed in Figure 5 uses large images to draw user attention to the center of the page. By doing this, these pages provide a visual structure that clearly presents entry points to a page. Such a visual structure enables the pages in Figures 3 to 5 to attract the attention of both generations in a similar way, as evidenced by the similar fixation patterns for both generations on this set of pages.

The above discussed visual attributes' presence on the most appealing pages in our study, and their absence on the least appealing pages, suggests that creating a prominent visual hierarchy through a main focal point on a homepage may play an important role in positively influencing a user's aesthetic

perception of the page. This interpretation, which suggests an intricate link between design principles and visual appeal, is aligned with the argument that including aesthetics in usability research can provide a better understanding of user experience [30].

This link between fixation and visual appeal was also evident in our other exploratory analyses. These results showed that fixations were a strong predictor of visual appeal ratings for both generations. Fixation count had a negative relationship with visual appeal ratings, regardless whether Generation Y liked or disliked the pages. For Baby Boomers, however, this negative relationship was much stronger on pages that they found appealing. Because aesthetic reactions tend to form within the first few seconds of viewing [32], these results provide important insight about the relationship between the visual structure of a page and its perceived appeal. In particular, these results suggest that visual structures that require more cognitive effort to process may lead to a negative first impression, and that Generation Y may be more sensitive to such visual structures. These results are consistent with research that indicates Generation Y has a stronger sense of immediacy [60] as well as the research that indicates this group of users have less tolerance for usability issues [45,56].

Together, the exploratory results suggest that the visual hierarchy of a page may affect aesthetic perceptions in two ways: arrangement and effort. Arrangement refers to the possibility that creating visual hierarchies with certain arrangements (such as using a centrally located main focal point) may be inherently more appealing to both generations. This argument is supported by the fact that all of the most appealing pages in our study created a similar hierarchy using a prominent, centrally located focal point, while all of the least appealing pages lacked such an arrangement. The appeal of such arrangements, however, may be affected by the degree to which they can be viewed effortlessly; this is evidenced by the significant drop in the visual appeal ratings of the most appealing pages that had a higher fixation count. Future studies are needed to explore these possibilities.

LIMITATIONS AND FUTURE RESEARCH

One limitation of the current research is that, for parsimony's sake, we only investigated retail web pages. Given this, it is unclear whether these results will generalize to other types of web pages and visual media. Therefore, future research should investigate whether the type of page matters. In addition, given the logistics and availability of the eye-tracking monitor and laboratory, the current experiment has a relatively small sample for the eye-tracking data. However, given the small sample size, the results of this work do suggest some robustness, as the analyses did show significant differences despite the small sample size. Because we used multiple t-tests to examine generational differences, an inflated alpha is also a limitation of this study. Future research, using a larger sample size, is needed to extend our analysis and to increase confidence in the generalizability of our findings. Future research should also consider extending our research beyond retail web pages in order to generalize the findings to other types and genres of web pages. Additionally, future research should examine whether having a specific task when viewing web pages influences the generational differences found here. In addition, a recent study suggests that the type of online advertisements (in-line, pop-up, etc.) on a page can have a significant impact on user experience [37]. Because online advertisements are a prevalent feature on many websites, an interesting extension of this work would be to examine the impact of different types of advertisements on users' viewing behavior and the visual appeal of web pages, as well as whether users' generation moderates the relationship between advertisement and appeal.

CONCLUSIONS

The results of this study call for further investigation into the preferences of Baby Boomers and Generation Y. The relationship observed between viewing behavior (fixation count and fixation

pattern) and visual appeal supports the importance of aesthetics in usability research, and provides a new direction for such combined investigations. Traditional usability studies often focus on functionality rather than aesthetics. This focus, however, has been criticized because it ignores users' growing expectation and need for beauty in technological artifacts [30]. This study, which demonstrates that both generations consider visual appeal to be an important attribute of web pages, provides further support for the argument that visual aesthetics are an essential component of user experience and, thus, usability research [30]. Moreover, by studying visual appeal and its relationship with viewing behavior, the current experiment provides support and theoretical direction for the use of eye-trackers in future studies that examine users' aesthetic reactions.

In addition to their theoretical contributions, these results suggest that companies targeting either generation could benefit from being mindful of the visual appeal of their websites. More specifically, these results suggest that prominent visual hierarchies may affect aesthetic perceptions by reducing the amount of cognitive effort needed to view the page (e.g., fixation counts), and subsequently influence users' visual appeal. By providing such a hierarchy, companies may improve the aesthetic evaluation of their homepages, potentially leading to an increase in return visits and, consequentially, an increase in their customer base.

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TABLES

The *r* values [49] are reported for significant results. The *r* values larger than 0.37 represent large effect sizes [6] and those smaller than 0.37 and larger than 0.24, represent medium effect sizes.

Table 1: Results of the one tailed t-tests for fixation count between the two generations

	Mean	Standard Deviation
Generation Y	130.15	39.29
Baby Boomers	166.07	44.66
<i>df</i> = 20, <i>t Stat</i> = 2.0, <i>p(one-tail)</i> =0.03, <i>r</i> =0.39		

Table 2: Results of the one tailed z-tests for fixation areas between the two generations

	Most Appealing Pages (Figure 3, 4, and 5)	Least Appealing Pages (Figure 6, 7, and 8)
Generation Y	48%	28%
Baby Boomers	55%	42%
<i>Z</i> =0.99, <i>p(one-tail)</i> =0.20		<i>Z</i> =2.08, <i>p(one-tail)</i> =0.02

Table 3: Results of one tailed t-tests for preference of the following characteristics on a page

	Generation Y	Baby Boomers
Images	4.00 (0.61)	4.00 (0.82)
<i>df</i> = 56, <i>t Stat</i> = 0, <i>p(one tail)</i> =0.50		
Large amount of textual information	2.06 (0.82)	2.16 (0.94)
<i>df</i> = 56, <i>t Stat</i> = 0.43, <i>p(one tail)</i> =0.33		
Large number of Web Components	2.27 (0.91)	2.72 (0.97)
<i>df</i> = 56, <i>t Stat</i> = 1.80, <i>p(one tail)</i> =0.04, <i>r</i> =0.23		

Table 4: Results of the t-tests comparing the mean of visual appeal ratings of pages in Figure 3 to Figure 8 between the two generations

	Mean	Standard Deviation
Generation Y	3.22	0.68
Baby Boomers	3.37	0.57
<i>df</i> = 10, <i>t Stat</i> =0.39, <i>p</i> =0.70		

Table 5: Results of the paired t-tests for the importance of visual appeal

	Mean	Standard Deviation
Generation Y	4.37	0.91
Baby Boomers	4.38	0.82

df= 58, t Stat= 0.02, p=0.49

Table 6: Results of the paired t-tests for comparing fixation count of the most and least appealing pages

	Mean	Standard Deviation
Most Appealing Pages	137.65	40.33
Least Appealing Pages	158.57	56.69

df= 22, t Stat= 2.46, p=0.02

Table 7: Regression results for the effect of fixation count and page category on visual appeal

Dependent Variable	Independent Variable	β	t-Value	P-value
Visual Appeal	Fixation Count	-0.52	-2.69	0.011
	Page Category (binary)	-1.42	-3.89	0.000
	Fixation Count * Page Category	0.97	2.29	0.028

Overall model $F = 14.57$; $p = 0.000$; $R^2 = 0.52$; adjusted $R^2 = 0.49$, $f^2=1.10$

Table 8: Regression results for the effect of fixation count, page category, and generation on visual

Dependent Variable	Independent Variable	β	t-Value	P-value
Visual Appeal	Fixation Count	-0.34	-2.99	0.005
	Page Category (binary)	-0.86	-7.13	0.000
	Fixation Count * Page Category*			
	Generation	0.49	3.69	0.001

Overall model $F = 19.76$; $p = 0.000$; $R^2 = 0.60$; adjusted $R^2 = 0.57$, $f^2=1.50$

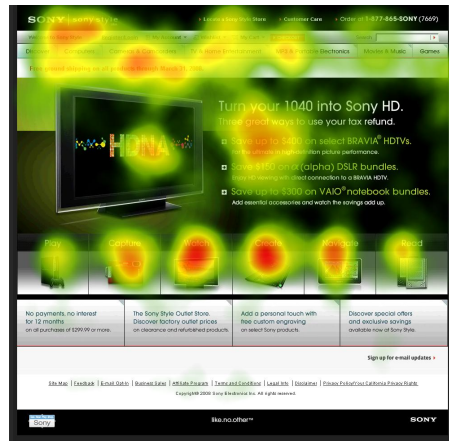
Table 9: Summary of the Results

Hypotheses		
H1a.	<i>Generation Y will have fewer fixations than Baby Boomers when viewing a page.</i>	Supported
H1b.	<i>Compared to Baby Boomers, Generation Y's fixation will cover a smaller area of the page.</i>	Partially Supported (for the least appealing pages only)
H2a.	<i>Generation Y, compared to Baby Boomers, will show significantly less preference for large amount of text.</i>	Not Supported
H2b.	<i>Generation Y, compared to Baby Boomers, will show significantly less preference for large amount of web components.</i>	Supported
H2c.	<i>Generation Y, compared to Baby Boomers, will exhibit more preference for images on a page.</i>	Not Supported
H3.	<i>Generation Y and Baby Boomers will differ in their aesthetic reactions to web pages.</i>	Not Supported
Exploratory Research Question		
	<i>Is there a relationship between a user's visual appeal rating of a page and his or her fixations?</i>	Yes
	<i>Does generation influence the relationship between a user's visual appeal rating of a page and his or her fixations?</i>	Yes

FIGURES



Rated as best page by 42% of Baby Boomers

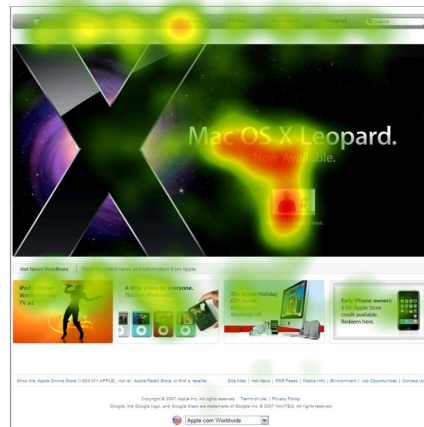


Rated as best page by 50% of Generation Y

Figure 3: Heat maps for the most appealing web page. The grey spots on the heat map indicate user fixations. The highest number of fixations is indicated in dark grey, with light and medium grey indicating lesser numbers of fixations. Areas with no grey spots indicate they were not fixated upon.



Rated as best page by 42% of Baby Boomers



Rated as best page by 28% of Generation Y

Figure 4: Heat maps for the second most appealing web page. The grey spots on the heat map indicate user fixations. The highest number of fixations is indicated in dark grey, with light and medium grey indicating lesser numbers of fixations. Areas with no grey spots indicate they were not fixated upon.

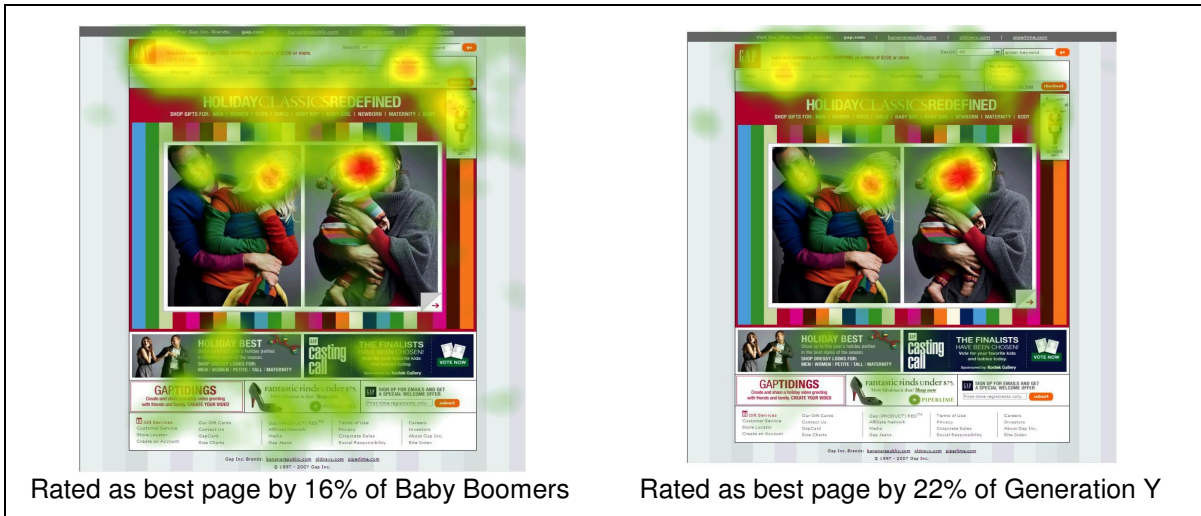


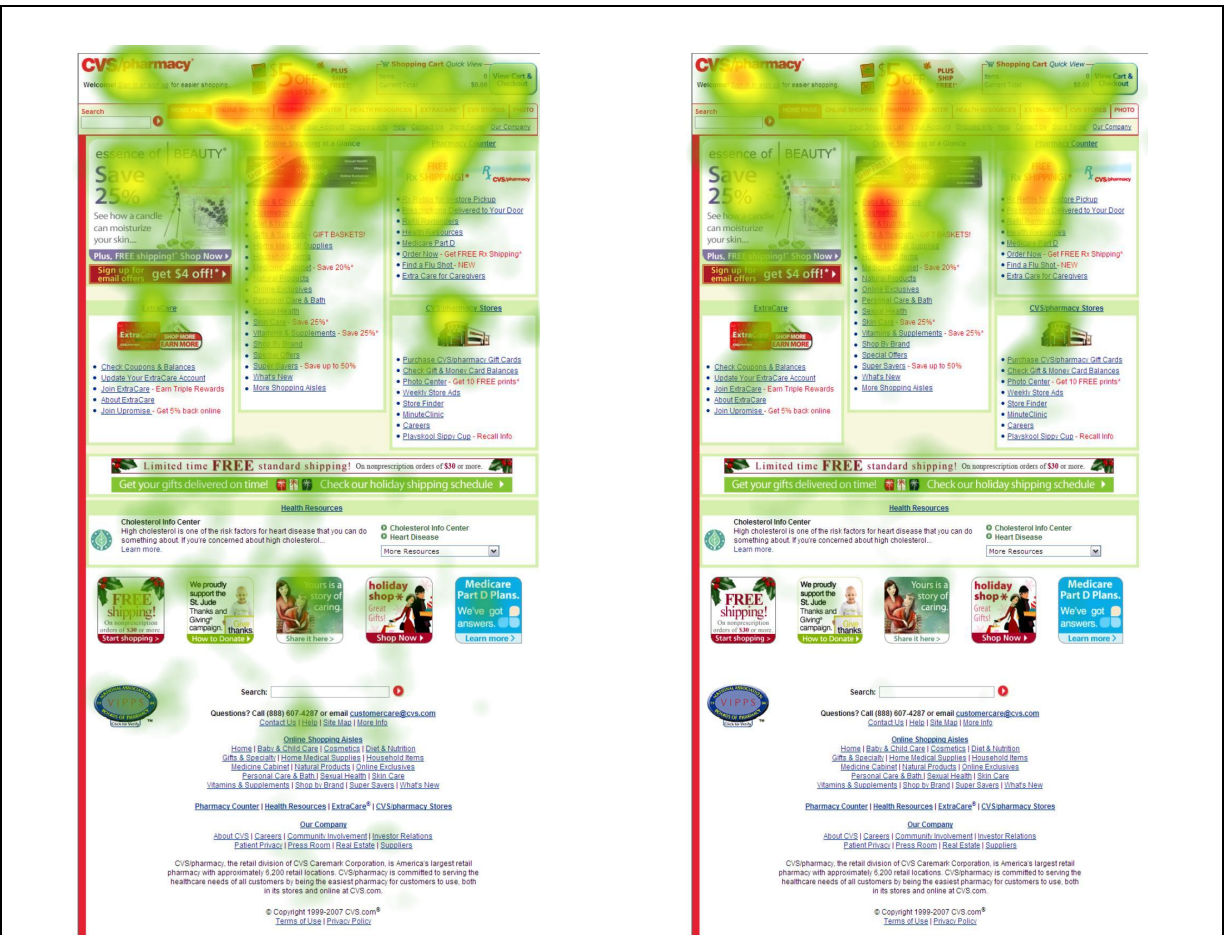
Figure 5: Heat maps for the third most appealing web page. The grey spots on the heat map indicate user fixations. The highest number of fixations is indicated in dark grey, with light and medium grey indicating lesser numbers of fixations. Areas with no grey spots indicate they were not fixated upon.



Rated as worst page by 60% of Baby Boomers

Rated as worst page by 52.4% of Generation Y

Figure 6: Heat maps for the least appealing web page. The grey spots on the heat map indicate user fixations. The highest number of fixations is indicated in dark grey, with light and medium grey indicating lesser numbers of fixations. Areas with no grey spots indicate they were not fixated upon.



Rated as worst page by 20% of Baby Boomers

Rated as worst page by 33.4% of Generation Y

Figure 7: Heat maps for the second least appealing web page. The grey spots on the heat map indicate user fixations. The highest number of fixations is indicated in dark grey, with light and medium grey indicating lesser numbers of fixations. Areas with no grey spots indicate they were not fixated upon.

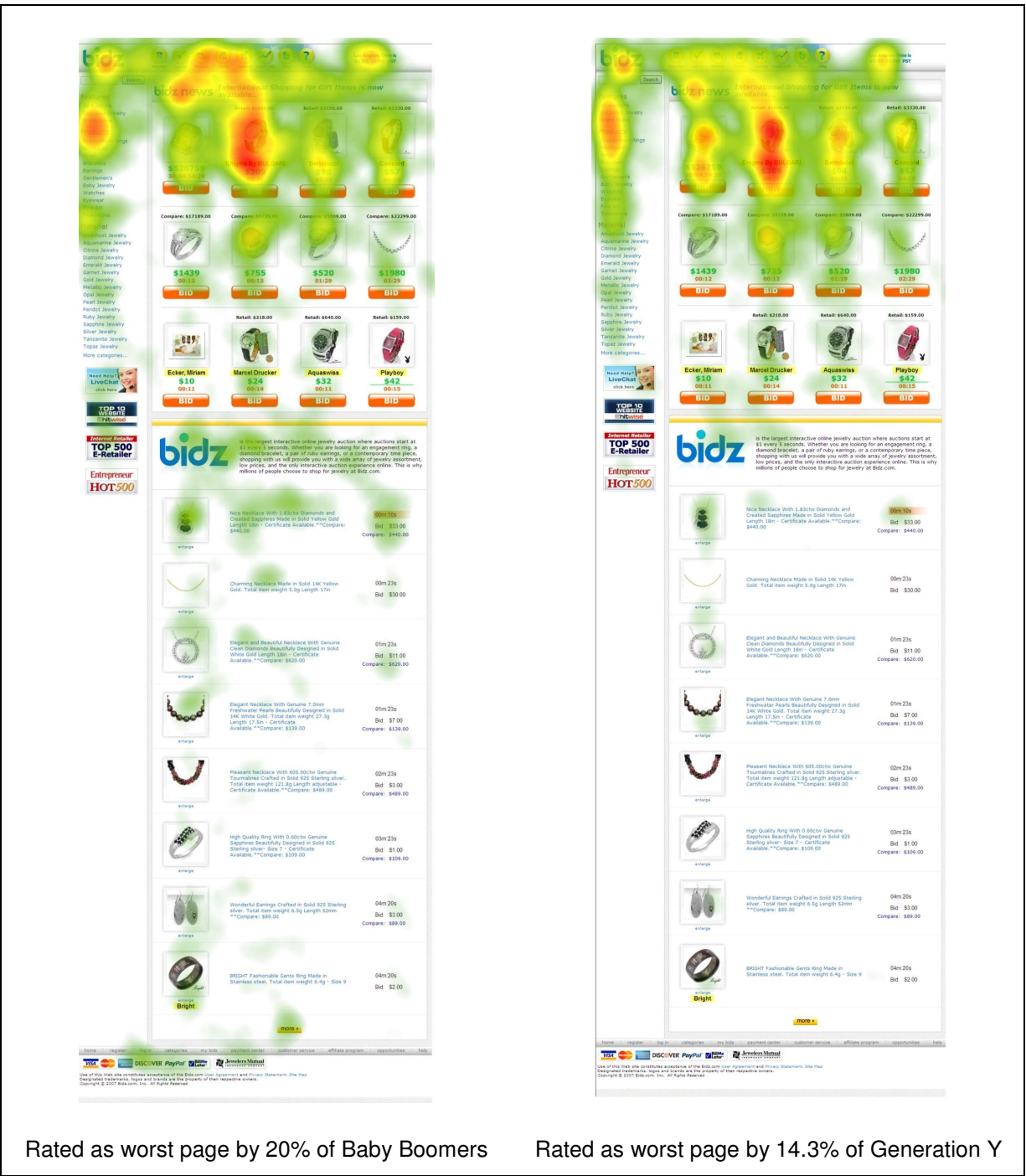


Figure 8: Heat maps for the third least appealing web page. The grey spots on the heat map indicate user fixations. The highest number of fixations is indicated in dark grey, with light and medium grey indicating lesser numbers of fixations. Areas with no grey spots indicate they were not fixated upon.

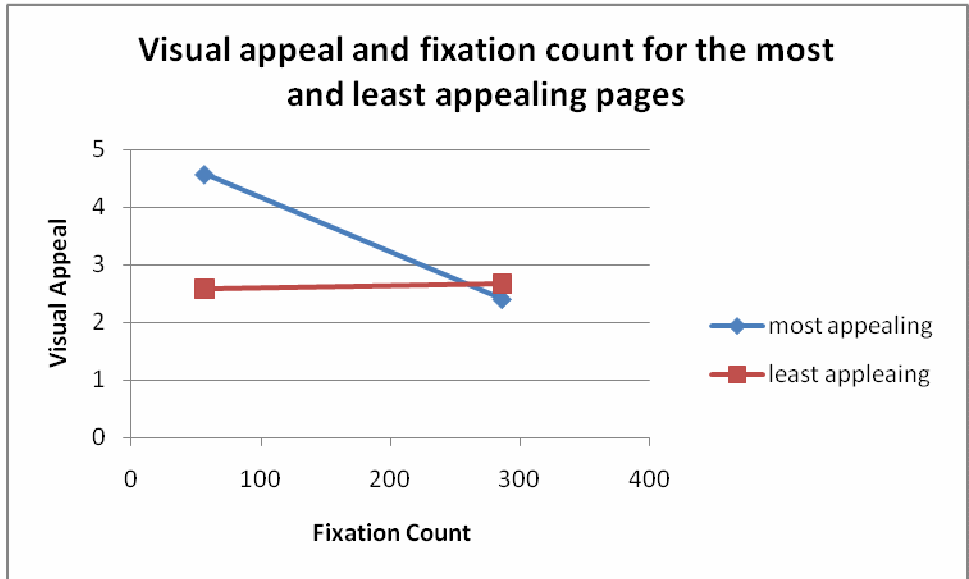


Figure 9: The interaction between page type (most and least appealing) and fixation count (see Table 7 for regression statistics)

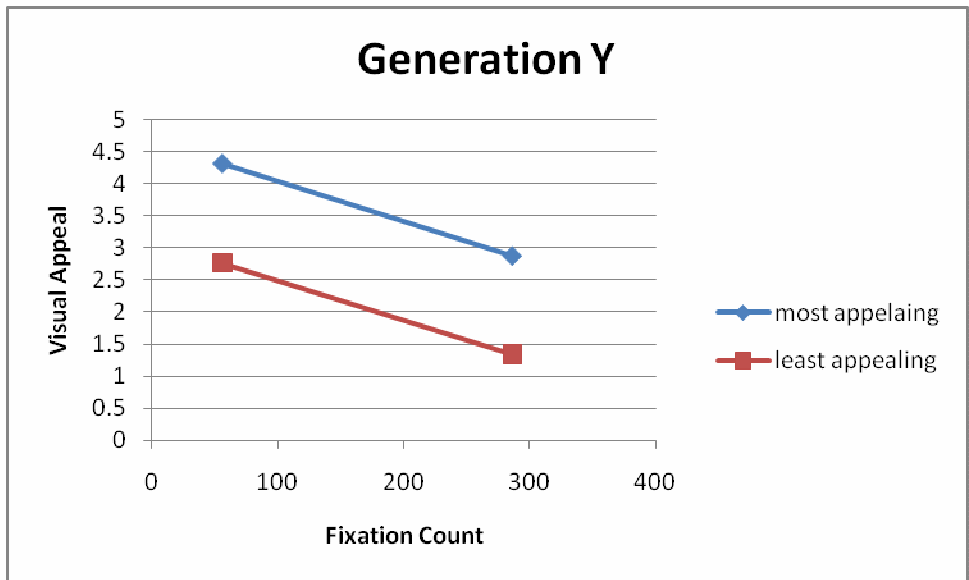


Figure 10: The impact of fixation count on visual appeal for most and least appealing pages for Generation Y (see Table 8 for regression statistics)

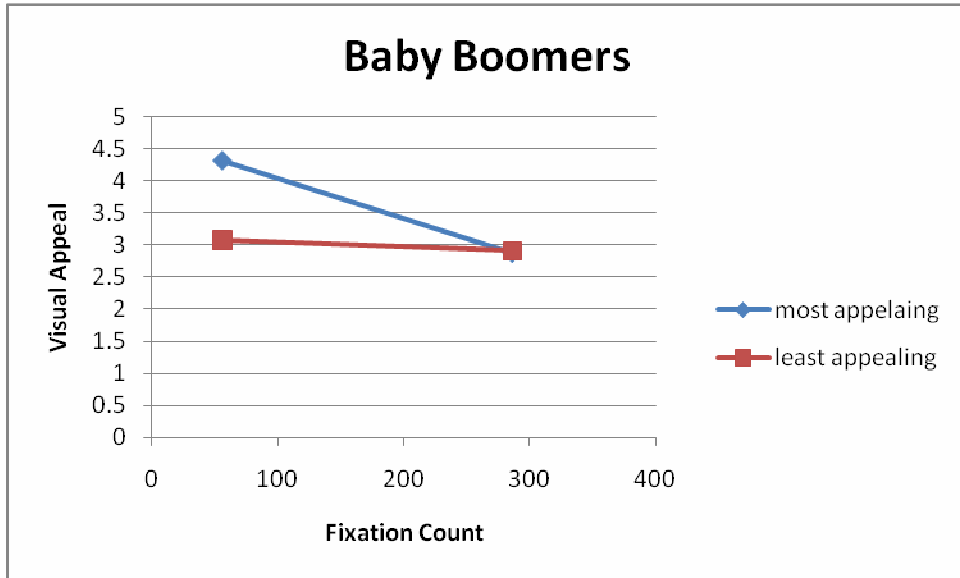


Figure 11: The impact of fixation count on visual appeal for most and least appealing pages for Baby Boomers (see Table 8 for regression statistics)