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Original Research

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Abstract

User experience is becoming increasingly important in gaining a competitive advantage in the marketplace. One way to improve user experience is by including images of faces. People are drawn to faces because paying attention to faces has played a significant role in human evolution. Hence, areas on a web page that typically receive less attention from users, such as the right side or below the fold, may benefit from the inclusion of images of faces. Although faces may be useful in attracting attention to particular places on a web page, they may also distract attention from key information. To test this possibility, we conducted two eye tracking studies in which images of faces were placed on areas of a web page that are shown to receive less attention. The results indicated that faces did not increase the number of people who viewed the areas where the faces were located, but that faces affected fixation patterns on these areas. Our results also showed that faces located above the fold of the web page negatively affected the performance of those who were completing tasks.

Keywords: Human Computer Interaction (HCI), usability, user experience, eye tracking, web design, attention, competition for attention, visual hierarchy, images of faces, fixations, news pages, opinion pieces

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INTRODUCTION

While web pages are utilized for a variety of purposes, their basic function is to communicate information to users. Companies expend a great deal of time and effort organizing and designing web pages to attract users to relevant and important information. A brief perusal of e-business websites makes it clear that images and graphics are a commonly used technique for drawing attention to areas of importance. Images of faces are especially valuable in drawing attention (Tullis et al., 2009). Additionally, faces are valuable in conveying rich information via non-verbal messages (Adolphs, 2002; Baron-Cohen, 1995; Haxby et al., 2000). While the value of faces in conveying information is evident in common daily interactions between people, the role of faces in non-verbal communication is particularly evidenced by people with Asperger syndrome, who have difficulty reading facial cues and consequently have a reduced comprehension of social interactions. This suggests that attention to and comprehension of faces and their expressions have been central to the evolution of human beings (Adolphs, 2002; Baron-Cohen, 1995; Haxby et al., 2000). In fact, some research has shown that part of the brain, the “Fusiform Face Area,” is primarily used for facial recognition (Davidson and Begley, 2012).

Given people’s tendency to be drawn to faces, it is not surprising that ad-supported sites are most likely to have ads that include pictures of people (Tullis et al., 2009). Attracting people’s attention to information through faces is not limited to ads on web pages. Faces also accompany articles such as those providing expert opinions and those attempting to convey a lifestyle (Tullis et al., 2009) (Figure 1).

A common problem on commercial web pages is a lack of real estate. This problem becomes even more prominent as eye tracking studies show that not all areas on a web page are viewed by users (Djamasbi et al., 2011). For example, studies show that the area below the fold of the web page (that is, the area that can only be seen by scrolling down the web page) and the area on the right side of the page are typically less explored by users (Buscher et al., 2009). These areas could potentially benefit from attention catching techniques, such as images of faces, to draw users to these areas of web pages. However, drawing user attention to these areas with images of faces may have a possible drawback. Because images of faces can draw attention (Tullis et al., 2009), they have the potential to upstage the textual information that accompanies them. This can become a problem if the textual information is intended to be the primary communication. In such cases, faces may have the unintended side effect of diverting users’ attention from the main message.

The main objective of this study was to investigate the impact of images of faces on viewing behavior or fixations on web pages. We conducted our investigation in the context of browsing and searching because these are two major activities performed by viewers. The task setting, in this case a search task, was particularly important in our study because it allowed us to investigate whether faces can divert attention to a point where performance is affected.

Figure 1: Examples of Lifestyle Photos, Banner Ads, and Opinion Articles that Include Images of Faces (Tullis et al., 2009)

To examine the impact of faces on viewing behavior (fixations), we conducted two exploratory studies. In the first study, we examined whether the presence of faces inside an opinion piece on a web page drew more attention to the right side of the page or below the fold during browsing. We also examined whether the presence of faces affected the attention that was given to key information placed next to them. In the second study, we examined the impact of faces compared to non-face images in the same opinion piece during a search task. In both studies described in this paper, eye tracking was used to record participants' gaze. When participants completed tasks (Study II), performance measures were also used. Our analysis did not show a significant improvement in the number of people who noticed the areas where faces were placed. However, our analysis did suggest that faces had an impact on the fixation pattern of participants in both studies. Additionally, our analysis showed that performance was affected by the presence and location of faces.

THEORETICAL BACKGROUND

This section provides a brief review of the relevant literature that serves as the background and rationale for our exploratory examinations. As stated previously, the objective of this study was to examine the impact of faces on viewing behavior. Thus, in this section, we discuss the literature that explains why images are important in attracting attention and why faces might be particularly effective in doing so. We then review the competition for attention theory, based on which we argue that faces may divert attention from key information placed next to them. Finally, we discuss the literature on F-shaped pattern of viewing, which we used to identify two areas on the page that are relatively less viewed. These two areas were then used in our study to examine the effect of faces on viewing patterns.

Theory of Visual Hierarchy

The visual hierarchy of a page refers to the order in which information is communicated to users based on perceived importance or ability to attract attention (Faraday, 2000). Web pages typically communicate information to users through perceptual elements. Visual hierarchy plays an important role in guiding users to navigate a page (Faraday, 2000). The visual hierarchy of a page can be manipulated by changing the attributes of its perceptual elements and/or their arrangements (Faraday, 2000). For example, the visual hierarchy of a page can be manipulated by changing the size of one of its objects. Because size cues visual importance, a large item on a page is viewed before smaller items (Faraday, 2000). The location of visual elements on a web page can also influence the visual hierarchy. Items placed at the top of a web page tend to be perceived as more important and thus are viewed before other elements (Faraday, 2000). Similarly, images and graphics affect visual hierarchy because viewers show a tendency to process images before other items (Brandt, 1954).

Grounded in the theory of visual hierarchy, a recent study shows that images are not only important in creating successful visual hierarchies, they also play a significant role in designing appealing web pages (Djamasbi et al., 2011). In addition, image-based information is popular among the younger generation (Weiler, 2005; Djamasbi et al., 2010). Preference for having images on a web page, however, is not limited to younger users. A recent study shows that both older and younger users prefer web pages that include images (Djamasbi et al., 2011).

Human Faces

The literature discussed in the last section suggests that images are likely to be effective in drawing attention. In this section, we explain why one type of image, namely faces, may be particularly effective in capturing users' attention.

Being drawn to faces has played a significant role in human evolution. Even at a very young age, humans exhibit a viewing preference for faces over other types of objects (Haxby et al., 2002). This tendency in infants to favor face-like patterns suggests that we are born with an innate neurological structure that provides us with information concerning the visual characteristics of faces (Morton and Johnson, 1991). As early as two months after birth, we acquire mental systems that help us distinguish between faces (Morton and Johnson, 1991). For reasons of safety and survival, it is important for infants to discriminate among individuals. For example, it is important for an infant to be able to distinguish "mother" from other individuals (Morton and Johnson, 1991). In fact, some studies have shown that there is a part of the brain dedicated to facial recognition called the "Fusiform Face Area" (Davidson and Begley, 2012).

Faces also provide a valuable source of information for social communication, such as shared attention (Adolphs, 2002; Baron-Cohen, 1995; Haxby et al., 2000). For example, humans tend to follow the direction of other people's gaze. This facial perception helps us direct our attention towards an event or an object to which others are attending (Hood et al., 1998; Vecera and Johnson, 1995). Because the tendency to follow someone's gaze can help detect threat from potential predators, it may have evolved to increase the likelihood of survival (Haxby et al., 2002).
Faces are also important for social interactions; faces provide a valuable source of information for conveying

nonverbal communication, particularly in social exchanges such as face-to-face communication (Adolphs, 2002; Baron-Cohen, 1995; Haxby et al., 2000). Faces allow humans to make inferences regarding others' intentions and mood (Haxby et al., 2002). Infants' tendency to imitate facial expressions is yet another argument for the importance of face perception in developing social interaction skills (Morton and Johnson, 1991).

Competition for Attention Theory

Visual attention is a cognitive process typically measured through fixations, which are often defined as steady gazes of at least 300 ms (Djamasbi et al., 2011; Pieters and Wedel, 2012). The area covered by the fixation or focal vision is about 2º around the fixation point and is a region of sharp focus. This small area is approximately the size of a person's thumbnail at an arm's length distance from his or her body. The reason for the sharpness of the focal vision is that light in that area is detected by the fovea, an area of the retina that houses a densely packed array of photosensitive cells facilitating clear and colorful vision (Gould et al., 2007).

Visual attention plays an important role in forming our viewing behavior, which is defined as a series of fixations (Faraday, 2000). According to the theory of visual hierarchy, viewing a stimulus is a sequential cognitive activity, during which a person can attend to only one item at a time (Faraday, 2000). Because people can process only one visual stimulus at a time, visual items, particularly those that are next to each other, compete for a viewer's attention (Desimone and Duncan, 1995). This is particularly true for items adjacent to the focal area (Anstis, 1974).

Competition for attention is not limited to items adjacent to the focal area. Large items that are not close to the focal area are also potential candidates competing for viewers' attention (Janiszewski, 1998). This competition for attention, according to Janiszewski, can be numerically evaluated given the size and the distance of the competing object. Janiszewski proposes that a non-focal item's demand for attention can be estimated by the ratio of the area it occupies (i.e., the square root of its size) and its distance from the focal vision. Using this formula, Janiszewski (1998) demonstrated a relationship between the strength of demand for attention of the objects surrounding the focal point and a person's fixation duration on the target object. Janiszewski also found that people looked at the target object longer when the target object was surrounded by items with weaker "demand for attention" values as computed by the formula. Based on Janiszewski's competition for attention theory, further studies have shown that presentation format can play a significant role in a user's performance when searching for information on a web page (Hong et al., 2004).

F-Shaped Viewing Pattern

Eye-tracking studies indicate that people exhibit an F-shaped pattern when viewing web pages. In other words, they usually favor the left portion of the page, particularly the top left, leaving areas on the right side of the page and those below the fold less attended (Buscher et al., 2009). In fact, it has been found that users tend to miss key information that is not placed on the left portion of a page (Nielsen, 2006; Shrestha and Lenz, 2007; Shrestha and Owens, 2008). In one study, researchers observed that there was no fixation on the right third of a page within the first second of viewing (Buscher et al., 2009). Similarly, although users are now more willing to scroll than they were in the past (Nielsen, 1997), they often pay less attention to information that requires scrolling, or is "below the fold" of a page (Djamasbi et al., 2011; Shrestha and Owens, 2008). There is also supporting evidence that fixations decrease as users scroll down a page (Granka et al., 2004; Nielsen, 2006; Shrestha and Lenz, 2007; Shrestha and Owens, 2008). Because screen real estate on a page is limited, attracting users' attention to important information on the right side of the page above the fold or information placed below the fold is particularly important. Users' fixation on these areas is limited, so the ability to highlight the information located in these sections is of value to designers.

METHODOLOGY

To examine how faces influence viewing behavior, we conducted two exploratory studies. In the first study we focused on the role of faces in browsing behavior. Based on the literature suggesting that images cue importance and the literature suggesting that people have a tendency to attend to faces, we expected images of faces to be helpful in increasing attention to the targeted areas. Based on literature that suggests faces might compete for attention, we expected faces to divert attention from information that was placed next to them.

In the second study, we examined the role of faces on search behavior. The tendency for faces to draw attention suggests that they may be also distracting. Faces may have a negative effect on the communication of key information, either summarized in titles or explained in the text that is placed next to them. Because people tend to fixate on images of faces (Tullis et al., 2009), some of their attention is likely to be directed towards the faces and therefore be diverted from the information that is placed next to them. This is likely to impact how effectively information is communicated and thus affect the performance of the task that relies on that information.

In both studies, we examined the impact of images of faces within the context of an "expert opinions" section of a web page titled "Expert Insights" in our study. This type of section of a web page is ideal because it contains information that is important for companies to communicate and may logically include images of people (e.g., the expert authors of the articles) in the section. The Expert Insights section was located either below the fold of the page or on the right side of the page above the fold. Because people tend to exhibit F-Shaped viewing patterns (Nielsen, 2006; Shrestha and Lenz, 2007; Shrestha and Owens, 2008), these areas are often less visited by the users (Buscher et al., 2009). Placing the critical section in these areas allowed us to determine if the images of faces made a noteworthy impact on drawing attention as opposed to the center of the page, which presumably would receive a high amount of attention regardless of the images of faces (Buscher et al., 2009). This also afforded us the opportunity to compare the impact of the images of faces between these two areas.

In the following sections, we explain how each of the two studies were designed and conducted. We also report the results of each study and discuss their implications.

STUDY I: BROWSING

In this study, we examined the impact of faces on browsing two areas of the page which are relatively less viewed, namely right side of the page above the fold and the central area of the page below the fold (Buscher et al., 2009). We also examined whether the presence of faces affected the amount of fixation on the information that was located next to them. In particular, we examined whether the amount of attention that titles and text received was affected by the presence of faces. As explained previously, an "expert opinions" section was utilized for our investigation because these sections often provide critical information and include faces.

Design and Manipulation

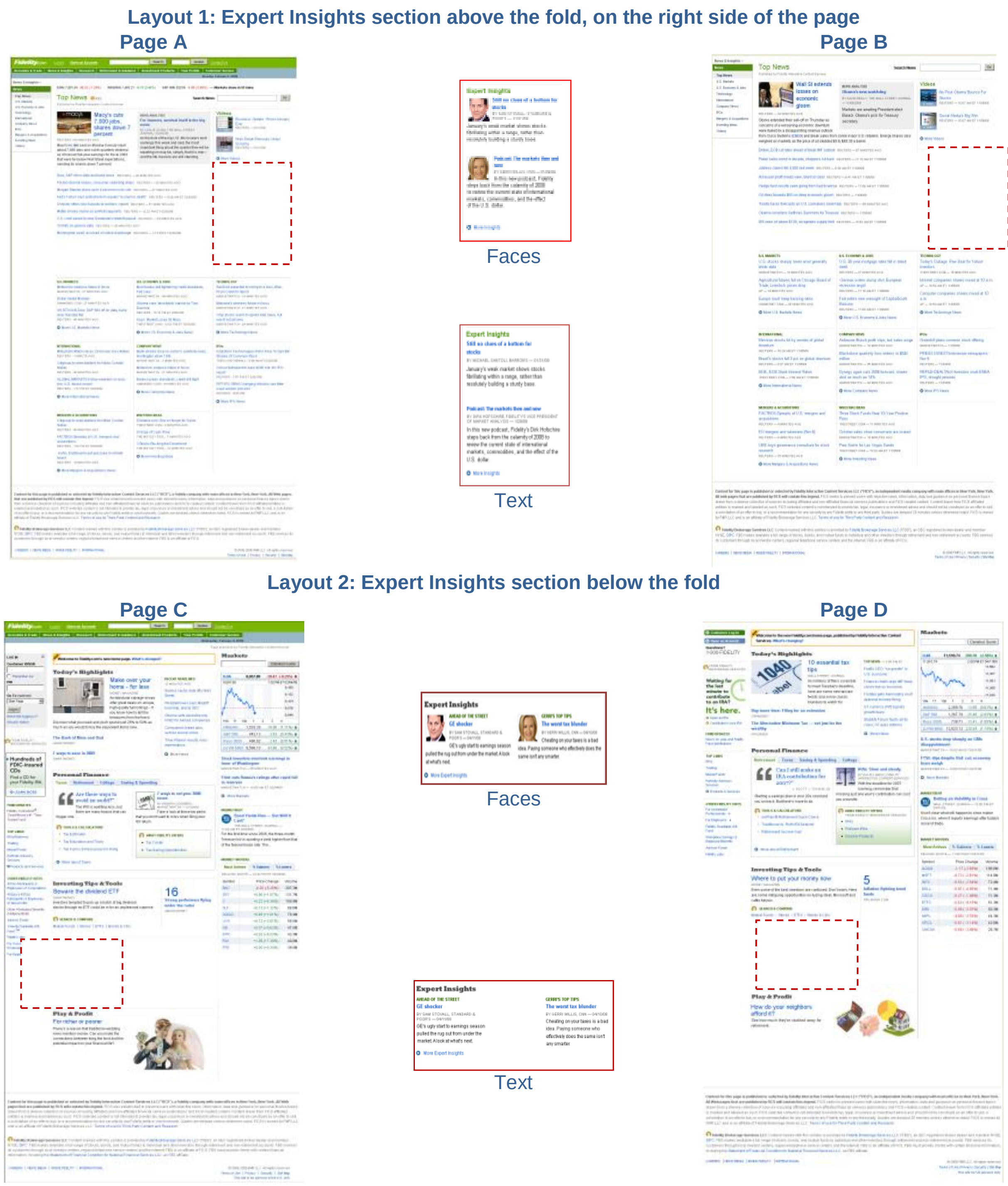
This investigation was conducted as a within-subjects controlled experiment with two independent factors: Image and Location. The Image factor had two levels representing presence vs. absence of faces in the Expert Insights section. Similarly, the Location factor had two levels signifying whether the Expert Insights section was placed on the right side of the page above the fold, or in the middle area of the page below the fold. These places were selected because studies show that these locations on a page tend to attract fewer fixations (Buscher et al., 2009; Djamasbi et al., 2011). Thus, each participant experienced four different treatments. To minimize the potential for a learning effect over the course of the study, the four treatments were presented to each user in a random order. Additionally, to reduce the possibility of a learning effect, the experiment was designed so that each of the four treatments viewed by a user had different content. In the next paragraph we explain how we created different prototypes for each of the four treatments in our study. Note that because the pages used in this study were prototypes we developed for the study, none of the participants had seen the pages used in the treatments prior to the experiment.

For each treatment, we developed a prototype that represented a news page on the website of a financial company. Because each user viewed four web pages, the prototypes were developed in a way so that users could view all four web pages without seeing identical content, thereby reducing the potential for a learning effect. To achieve this goal, first, two different page layouts were developed to accommodate the investigation of the desired location of the Expert Insights section on the page: Layout 1 for placing the Expert Insights section above the fold on the right side of the page and Layout 2 for placing the Expert Insights section below the fold (Figure 2). In both layouts, the Expert Insights section occupied the same amount of space. Next, two pages were created for each layout. As illustrated in Figure 2, pages A and B were designed with Layout 1, and pages C and D with Layout 2. The content of the pages, however, varied between all four pages. The Expert Insights sections were then randomly assigned to the pages.

Participants

A total of 15 professionals participated in this study. These professionals came from a variety of backgrounds and specialties. Reported occupations varied, but included finance, design, and real estate. Of those who participated, 33% were male and 67% were female, ranging in age from their 20's to their 60's. Participants for this study were recruited through corporate emails and were given two movie tickets as incentive to attend the study.

Capturing eye movements requires participants to complete a calibration process. While this process is successfully completed for the majority of the participants, typically a few participants are unable to complete this process. Two potential participants were not included in the study because they could not successfully complete the calibration process. Compared to other studies that we conducted in the same eye tracking lab, this was not an unusual rate of calibration.



Note: The dotted areas show manipulated sections

Figure 2: Prototypes Used in the Study

Procedure

The experiment was conducted in a single day in a usability laboratory. The laboratory was designed to mimic a typical home or office work environment. The monitor on the desk, however, included an eye-tracker. Data were collected for each participant individually, with only one participant in the lab at a time. Sessions lasted approximately 30 minutes.

As participants arrived for their scheduled session, they were greeted by one of the authors, who acted as the experimenter for this study and gave the instructions to all of the participants. The experimenter explained to the participants that the monitor that they were using included an eye tracker and that their eye movements would be recorded as they browsed the web pages. Next, the experimenter calibrated the eye tracker for the participant. This was a brief procedure during which the participant's gaze was mapped to several points on the screen. After calibration, participants were given instructions to view the pages as they normally would when browsing. The eye tracking software then launched the first of four prototypes; four prototypes were displayed in random order in an Internet Explorer browser. Each participant saw a prototype with faces above the fold, faces below the fold, no faces above the fold, and no faces below the fold. The participant was left alone in the lab to complete the study; however, the experimenter viewed the session from an observation room. Upon completion of the study, participants were asked to provide demographic information and then debriefed.

Measurements

To determine how the different treatments affected users' viewing behavior, a Tobii 1750 eye-tracker with a sampling rate of 50 Hz was used. This eye tracker utilizes infrared sensors built into the monitor to capture the infrared light that is reflected off the users' eyes. Using this information, the eye tracker can interpolate the position of the pupil. The Tobii 1750 eye tracker has been used in a number of prior studies to examine users' reactions to websites (e.g., Djamasbi et al., 2011; Djamasbi et al., 2010; Shrestha et al., 2007; Tullis et al., 2009; Lunn and Simon, 2011).

The use of an eye tracker allowed us to determine where on each page participants fixated. A fixations is a steady gaze of at least 80-100 ms, during which visual information can be perceived (Buscher et al., 2009). Because fixations of 300 ms have been shown to reliably indicate interest (Rayner et al., 2003), they are often used to indicate which parts of a page received users' attention (Djamasbi et al., 2010). Thus, fixation in this study is defined as a gaze of a minimum of 300 ms in length.

As explained previously, we used the Expert Insights section of the web page to examine the impact of faces and their location on viewing behavior. To investigate users' attention, we looked at several measures: 1) the percentage of people who fixated at least once on the Expert Insights section, 2) the average fixation length in the Expert Insights section, 3) the fixation count, or the number of times that users fixated on the Expert Insights section, and 4) the fixation length on the elements of the Expert Insights section, namely titles and the text.

In addition to statistical tests, we created heat maps to examine fixation patterns. Because heat maps visualize users' focal points on the screen, they provide a comprehensive picture of a user's viewing pattern during the experiment. Qualitative analysis of users' fixation patterns on the screen is a valuable complement to statistical analysis and is commonly used in eye tracking studies (Buscher et al., 2009; Djamasbi et al., 2010; Djamasbi et al., 2007; Tullis et al., 2009).

Results

This study focused on browsing behavior. In particular, we wanted to see whether images of faces, combined with their location, improved users' attention to the information that was placed in the Expert Insights section. To do this we examined several different factors. First, we compared the percentage of users who fixated at least once on the Expert Insights section. Because fixation is a reliable measure of attention (Vertegaal and Ding, 2002), this analysis helped us to understand how many people noticed these targeted areas. Our analysis showed that 80% of users viewed the Expert Insights section that included faces when it was placed above the fold, and it was viewed by 60% of users when it was placed below the fold. The Expert Insights section that did not have images and was above the fold was viewed by 67% of the users. When the Expert Insights section that did not have images was placed below the fold it was viewed by 47% of the users. We used a chi-square test to determine possible differences in the proportion of participants who fixated on the Expert Insights section. The results did not show a significant difference in number of people who viewed the four different Expert Insights sections (X^2 (60) = 3.732, p = 0.292). These results show that faces did not have a significant impact on the number of people who noticed the Expert Insights section.

Next, we compared the fixation length and count on the Expert Insights section. To do this, we used the repeated measure MANOVA method of analysis with two within-subjects factors: Location and Image. The within-subjects factor Location signified whether the Expert Insights section was placed above or below the fold, and the Image factor indicated whether images of faces were present or absent in the Expert Insights section. We used four dependent variables to measure viewing behavior. The first variable, Length of Fixations, was used to compare the duration of fixations inside the Expert Insights section, or in other words how long users viewed that area. The second variable, Number of Fixations, measured the number of times that users looked at the Expert Insights section. Again, these two variables helped us to examine the amount of attention given to the areas of interest. Small informational sections, such as the Expert Insights piece used in this study, are often used to communicate essential information to users (Djamasbi et al., 2012; Djamasbi et al., 2007). If the images of faces attracted attention, then the Expert Insights sections that included faces were likely to have higher fixation lengths and counts than the sections that did not. The last two variables, Length of Fixations on Titles and Length of Fixations on Textual Information, were used to see whether the presence of faces influenced the duration of fixation over the primary messages of the section: the titles and the text. Because the size of titles and textual information inside the different Expert Insights sections were the same, this analysis allowed us to examine possible differences in attention given to the titles and the text.

The descriptive statistics displayed in Table 1 show that the means of all of the dependent variables were higher for the Expert Insights sections that were placed above the fold. The table also shows that the means for Length of Fixations, and Number of Fixations were higher for the Expert Insights sections that included faces (compared to their text only counterparts) regardless of their location (above or below the fold). We used MANOVA for repeated measures to test whether the mean values of the dependent variables shown in Table 1 were significantly different in the four treatments.

Table 1: Means and Standard Deviations for Fixations

Treatments	**Dependent Variables**			
	Length of Fixations	Number of Fixations	Length of Fixations on Titles	Length of Fixations on Textual Inf.
Faces above the fold	2.77 s (2.45)	7.57 (4.43)	1.04 s (1.02)	0.98 s (0.46)
Faces below the fold	1.61 s (2.37)	3.17 (4.64)	0.55 s (1.19)	0.64 s (0.54)
Text above the fold	1.96 s (2.12)	5.57 (4.82)	1.36 s (1.48)	0.50 s (0.71)
Text below the fold	1.21 s (2.01)	1.86 (3.50)	0.98 s (1.03)	0.12 s (0.26)

Notes: Values are displayed as mean (SD)

The results of the omnibus MANOVA (Table 2) did not show a significant interaction effect between Image and Location ($F(4, 11) = 0.052$, $p = 0.998$). Nor did the result show a significant Image effect ($F(4, 11) = 1.592$, $p= 0.248$). However, the results showed a significant Location effect ($F(4, 11) = 3.428$, $p = 0.047$). These results show that faces did not have a significant effect on the number and the length of fixations inside the Expert Insights section. In addition, the results show that faces did not have a significant impact on fixations on titles and textual information that was placed next to the faces. What affected the viewing behavior significantly, according to the results, was the location of the Expert Insights section.

The significant effect of Location in the above MANOVA warranted follow up univariate tests for this independent variable (Table 3). Because there were only two-level variables in this study, the reported results below reflect that the sphericity assumption was met (Maxwell and Delaney, 2004). The results in Table 3 show that the effect of Location was significant only for the Number of Fixations; Expert Insights sections above the fold received significantly more fixations.

Table 2: Omnibus MANOVA Results for Fixations

Effects	**(df1, df2)**	**F-value**	**p-value**
Location[a]	(4,11)	3.428	0.047*
Image[a]	(4,11)	1.592	0.248
Location X Image	(4,11)	0.052	0.998

Notes: [a] Within-subjects factor; *$p < 0.05$

Table 3: Results of Univariate Tests for Fixations

Source	**Dependent Variables**			
	Length of Fixations	Number of Fixations	Length of Fixations on Titles	Length of Fixations on Textual Inf.
Location	F=1.866 p=0.194	F=7.288 p=0.017*	F=2.033 p=0.176	F=0.841 p=0.375
Image	F=0.04 p=0.86	F=0.44 p=0.52	F=1.33 p=0.27	F=1.62 p=0.22
Location X Image	F=0.04 p=0.86	F=0.44 p=0.52	F=1.33 p=0.27	F=1.62 p=0.22

Notes: *$p < 0.05$

While the above statistical analyses helped to investigate whether the intensity and/or frequency of fixations were significantly different in the four different Expert Insights sections, they did not provide information about how users viewed these areas. The information regarding fixation patterns, which is an important complement to statistical analysis, is available through heat maps. Thus, we used heat maps to compare users' fixation patterns across the four different treatments. On these heat maps (Figure 3), the length of fixation on a given area is represented as red, yellow, or green. Red indicates the highest fixation time, and green indicates the lowest fixation time. Areas with no color received no fixation. These heat maps were standardized so that the colors represent the same amount of fixation time across the prototypes, allowing us to compare them.

The heat maps showed that faces had an impact on the way attention was distributed inside the Expert Insights section. For example, the heat maps revealed a more dispersed fixation pattern when faces were present, as evidenced by the large yellow and green areas on the images (3a, 3c). Additionally, when faces were present, a larger area of the Expert Insights section was covered with fixations. When faces were not present, the heat maps showed a more concentrated and focused fixation pattern, as indicated by the contained red areas with yellow outlines (3b, 3d). When faces were present, fixation was more distributed among faces, titles, and text. The green color in Figure 3c and the faint red color in Figure 3a indicate that the titles received fixation when faces were present. However, when faces were not present, the titles received a more focused fixation, as indicated by the contained bright red color on titles in Figure 3b and Figure 3d.

These heat maps showed that faces had an impact on fixation patterns or the way the Expert Insights sections were viewed. Consistent with the notion that visual stimuli compete for attention, the fixation pattern revealed by the heat maps suggests that faces may have diverted some attention from the titles inside the Expert Insights section. In Study II, we test this possibility more directly.

Expert Insights Section above the Fold

3a: Faces Treatment

3b: Text Treatment

Expert Insights Section below the Fold

3c: Faces Treatment

3d: Text Treatment

Figure 3: Heat Maps for Browsing the Manipulated Section of the Page

STUDY II: RETRIEVING INFORMATION

In the second study, we extended the investigations of the first study in two ways. First, we included an additional non-face image treatment in our experiment. This refinement allowed us to test the impact of faces on viewing behavior more directly. Second, we asked users to complete tasks that required retrieving information located next to images. If the faces diverted attention from key information, they were also likely to affect performance that relies on that information. Thus, in the second study, in addition to viewing behavior we also examined performance.

Design and Manipulation

This study was conducted as a between-subjects experiment with Image and Location as between-subjects factors. The Image factor had three levels: images of faces, non-face images (logos), or no images. The Location factor, as in

Study I, had two levels representing the location of the Expert Insights section on the right side of the page above the fold or in the middle section of the page below the fold. Thus, our experiment had a 3 X 2 factorial design. Each participant was randomly assigned to one of the six treatments. As in Study I, we developed one prototype for each treatment.

The same experimental material that was used in the first study was used here as well (Figure 2). However, in addition to the Expert Insights sections that were used in Study I, two new Expert Insights section were added to this study. These new Expert Insights sections, one of which was placed above the fold and one below the fold, included non-face images (logos) that were relevant to the article to which they were adjacent. Thus, we created six prototypes using page layouts 1 and 2, which are displayed in Figure 2. The size of images, titles and textual information inside the different Expert Insights sections were the same.

Participants

There were a total of 1,327 participants in this study. They were close to evenly split in gender, with 52% male and 48% female. All participants were employed, working in a range of professions, including finance, design, and the food industry. They ranged in age from their 20's to their 60's. As in study I, participants were recruited through daily corporate emails. From this pool a randomly selected group was invited to complete the study in the eye tracking lab; the rest completed the study online. We were able to successfully capture the eye movements of 56 participants. Because they were unable to complete the calibration process, six potential participants were not included in the eye tracking portion of the study. As an incentive to participate in our study, participants were offered the chance to be entered into a raffle to win one of three $50 gift cards.

Procedure

The participants in this study were invited to complete an online study. The data for the online study were collected over five days. Because recording users' eye movements requires a specialized laboratory setting with specific equipment, a relatively small subset of participants was randomly selected to complete the study in the eye tracking laboratory. This part of the experiment was conducted over three days in the usability laboratory. The eye tracking data were collected individually for each participant during experimental sessions, each of which lasted about 30 minutes. As in Study I, the same person gave the instructions to all of the participants. The same person also calibrated the eye tracker for each individual participant.

After the calibration process, the eye tracking software launched one of the six prototypes in an Internet Explorer browser. The participants were asked to complete several tasks on the web page in the lab while the experimenter monitored the session from an observation room outside the lab. Demographic information was collected from the participants after they completed the tasks. Next, the participants were debriefed and thanked for their participation by the experimenter.

Task

All participants were required to complete six tasks (Appendix A), which were presented to them in random order. Four of these tasks drew the participants' attention to different areas around the page, while two tasks required participants to look for information that was located in the Expert Insights area of the web page. These two tasks were considered "critical tasks." One of these two tasks required participants to find information on "what is next for GE," which required them to use information on the left side of the Expert Insights section. The other critical task required participants to find information describing the worst mistake they could make when doing their taxes. This information was found on the right side of the Expert Insights section.

During the study, two windows were displayed: a thin window at the top of the screen that presented the tasks as well as a dropdown menu from which to select the answer, and a large bottom window that displayed the prototype. Tasks were presented in random order in the top window. Participants completed each task by finding the appropriate link in the prototype window and clicking; subsequently, a window appeared with a unique number that indicated the link on which the participant had clicked. Participants then selected that number from the dropdown menu in the top window. Participants were required to complete each task by selecting an answer (a number) from the dropdown menu before moving onto the next task.

Measurements

To measure task performance, we captured completion time and accuracy. Completion time was determined by calculating the time between the assignment of a critical task (the tasks related to the Expert Insights section) and selection of the answer from the menu for that task. Accuracy was defined as the rate of correct answers for the critical tasks.

As in Study I, viewing behavior was assessed by comparing the percentage of participants who fixated in the Expert Insights section, their mean fixation length and fixation count in the Expert Insights section (Length of Fixations and Number of Fixations), as well as the mean fixation length on key information inside the Expert Insights section (Fixation Length on Titles and Fixation Length on Textual Information). Fixation patterns were compared across different treatments using standardized heat maps.

Results

Because the tasks used in this study were simple information retrieval tasks, data from a large sample size were collected in order to more sensitively detect differences in performance between the treatments. To gather these performance data from a larger sample size, an online study was conducted. In addition to collecting a greater amount of data, the online study also allowed participants to participate in a realistic environment. Participants were able to perform tasks in the location of their choice, using their normal computer setup.

Because the collection of physiological measures, such as eye tracking, required specific equipment and setting, only a subset of 56 participants were included in the eye tracking portion of the study. These 56 participants were randomly selected to complete the same study in the lab. Thus, the analysis of eye tracking data reported in this section is for the 56 participants that completed the experiment in the usability lab.

The performance data for the online study and the eye tracking lab study were tested for systematic differences. The analysis of t-tests did not reveal any significant differences in completion time (Mean (online) = 47.20, Mean (lab) = 43.76, $t(2, 1320) = 1.28$, $p = 0.21$) and accuracy (Mean (online) =0.68, Mean (lab)=0.73, $t(2, 1320) = 1.05$, $p = 0.30$) between these two groups. As a result, the data were pooled and the reported performance analysis in this section includes the data for all the participants in this study. In the following section, we first report the analysis of user performance and then the analysis of the eye-tracking data.

Performance

To compare performance across the six treatments, we used a two-way MANOVA where the between-subjects criteria were defined by two variables: Location and Image. As in Study I, Location had two levels to signify whether the Expert Insights section was placed above or below the fold. Image had three levels, one more level than it had in Study I, to signify whether the Expert Insights section included images of faces, logos, or no images at all (text only condition). We used two dependent variables to measure two aspects of performance: Completion Time and Accuracy. This analysis allowed us to examine the effects of images and/or their location on performance behavior. The descriptive statistics for the dependent variables are displayed in Table 4.

Levene's statistics for Completion Time and Accuracy were not significant at the 0.05 alpha level. Hence, the variances were homogenous across the treatment groups. The Box's M test of equality of variances was significant at 0.002. However, when the ratio of the size between the smallest and the largest group in the study is less than 1.5, the acceptable level of significance for this test can be set to 0.001 (Tabachnick and Fidell, 2007). Because the p-value of the Box's M test was larger than the accepted threshold (0.001), we used Wilks's criteria in the subsequent evaluations (Olson, 1976).

Table 4: Means and Standard Deviations for Performance

Treatments	**Dependent Variables**	
	Completion Time	Accuracy
Faces above the Fold	39.93 s (30.66)	0.87 (0.23)
Logos above the Fold	36.13 s (26.99)	0.94 (0.24)
Text above the Fold	35.63 s (28.72)	0.94 (0.32)
Faces below the Fold	49.31 s (33.12)	0.51 (0.47)
Logos below the Fold	57.43 s (34.52)	0.55 (0.47)
Text below the Fold	51.87 s (35.97)	0.56 (0.47)

Notes: Values are displayed as mean (SD)

The MANOVA (Table 5) showed a significant interaction between Location and Image (Wilk's Lambda = 0.925, $F(4, 2640) = 2.405$, $p = 0.048$). The results were also significant for Location (Wilk's Lambda = 0.816, $F(2, 1320) = 148.968$, $p = 0.000$), but they were not significant for Image (Wilk's Lambda = 0.995, $F(4, 2640) = 1.574$, $p = 0.179$). While these results show that images (or lack of them) did not affect performance, they show that images combined with their location had a significant impact on performance. Univariate tests for significant MANVOA results showed that the effect of Location was significant for both of the dependent variables. Univariate tests for the interaction effect, however, were significant only for the completion time. The results of the univariate tests are displayed in Table 6.

Table 5: Omnibus MANOVA Results for Performance

Effects	(df_1, df_2)	F-value	p-value
Location [b]	(2,1320)	148.968	0.000**
Image [b]	(4,2640)	1.574	0.179
Location X Image	(4,2640)	2.405	0.048*

Notes:[b] Between-subjects factor; *p < 0.05, **p < 0.001

Table 6: Results of Univariate Tests for Performance

Source	Dependent Variables	
	Completion Time	Accuracy
Location	F=61.859 p=0.000**	F=257.832 p=0.000**
Image	F=0.811 p=0.445	F=2.281 p=0.103
Location X Image	F=3.340 p=0.036*	F=0.163 p=0.849

Notes: *p < 0.05; **p < 0.001

These results show that regardless of the image type and/or presence, accuracy was significantly better for treatments in which the Expert Insights section was placed above the fold. As the charts in Figure 4 show, the mean values for accuracy were consistently higher in the treatments that placed the Expert Insights section above the fold. For completion time, the results show a more complex pattern of behavior. For example, as displayed in Figure 4, when placed above the fold, the Expert Insights section without any images had the shortest average completion time. When the Expert Insights section without any images was placed below the fold, the participants performed the task in the second shortest completion time. The Expert Insights section that included faces had the longest mean completion time when placed above the fold, while it had the shortest mean completion time when placed below the fold. Above the fold, the average completion time for the Expert Insights section that included logos was shorter than for the Expert Insights section that included faces; below the fold, the situation was reversed.

To examine the impact of faces and logos on completion time more directly, we conducted a follow up exploratory analysis looking at the differences between the treatments that included images of faces and logos only.

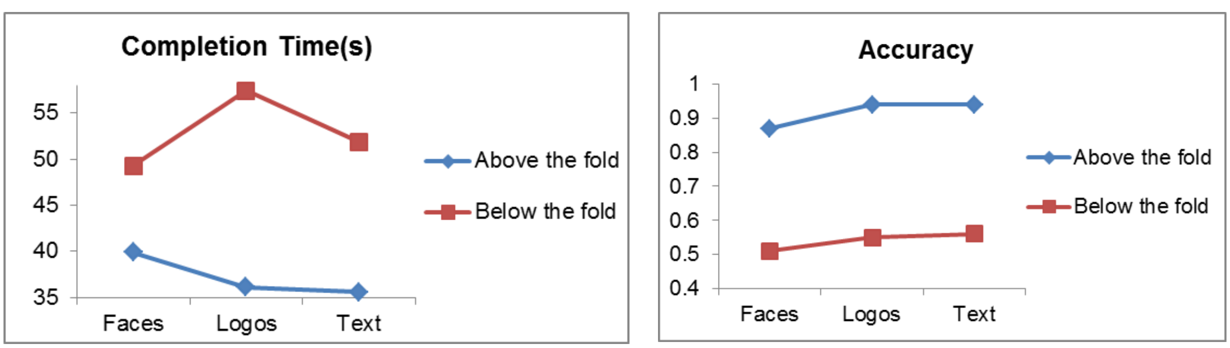


Figure 4: Task Performance

The results of the two-way ANOVA (Table 7) indicated a significant interaction between Location and Image (F(1, 881) = 5.836, p = 0.016). The results were also significant for Location (F(1, 881) = 38.694, p = 0.000), but they did not show a significant effect for Image (F(1, 881) = 0.767, p = 0.381). These results show that faces and logos influenced completion time differently above and below the fold. Above the fold, faces increased the completion while they decreased it below the fold. Logos had the opposite effect on completion time. Above the fold logos decreased the completion time, while they increased it below the fold.

Table 7: Results of Two-Way ANOVA for Performance in Faces and Logos Treatments

Source	Completion Time
Location	F=38.694 p=0.000**
Image	F=0.767 p=0.381
Location X Image	F=5.836 p=0.016*

Notes: *p < 0.05; **p < 0.001

Viewing Behavior

As in Study I, we compared viewing behavior across the treatments by examining the eye tracking data. First, we examined the proportion of participants in each treatment who noticed the Expert Insights section (fixated on the Expert Insights section at least once). Above the fold, the Expert Insights section with faces, logos, and no images was noticed by 100%, 90%, and 90% of users respectively. Below the fold, the Expert Insights section with faces was noticed by 88% of users, the Expert Insights section with logos by 77% of users, and the Expert Insights section with no images by 86% of users. The chi-square test did not show a significant difference in the rate of people who noticed the six different Expert Insights sections (X^2 (56) = 3.732, p = 0.292). This analysis shows that faces did not have a significant impact on the number of people who viewed the Expert Insights sections when completing tasks.

Next, we performed a MANOVA to test for possible differences in viewing behavior between the six treatments. We used the same four dependent variables that were used in Study I: Length of Fixations, Number of Fixations, Fixations on Titles, and Fixations on Textual Information. The descriptive statistics for these dependent variables are displayed in Table 8.

Levene's test was not significant for any of the dependent variables, indicating that the assumption of homogeneity of variances was not violated. Because all the treatments had almost equal cell sizes, we used 0.001 as the significance threshold for the Box's M test (Tabachnick and Fidell, 2007). The Box's M test, which was not significant at the 0.001 level, indicated that the variance/covariance of the dependent variables were equal across different treatments. Hence, we used the Wilk's Lambda criteria to report the results (Olson, 1976).

Table 8: Means and Standard Deviations for Fixations

Treatments	Dependent Variables			
	Length of Fixations	Number of Fixations	Length of Fixations on Titles	Length of Fixations on Textual Inf.
Faces above the fold	15.03 s (4.91)	47.40 (11.80)	3.93 s (2.70)	3.82 s (2.02)
Logos above the fold	12.98 s (4.64)	35.10 (13.22)	6.71 s (2.23)	2.81 s (2.90)
Text above the fold	13.45 s (5.02)	33.25 (13.62)	8.16 s (3.12)	3.09 s (1.41)
Faces below the fold	4.61 s (4.34)	15.38 (11.42)	2.20 s (2.82)	0.78 s (1.58)
Logos below the fold	6.49 s (4.20)	8.92 (11.08)	2.49 s (2.56)	0.89 s (1.34)
Text below the fold	5.64 s (4.22)	24.00 (12.26)	2.40 s (2.32)	2.79 s (2.22)

Notes: Values are displayed as mean (SD)

The MANOVA (Table 9) revealed a significant interaction effect between the independent variables Location and Image (Wilk's Lambda = 0.709, $F(8, 94) = 2.209$, $p = 0.033$). The results also showed a significant main effect for Location (Wilk's Lambda = 0.635, $F(4, 47) = 6.750$, $p = 0.000$). The results, however, did not show a significant main effect for Image (Wilk's Lambda = 0.916, $F(8, 94) = 1.099$, $p = 0.361$). These results show that the location of the Expert Insights section had a significant effect on viewing behavior. The results also show that faces, logos, and no images did not affect viewing behavior by themselves. However, when combined with their location, faces, logos, and no images had a significant impact on viewing behavior.

The significant effects of the omnibus MANOVA (Table 9) allowed us to proceed with univariate analysis for the Location effect as well as its interaction with Image. The univariate test for the interaction effect was significant only for the variable that captured the length of fixations on textual information. For Location, univariate tests were significant for all of the dependent variables. The results of the univariate tests are displayed in Table 10.

Table 9: Omnibus MANOVA Results for Fixations

Effects	(df_1,df_2)	F-value	p-value
Location [b]	(4,47)	6.750	0.000**
Image [b]	(8,94)	1.099	0.361
Location X Image	(8,94)	2.209	0.033*

Notes: [b] = Between-subjects factor; *p < 0.05, **p < 0.001

Table 10: Results of Univariate Tests for Fixations

Treatments	Dependent Variables			
	Length of Fixations	Number of Fixations	Length of Fixations on Titles	Length of Fixations on Textual Inf.
Location	F=21.977 p=0.000**	F=23.480 p=0.000**	F=13.953 p=0.000**	F=14.492 p=0.000**
Image	F=012 p=0.988	F=1.628 p=0.206	F=2.192 p=0.122	F=0.14 p=0.986
Location X Image	F=0.938 p=0.398	F=1.938 p=0.155	F=1.240 p=0.298	F=4.095 p=0.023*

Notes: *p < 0.05; **p < 0.001

The above results show that the location of the Expert Insights section (above or below the fold) had an impact on viewing behavior during task completion. The results also show that the presence of images and/or the type of image combined with their location had an impact on the attention given to the textual information.

Figure 5 displays the mean of fixation values in various treatments. The charts in Figure 5 show that in all treatments the Expert Insights sections above the fold received more attention, except in one case. Regardless of being above or below the Fold, the textual information inside the Expert Insights section that did not have images received almost the same amount of attention. Above the fold, images of faces increased the length of fixations on the textual information. Below the fold, both images (faces and logos) decreased the amount of fixations on the textual information.

The charts also suggest that the type of image (faces vs. logos) may have had an impact on the mean value of fixations. For example, regardless of locations the mean value for the Number of Fixations was much larger in the Expert Insights section when faces (rather than logos) were present. Similarly, above the fold, the average fixation length on titles in the Expert Insights section with logos was much larger than the average fixation length on titles in the Expert Insights section with faces.

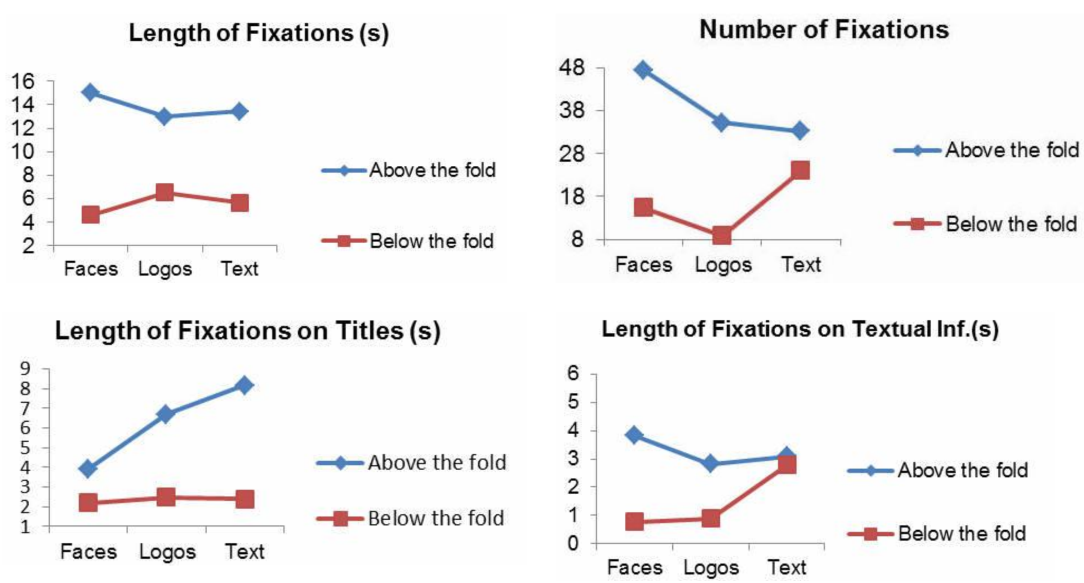


Figure 5: Average Fixation Values Inside the Expert Insights Section

To examine possible differences in regard to fixation count inside the Expert Insights section and fixation length on titles between faces and logos more directly, we performed another exploratory MANOVA that included the Faces and Logos treatments only. In addition to the dependent variables Number of Fixations and Length of Fixations on Titles, we also included a new variable called Length of Fixations on Images. This new variable allowed us to examine whether there were any differences in the amount of attention that the two different images received. The independent variables in the MANOVA, as before, were Image and Location. The descriptive statistics for the dependent variable Length of Fixations on Image are displayed in Table 11.

Table 11: Means and Standard Deviations for Length of Fixations on Images of Logos and Faces

Treatments	Length of Fixations on Images
Faces above the fold	4.28 s (4.68)
Logos above the fold	1.34 s (1.85)
Faces below the fold	0.92 s (1.63)
Logos below the fold	0.55 s (0.62)

Notes: Values are displayed as mean (SD)

The Levene's test for the variable Length of Fixations on Images was significant. Therefore, a logarithmic transformation was applied to this variable before any further analyses were conducted. The subsequent tests showed that the Levene's and Box's M tests were not significant. The MANOVA results (Table 12) showed a significant interaction effect (Wilk's Lambda = 0.754, $F(3, 27) = 2.979$, $p = 0.049$). The results were also significant for Image (Wilk's Lambda = 0.722, $F(3, 27) = 3.473$, $p = 0.030$) and Location effects (Wilk's Lambda = 0.403, $F(3, 27) = 13.320$, $p < 0.001$). These results show that faces and logos combined with their placement had a different effect on the dependent variables.

The follow up univariate analyses, as shown in Table 13, demonstrated that all of the dependent variables were significant for Location. For Image, however, the results were only marginally significant; the p-values for the dependent variables Length of Fixations on Titles and Length of Fixations on Images were 0.068 and 0.093 respectively. For the interaction between Location and Image, the results were significant for the dependent variable Length of Fixations on Titles ($p = 0.030$). The results indicate that faces, compared to logos, decreased the amount of attention that was given to titles. The differences between the effect of faces and logos were more apparent above the fold.

Table 12: Omnibus MANOVA Results for Fixations in Faces and Logos Treatments

Effects	(df_1,df_2)	F-value	p-value
Location [b]	(3,27)	13.320	0.000**
Image [b]	(3,27)	3.473	0.030*
Location X Image	(3,27)	2.944	0.049

Notes: [b] = Between-subjects factor; $*p < 0.05$, $**p < 0.001$

Table 13: Results of Univariate Tests for Fixations in Faces and LogosTreatments

Source	Dependent Variables		
	Number of Fixations	Length of Fixations on Titles	Length of Fixations on Images
Location	F=38.562 p=0.000***	F=8.447 p=0.007**	F=14.492 p=0.000***
Image	F=4.98 p=0.468	F=3.593 p=0.068	F=3.000 p=0.093
Location X Image	F=0.114 p=0.738	F=5.190 p=0.030*	F=0.792 p=0.381

Notes: $*p < 0.05$; $**p < 0.01$; $***p < 0.001$

As in Study I, we examined viewing patterns across the treatments by generating heat maps for recorded eye movements (Figure 6). Again, these heat maps were standardized so that we could compare them. The heat maps showed different viewing patterns between the Expert Insights section with faces and logos. Above the fold, the

Expert Insights section with logos had the most focused fixations, while the Expert Insights section with faces had the most diffuse pattern of fixation. Among the three treatments above the fold, the area covered by fixations was largest in the Expert Insights section with faces and smallest in the Expert Insights section with logos. When the Expert Insights section was placed above the fold, images of faces attracted more fixations than the images of logos, as evidenced by the larger fixation coverage on images of faces compared to fixation coverage on logos. The difference between treatments was less pronounced below the fold. All three treatments below the fold received less attention compared to their counterparts above the fold. Additionally, below the fold, neither images of faces nor images of logos received much attention, as evidenced by the paucity of fixations on images. These heat maps show that faces and logos had a different impact on fixation patterns and that the difference between the effects of faces and logos was more pronounced above the fold.

Expert Insights section above the fold


6a: Faces Treatment

6b: Logos Treatment


6c: Text Treatment

Expert Insights section below the fold


6d: Faces Treatment


6e: Logos Treatment


6f: Text Treatment

Figure 6: Heat Maps for Completing Tasks in the Manipulated Section of the Page

DISCUSSION

This paper examined the impact of images of faces on viewing behavior. We set out to test whether faces can increase attention to areas of the page that are often left out by the F-shaped viewing pattern of users. We also wanted to see if the presence of faces can divert attention from the text-based information that accompanies them. We tested these possibilities in two exploratory studies.

In the first study, we examined viewing behavior as users browsed a web page. Our statistical analyses did not provide evidence for the effectiveness of faces in attracting attention to the target areas on the page as measured by the number of people who noticed the target areas and the number of times the target areas were visited. In addition, the statistical tests did not show any significant differences in the amount of attention (measured as fixation length) given to the Expert Insights section with or without faces. The amount of attention received by the key information inside the targeted areas was also not significantly different when faces were present. The only significant statistical result involved the location of the Expert Insights section. The Expert Insights sections that were placed above the fold received significantly more fixations. This viewing behavior is consistent with the theory of visual hierarchy, which suggests an item placed on the top part of a page receives more attention than when it is placed on the bottom part of the page.

While the statistical tests suggest that faces did not have a significant impact on fixation intensity on key information inside the Expert Insights section, the qualitative analysis of the heat maps suggests that faces may have had an influence on how attention was distributed in these target areas. The fixation pattern on these heat maps suggested that faces encouraged a more dispersed viewing pattern, where attention was somewhat equally distributed on different items in the Expert Insights section. Supporting the literature that suggests visual stimuli compete for attention, this fixation pattern suggests that faces may have redirected some of the attention away from the key information surrounding them.

To better understand what role faces may possibly play in attracting attention to and diverting attention from key information around them, we conducted a second exploratory study that examined the impact of faces on performance. Furthermore, we included an additional condition with an image that was not a face. This allowed us to go beyond examining just the presence of an image of a face (as we did in Study I). Thus, in Study II, we were able to compare the effect of non-face images (in this case, logos) to the effect of images of faces on user reactions. Our analysis showed that task performance was significantly better when the Expert Insights sections were above the fold. This behavior is consistent with the theory of visual hierarchy (Faraday, 2000), which suggests that people tend to more readily process information that is located above the fold.

The results also showed that completion time was significantly affected by the combined effect of the location of the Expert Insights section and the presence/absence of images inside them. Above the fold, the fastest completion time belonged to the group of users that viewed the Expert Insights section without any images. This viewing behavior is consistent with competition for attention theory, which suggests that the absence of images allowed users to focus their attention on the text-based information that was needed to complete the task. Below the fold, the fastest completion time belonged to the Expert Insights sections with images (particularly faces). In other words, the impact of images on performance was different above and below the fold. The difference in the impact of images on viewing behavior above and below the fold is consistent with the theory of visual hierarchy, which suggests that the location of an object can influence the attention it receives. The viewing behavior below the fold, however, is not consistent with the competition for attention theory. One possible explanation is that people pay attention to provided information differently when its placed above the fold compared to when is placed below the fold. Future studies are needed to examine this possibility.

When comparing the treatments that included faces and logos alone, the results showed that faces and logos had a significantly different impact on completion time above and below the fold. Above the fold, faces increased the completion time, while logos decreased it. Below the fold, the impact of logos and faces on completion time was reversed. The negative impact of faces on performance above the fold is consistent with the literature that suggests faces may be particularly effective in drawing attention to them. Faces, however, improved task completion time below the fold. This performance behavior suggests that faces were not distracting when they were placed below the fold. Again, this performance behavior supports the theory of visual hierarchy in that it shows the same image can elicit different reactions in different locations. The differences in effects of faces on performance above and below the fold also suggest that people may use different viewing strategies when looking for information above and below the fold.

The analysis of the eye tracking data provided additional insight that complemented the above findings. Faces did not have a significant influence on the attention received by the Expert Insights section during task completion. They did not significantly increase the number of people who noticed the Expert Insights section, nor did they significantly increase the number of fixations inside these areas. Similarly, faces did not significantly increase the length of fixations inside the targeted areas. However, faces had a significant impact on how attention was distributed inside the Expert Insights section. In particular, the effect of faces and logos on the amount of attention given to titles was significantly different. Faces decreased attention to titles, while logos increased it. Regardless of location, the duration of fixation on images of faces was longer than fixation on logos. These results together are consistent with the literature that suggests faces have an innate ability to draw attention, and show that faces and logos had a significantly different impact on how attention was distributed inside the Expert Insights section. The results also show that the difference between the effects of faces and logos on distribution of attention was much larger above the fold. These results support the theory of visual hierarchy because they show that the location of faces and logos had an impact on attention to titles.

The heat maps supported the above analysis by showing a more diffuse pattern of viewing when faces were present. In particular, the heat maps showed that titles received more focused attention when faces were absent. Below the fold, the difference between the effect of logos and faces was less pronounced. These heat maps suggest that the effect of faces on the fixation pattern was different from that of logos during task completion. The difference between the effect of logos and faces on pattern of fixation is consistent with the literature that suggests attention to faces has played a significant role in human evolution. In addition, consistent with the theory of visual hierarchy, the heat maps show that the effect of faces and logos on the fixation pattern was influenced by their location on the page.

Together, the results of Study I and Study II show that faces did not have a significant impact on increasing attention to the top right and below the fold of a page. However, faces influenced fixation patterns, more so above the fold, making fixations more dispersed and less focused. During task completion, faces had a significant negative impact on attention to titles, which was more noticeable above the fold. Similarly, faces affected performance significantly, but their effect on performance was diametrically opposed above and below the fold. These results suggest that faces, when placed above the fold, may have the unintended effect of diverting attention from key information that is summarized in titles. Below the fold, however, faces may not have the same effect that they may have above the fold. For example, the results of our study showed that faces increased task completion time above the fold but decreased it below the fold.

The results of these studies provide a theoretical rationale for extending research on images of faces in relation to websites. Grounded in social presence theory (Short et al., 1976), many studies promote the inclusion of faces in web pages. These studies argue that images of faces can improve users' perception of a website because they can give websites human warmth (Cyr et al., 2009; Head et al., 2001). Thus, it is argued that including images of faces is likely to improve page views as well as user trust (Cyr et al., 2009). These studies, however, often examine the behavior of those who browse a web page. In contrast, our study looked at task performance. These results show that task performance may be affected by the presence of faces and thus provide insight into an aspect of faces or human presence on websites that is rarely examined in the literature. Our study extends the existing literature by showing that the effect of human images on a web page is not limited to subjective measures such as users' perceptions. As tested in our current study, images of human faces can also affect objective measures such as viewing behavior and task performance.

From a practical point of view, the results suggest that important information is communicated more effectively when placed above the fold. In our studies, users paid significantly more attention to the Expert Insights section when it was located above the fold. Users were not only significantly more successful in finding the right answers when the Expert Insights section was located above the fold, but were also significantly more efficient in doing so, as evidenced by their task completion times. In regard to images of faces, our results suggest that including faces in opinion pieces is beneficial when they are placed below the fold (they decreased task completion time in our study). Caution should be given, however, when faces are placed in opinion pieces that are placed above the fold. In our study, including faces in opinion pieces above the fold decreased attention to the key information that was summarized in titles and increased the task completion time.

LIMITATIONS AND FUTURE RESEARCH

As with any research, the generalizability of the results in our study is limited to the task and the settings used. Additionally, because our research was exploratory, caution must be taken when generalizing its results. The small sample size in the eye tracking portions of the studies is another limitation of this investigation. While small sample sizes are not uncommon in eye tracking research, they can result in low power in statistical tests. Considering a test that fails to reach a significant p-value as "not statistically different" when the power is low may be misleading. Because the power of statistical tests in the eye tracking portions of our study was relatively low, the non-significant tests in our study may yield different results if the sample sizes are increased. Future research with larger sample sizes is needed to increase the power of statistical tests for the eye tracking portions of our experiments and thus overcome this shortcoming in the current study.

Future investigations can also extend the results of our study. For example, future research can determine whether different attributes of the images of faces can affect the results. For example, the size and quality of an image could have an effect on attracting attention. The use of different colors in images may also affect the viewing behavior of users by either drawing or repelling attention. Another interesting possibility is to examine the effect of the type of information that is adjacent to faces. In our study, we examined the effect of faces in an opinion section. Images of faces next to advertisements or in lifestyle sections may yield different results.

An examination of user behavior related to tasks other than those used in this study can also extend our results. Similarly, in regard to the effect of faces, different genres of web pages with differing content should also be studied. In our study, the faces were located on the news page of a financial website. Users' reactions to faces on retail or lifestyle websites may vary. Further, a content page was used in this study. Other types of web pages, such as home pages or portal pages, could also be studied.

Finally, the images could be manipulated to determine the effect of differing content. This could include manipulating characteristics of the faces, such as gender and age, to determine their effectiveness in different contexts and with varied user groups. Outside of faces, categories of images to be examined could include photographs, informational graphs, and tables.

CONCLUSION

The results of this study have important implications. Consistent with the visual hierarchy and competition for attention theories (Desimone and Duncan, 1995; Faraday, 2000; Janiszewski, 1998), our results showed that faces can compete with other visual stimuli for users' attention. In particular, our results showed that faces decreased attention to titles significantly during task completion. Faces also had some negative effects on user performance when placed above the fold. Below the fold, however, faces improved task performance. This suggests that user experience may be negatively influenced by the presence of faces in certain situations. From a theoretical perspective, these results extend past research on the effects of images, particularly faces, on the behavior of users. The results also provide a rational and theoretical direction for future research to examine user experience by focusing on the impact of images of faces on web pages and performance.

The results also have important practical implications. Because the results provide insight into how users view web pages, these results can help companies strategically design their pages to be more effective. This, in turn, can help companies to better communicate with the users who utilize their web pages.

REFERENCES

Adolphs, R. (2002) "Neural Systems for Recognizing Emotion," *Current Opinion in Neurobiology* (12) 2, pp. 169-77.

Anstis, S.M. (1974) "A Chart Demonstrating Variations in Acuity with Retinal Position," *Vision Research* (14) 7, pp. 589–592.

Baron-Cohen, S. (1995) "The Eye Direction Detector (EDD) and the Shared Attention Mechanism (SAM): Two Cases for Evolutionary Psychology," in C. Moore and P. J. Dunham (Eds.) *Joint Attention: Its Origins and Role in Development*, Hillsdale, New Jersey: Lawrence Erlbaum, pp. 41-59.

Brandt, H. (1954) *The Psychology of Seeing*. New York: The Philosophical library.

Buscher, G., E. Cutrell, and M. R. Morris (2009) "What Do You See When You're Surfing? Using Eye Tracking to Predict Salient Regions of Web Pages," in *Proceedings of the 27th international Conference on Human Factors in Computing Systems*, D. R. Olsen Jr., R. B. Arthur, K. Hinckley, M. R. Morris, S. E. Hudson, and S. Greenberg (Eds.), New York: ACM, pp. 21-30. Boston, Massachusetts, April 4-9, 2009.

Cyr, D., M. Head, H. Larios, and B. Pan (2009) "Exploring Human Images in Website Design: A Multi-Method Approach," *MIS Quarterly* (33) 3, pp. 539-566.

Davidson R. J. and S. Begley (2012) *The Emotional Life of Your Brain: How Its Unique Patterns Affect the Way You Think, Feel, and Live--and How You Can Change Them,* New York: Hodson Street Press.

Desimone, R. and J. Duncan (1995) "Neural Mechanisms of Selective Visual Attention," *Annual Review of Neuroscience* (18), pp. 193-222.

Djamasbi, S., M. Siegel, J. Skorinko, and T. Tullis (2011) "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* (15) 4, pp. 121–157.

Djamasbi, S., M. Siegel, and T. Tullis (2012) "Designing Noticeable Bricklets by Tracking Users' Eye Movements," in *Proceedings of the Forty-Fifth Annual Hawaii International Conference on System Sciences, IEEE Explore Digital Library,* pp. 1-10. Maui, Hawaii, January 4-7, 2012.

Djamasbi, S., M. Siegel, and T. Tullis (2010) "Generation Y, Baby Boomers & Web Design: Usability Testing through Eye Tracking," *International Journal of Human Computer Studies* (68) 5, pp. 307-323.

Djamasbi, S., T. Tullis, J. Hsu, E. Mazuera, K. Osberg, and J. Bosch (2007) "Gender Preferences in Web Design: Usability Testing through Eye Tracking," in *Proceedings of the 13th Americas Conference on Information Systems, AIS Electronic* Library, pp. 1-8, Keystone, Colorado, August 9-12, 2007.

Faraday, P. (2000) "Visually Critiquing Web Pages" in *Proceedings of the 6th Conference on Human Factors and the Web*, pp. 1-13. Austin, Texas, June 19, 2000.

Gould, S., J. Arfvidsson, A. Kaehler, B. Sapp, M. Meissner, G. Bradski, P. Baumstarck, S. Chung, and A. Y. Ng. (2007) "Peripheral-foveal vision for real-time object recognition and tracking in video," In *Proceedings of the International Joint Conference on Artificial Intelligence (IJCAI)*, pp. 23-30. Hyderabad, India, January 9-12, 2007. Available at https://www.aaai.org/Papers/IJCAI/2007/IJCAI07-341.pdf.

Granka, L., T. Joachims, and G. Gay (2004) "Eye-Tracking Analysis of User Behavior in WWW Search," in *Proceedings of the 27th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*, M. Sanderson, K. Järvelin, J. Allan, P. Bruza (Eds.), New York: ACM, pp. 478-479. Sheffield, UK, July 25-29, 2004.

Haxby, J. V., E. A. Hoffman, and M. I. Gobbini (2000) "The Distributed Human Neural System for Face Perception," *Trends in Cognitive Sciences* (4) 6, pp. 223-233.

Haxby, J. V., E. A. Hoffmana, and M. I. Gobbinia (2002) "Social Anxiety: From Laboratory Studies to Clinical Practice," *Biological Psychiatry* (51) 1, pp. 59-67.

Head, M. M., Y. Yuan, and N. Archer (2001) "Building Trust in e-Commerce: A Theoretical Framework," in *Proceedings of the Second World Congress on the Management of Electronic Commerce,* pp. 1-10. Hamilton, Ontario, Canada, January 17-19, 2001.

Hong, W., J.Y.L. Thong, and K.Y. Tam (2004) "The Effects of Information Format and Shopping Task on Consumers' Online Shopping Behavior: A Cognitive Fit Perspective," *Journal of Management Information Systems* (21) 3, pp. 151-188.

Hood, B., J. Willen, and J. Driver (1998) "Adult's Eyes Trigger Shifts of Visual Attention in Human Infants," *Psychological Science* (9) 2, pp. 131-134.

Janiszewski, C. (1998) "The Influence of Display Characteristics on Visual Exploratory Search Behavior," *Journal of Consumer Research* (25) 3, pp.290–301.

Maxwell, S. E. and H. D. Delaney (2004) *Designing Experiments and Analyzing Data*, Mahwah New Jersey: Lawrence Erlbaum Associates, Inc.

Morton, J. and M. Johnson (1991) "CONSPEC and CONLEARN: A Two-Process Theory of Infant Face Recognition," *Psychological Review* (98) 2, pp. 164-181.

Nielsen, J. (1997) "Changes in Web Usability Since 1994," *useit.com*, Retrieved September 13, 2012, from http://www.useit.com/alertbox/9712a.html.

Nielsen, J. (2006) "F-Shaped Pattern For Reading Web Content," *useit.com*, Retrieved September 13, 2012, from http://www.useit.com/alertbox/reading_pattern.html.

Pieters, R. and M. Wedel (2012) "Ad Gist: Ad Communication in a Single Eye Fixation," *Marketing Science* (31) 1, pp. 59–73.

Olson, C. L. (1976) "On Choosing a Test Statistic in Multivariate Analyses of Variance," Psychological Bulletin (83) 4, pp. 579-586.

Rayner, K., Liversedge, S. P. , S. J. White, and D. Vergilino-Perez (2003) "Reading Disappearing Text: Cognitive Control of Eye Movements," *Psychological Science* (14) 4, pp. 385-388.

Short, J., E. Williams, and B. Christie (1976) *The Social Psychology of Telecommunications*. New York: John Wiley and Sons Ltd.

Shrestha, S. and K. Lenz (2007) "Eye Gaze Patterns while Searching vs. Browsing a Website," *Usability News*, Retrieved September 13, 2012, from http://www.surl.org/usabilitynews/91/eyegaze.asp.

Shrestha, S., K. Lenz, J. Owens, and B. S. Chaparro (2007). "F-Pattern Scanning of Text and Images on Web Pages," in *Proceedings of the 51st Annual Meeting of the Human Factors and Ergonomics Society* (51)18, pp. 1200-1204. Baltimore, Maryland, October 1-5, 2007.

Shrestha, S. and J. W. Owens (2008) "Eye Movement Patterns on Single and Dual-Column Web Pages," *Usability News*, Retrieved September 13, 2012, from http://www.surl.org/usabilitynews/101/column.asp.

Tabachnick B.G. and L. S. Fidell (2007) *Using Multivariate Statistics*. Pearson/Allyn and Bacon: Boston, Massachusetts.

Tullis, T., M. Siegel, and E. Sun (2009) "Are People Drawn to Faces on Webpages?" in *Proceedings of the 27th International Conference Extended Abstracts on Human Factors in Computing Systems,* D. R. Olsen Jr., R. B. Arthur, K. Hinckley, M. R. Morris, S. E. Hudson, and S. Greenberg (Eds.), New York: ACM, pp. 4207-4212. Boston, Massachusetts, April 4-9, 2009.

Vecera, S. and M. Johnson (1995) "Gaze Detection and the Cortical Processing of Faces: Evidence from Infants and Adults," *Visual Cognition* (2) 1, pp. 59-87.

Vertegaal, R. and Y. Ding (2002) "Explaining Effects of Eye Gaze on Mediated Group Conversations: Amount or Synchronization?" In *Proceedings of Computer Supported Cooperative Work (CSCW)*, E. F. Churchill, J. F. McCarthy, C. Neuwirth, and T. Rodden (Eds.), New York: ACM, pp. 41-48. New Orleans, Louisiana, November 16-20, 2002.

Weiler, A. (2005) "Information-Seeking Behavior in Generation Y Students: Motivation, Critical," *The Journal of Academic Librarianship* (31) 1, pp. 46-53.

APPENDIX

Participants were presented with six tasks in random order. Two of the tasks (the first two items in the following list) required users to use information inside the Expert Insights section.

1. You want to find an opinion on what's next for GE.
2. You want to find an opinion about what the worst mistake on your taxes is.
3. The market has been moving significantly today and you would like to see which stocks are up the most for the day.
4. You want to know more about a fall in Brazil's stocks.
5. You would like to find more International News articles.
6. You want to watch a video about social media.

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