MEETING EYE TO EYE: HOW TRAINED DESIGNERS AND TYPICAL VIEWERS SEE DESIGN PIECES: AND THEIR IMPLICATIONS FOR CONTEMPORARY DESIGN EDUCATION

by

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Abstract

This study investigated and compared gaze patterns of typical viewers and trained designers to learn if there are differences in the gaze patterns between the two groups. Using eye tracking technology, participants were asked to interpret orally and in writing the effectiveness of the compositions of several advertisements and a company letterhead. The research data included the recorded gaze patterns of participants and the oral and written remarks of the viewers. The questions asked the participants to assess their responses to and appreciation of the compositions. This study shows that similar elements

of design are of importance to experts and novices alike, but that experts viewed the art differently than novices.

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BIOGRAPHICAL SKETCH

Tyler Dockery received his Bachelor of Fine Arts degree from the University of North Carolina at Greensboro in 1998. He has worked in the field of design since 1995, and runs his own successful freelance business. He teaches Advertising & Graphic Design, Web Design, and Simulation & Video Game Design courses at Wake Technical Community College. He has been teaching at the collegiate level since 2005, and hopes to continue teaching higher education for the rest of his life.

MEETING EYE TO EYE: HOW TRAINED DESIGNERS AND TYPICAL VIEWERS SEE ADVERTISEMENTS: IMPLICATIONS FOR CONTEMPORARY DESIGN EDUCATION

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CHAPTER 1: INTRODUCTION

In almost all cases, designers are trained, evaluated, and hired by other professional designers. This creates an environment in which the "best practices" of design are continuously defined, refined, adjusted, and rewarded by practitioners of the art with outcomes within the field moving slowly and surely towards the ideals suited to a truly professional small population. Designers wishing to be hired professionally are trained to create these “ivory tower” standards in their works and to push their designs toward that end. Designers constantly push themselves to create conceptual masterpieces, which break barriers or reduce the message to simple words, images and phrases in the hopes of creating some truly fantastic portfolio pieces and unforgettable designs.

On the other hand, average people view thousands of these images and messages every single day. Beyond being inundated, they are literally flooded with brands and suggestions. Are they truly attracted to these pieces of “fine design” which the designers create? Do they care about proper kerning and the gold standard typography over which designers truly slave? What do they see when they look at these works of design? Which items are seen as being crucially important? Is the typical viewer really drawn by bigger, more prominent logos and gaudy color schemes? Are their needs being met and are consumers being properly considered in the creation of most design pieces?

The graphic designer is a creative problem solver, a creative artist that is always trying to ensure that the message of the customer is meeting the intended audience clearly. Understanding how design elements and the principals of art and design work together to create effective communication is a t the core of what every graphic designer needs to know. Design is a visual language of creation, a way of creating order and visual interest while opening a narrative between the creator and the viewer—yet, one of the most important aspects of this is to understand that each piece of design *must* be centered around the interests of the user and not the aesthetic interests of the designer (Claire & Busic-Snyder, 2005, Felton 2006, Landa, 2011, Evans & Thomas, 2004, Stewart, 2011, Ocvirk, Stinson, Wigg, Bone, & Cayton, 2005, Lauer & Pentak, 2011).

The target audience—the group or individual toward whom you are directly marketing your message or communication—must be taken into account at every turn. You cannot effectively market to children in the same way that you market to senior citizens, their needs are simply too different. For children, designs should show children and be “fun”. Those 65 and older generally enjoy ads which are conservative, although many in this age range increasingly feel that they are active and capable of doing anything they want to do. Small text is perfectly fine for children (secret hints or text to find and explore for fun), while on the other hand those who are 65 and older often find that text in 12pt or 14pt size is more appropriate (Clair & Busic-Snyder, 2005).

Knowing your target audience will help you to gather data about how best to communicate to this group. These data are critical information about human activity, that is, individual and group behavior, attitudes, and beliefs (Evans & Thomas, 2004).

Over the last decade, a great deal of eye tracking in the world of design has been centered around look patterns and how they relate to web usability. This has been most profitable for the usability and interests of this discipline (Nielsen & Pernice, 2010, Nielsen & Pernice, 2009). In the words of Nielsen & Pernice (2010), "We have studied many topics with other research methods, and through 16 years of testing sites and conducting field studies, we have discovered 2,503 usability guidelines for Web sites, intranets, social network postings, and email newsletters" (p. xv).

While the web seems to continue to command a larger and larger market share, graphic designers are increasingly in demand. As designers build web advertisements, print advertisements, and standard design pieces, the need for a greater understanding of the connections between the hiring bodies and the clients/viewers who will ultimately purchase and be influenced by these designs will only increase. Now, more than ever, designers need this insight to better prepare themselves for the working world.

Statement of the Problem

The purpose of this study was to investigate if typical viewers look at pieces of design the same way that trained artists/designers do, and to see if typical viewers are

troubled, excited or influenced by the same things trained artists/designers are. If both populations see things the same way, which aspects are the most important? If they see things differently, which can be said to be most important to experts, and which are most important to everyday people?

The results of this study will give some insight into the nature of design expertise and how design education affects what designers see and think is important. This information will allow us to draw conclusions about which elements of design education might be stressed for each sample group. Based on the need to satisfy these groups, this information will allow us to make recommendations about the skills/skillsets which students should learn, and possibly at what stage in their education the skills could be taught to give designers a maximum amount of time to learn the methods of the profession.

Research Questions

Based on art and design curricula published in college design text books (Stewart, 2011, Ocvirk, Stinson, Wigg, Bone, & Cayton, 2005, Lauer & Pentak, 2011, Landa, 2011) trained artists and designers are taught to look for design elements (line, shape/form, color, space, and texture) as part of their visual observation of artistic pieces. This reductive analysis of the image elements may allow artists and designers to come to faster answers to questions relating to art and design. Average people look for these same elements to a degree, but gloss over certain aspects or relations between the elements used in the design process as they search for the semiotic/linguistic message of the

composition while ignoring the implied relations between the visual elements. This may cause the typical viewer to be unsure and cause their answers to come slower in questions relating to art and design. By recording the gaze patterns and oral and written responses of both populations, I hope to establish which elements of design are important to experts (therefore important to getting hired in a studio or freelance capacity), and which elements are important to average viewers (critical skills for client satisfaction and marketing). While there may be some overlap, this information may shed light on which skills should be emphasized early and often in design education, and which skills should be emphasized for portfolio-level work.

CHAPTER 2: REVIEW OF RELATED LITERATURE

Overview

In reviewing the current and related literature for the use of eye trackers and eye tracking studies in art, it becomes apparent that the vocabulary used may require some explanations. To fully show the literature related to this study, materials in this chapter include some of the basic concepts in eye tracking history, vision types and how they relate to vision and attention, as well as a section on how to interpret the visualizations presented in this paper. Terms and usage throughout this section will provide an excellent base of vocabulary and concepts with which to better understand the results and discussion chapters of this paper.

What is Eye tracking?

Eye trackers and eye tracking software have been used routinely in the past to follow gaze patterns between populations of differing skill levels or levels of education. In studies between novice drivers (3 years of experience) and expert drivers (20+ years of experience), the patterns were distinctly pronounced. “As skill increases, so does scanning. The novice’s failure to scan…as fully as experienced and expert drivers places them at a disadvantage” (Underwood, 2007, p. 1248).

Novice and expert studies are a good way to gauge how training within a discipline can affect the way in which viewing patterns, reactions, actions, attitudes, etc. change or develop. Eye tracking adds another layer to theses testing styles by being able to gather data on the unconscious actions of the eye—a tool only recently available. Locher (2006) explains the history and connections with aesthetics thus:

> In the field of experimental aesthetics, the study of eye movements has been used as a tool by researchers for many decades to reveal covert perceptual and cognitive process that underlie the perception and aesthetic evaluation of artworks (see Nodine & Krupinski, 2003, for a review). (p.107)

The use of eye trackers for the study of art (drawing and painting, etc.) is fairly recent. Miall and Tchalenko (2001) carried out the first in-depth investigation of a professional painter, Humphrey Ocean, observing the basic rhythm between fixations on the model and fixations on the drawing, as well as the pattern of hand movements with respect to eye position when drawing specific details and quick (12 min) sketches. Tchalenko et al (2003) looked at six experienced to professional subjects drawing portraits and found that, in the periods where the hand was drawing, fixations were located on the paper generally about 0.5 to 1.0 degrees away from the pencil tip. The eye then kept up with the pencil by short sequences of fixations and saccades. Gowen and Miall (2006) investigated the differences between eye-hand interactions during tracing and drawing, and Land (2005) observed eye-hand coupling where saccades from the model to the paper brought fixations to the end-point of a future line to be drawn before drawing actually started.

The use of eye trackers in the last decade has taken advantage of the integration of greater technology, greater miniaturization, and greater flexibility of modern eyetracking. The 2007 study of Locher, Krupinski, Mello-Thoms, and Nodine was the first investigation to directly address the limitation of previous eye movement studies through the simultaneous recording of eye movements and verbal reactions of observers as they evaluated for "pleasingness" a series of reproductions of paintings by renowned artists. In the words of (Locher, 2006):

> Specifically, Locher et al. examined the relationship across the time course of exploration among participants' reactions to the art stimuli obtained from their verbal responses to the works, their scanning patterns, and each painting's compositional organization. University students who had no formal training in the visual arts were shown reproductions of paintings by Bruegel, Edo Period, Giotto, Klee, Leger, Matisse, Marin, and Vermeer. Their task was to examine each painting carefully and rate it on a 10-point scale for pleasingness. Subjects were asked to describe all of their thoughts and reactions to each picture as they looked at it and decided upon its rating. (p. 107)

The verbal responses of each participant were then classified on a 7-point scale. While answers varied with their reasoning and results, the research findings showcase the value and potential of eye-movement research to reveal the attention and cognitive processes that occur and how this contributes to the aesthetic evaluative judgments of art works.

State of the art eye fixation recording systems couple with recording devices, computers, and software packages to create sophisticated results. But, how does it happen?

Eye tracking is a technique whereby an individual's eye movements are measured so that the researcher knows both where a person is looking at any given time and the sequence in which their eyes are shifting from one location to another. In most eye tracking operations, infrared light from an LED embedded in the infrared camera is directed into the eye to create strong reflections in target eye features to track the movement of the corneal lens. Infrared light is used to avoid blinding the user with light during operation.

The use of eye tracking brings with it an essential element: the mind-eye hypothesis. This principal lies at the heart of most eye tracking research. In basic terms, the mind-eye hypothesis assumes that what you are thinking about, you look at, or in more concrete terms:

> What a person is looking at is assumed to indicate the thought 'on top of the stack of cognitive processes' (Just & Carpenter, 1976, p. 441). This "mind-eye" hypothesis means that eye-movement recordings can provide a dynamic trace of where a person's *attention* is being directed in relation to a visual display. Measuring other aspects of eye movements, such as fixations (moments when the eyes are relatively stationary, taking in or "encoding" information), can also reveal the *amount* of processing being applied to objects at the point-of-regard. In practice, the process of

> inferring useful information from eye-movement recordings involves the HCI researcher defining "areas of interest" over certain parts of a display or interface under evaluation, and analyzing the eye movements which fall within such areas. (Poole & Ball, 2006, p. 214)

Recording eye movements can provide a workable tracking method of a viewer's attention, showing us where their attention is being directed. This can be an especially helpful artifact in determining what things are important, in what order they are assessing items, and the overall pattern in which viewers are assessing the images they are confronted with.

> Eye tracking has an accurate base in its work with visual design, allowing us to
>
> Focus on the way people look at design products by analyzing their gaze paths. This way we get detailed information from the perception process. Different methods do exist for the related fields of usability evaluation and eye tracking research in studying perception of visual layouts. This research gives us some insight into real-time applications using these established methodologies in the field of design research, in order to create a methodology that is both feasible and reliable. (Koivunen, Kukkonen, Lahtinen, Rantala, & Sharmin, 2004, p. 1)

Several papers present eye tracking tests conducted in order to develop methods for studying design products, or internet usability with eye tracking. These tests "aimed to explore possible connections between people's gaze, product attitude and preference in comparing and evaluating the design products" (Kukkonen, 2005, p. 22). Lessons learned

through eye tracker studies include possible ways to improve the testing and analysis methods, and of the benefits and the means to utilize future eye tracking research.

What Is Eye tracking?

In its most basic form, eye tracking can be described as the manual or electronic process of following the trail of where a person looks, or is looking. Using current technology and the right equipment, it is fairly easy to observe the path where viewers look—whether it is at displayed art, products on a shelf, or on a computer screen. To gather this data (where viewers look, how long they look, and in what order they perceive parts of the image), eye tracking equipment is used in conjunction with software. This equipment can be built into a computer monitor, housed in a helmet, or included in specialty glasses. Corresponding eye tracking software programs can keep a recording of what is displayed in front of the viewer while they are looking.

Foveal Vision vs. Parafoveal and Peripheral Vision

In many ways, the human eye is comparable to a camera. It has a lens that can focus on items at a range of distances, an irising diaphragm (your pupil) which can adjust and react automatically for various levels of lighting, and a visual sensor in the form of a retina to record the visual image. But unlike a camera, the sensor of the human eye does not provide the same amount of focus and consistent resolution across an entire image. Photographs can look equally sharp at the center and their edges, but human vision is only truly focused at the center. At the edges, it is fairly inaccurate. For example, in the corner of your eye (in your peripheral vision), the eye can occasionally interpret

movement when there is none. Further, your peripheral vision is not very good at deciphering colors or details, requiring your eye to constantly jog around and adjust its focus. Peripheral vision is in no way useless—it does detect sharp contrasts between large luminance areas and it is excellent at recognizing and detecting movement.

With a small amount of focused viewing area, and large blurry areas comprising most of what we see on a daily basis, how do humans "see" what they perceive they see?

> The wonder of the human visual system is that you think you have a clear image of your entire environment even when you can hardly see most of it. This works because the instant you want to pay attention to a particular part of your surroundings, you point your gaze straight at it, and it comes into sharp focus. Your brain stitches together these bits and pieces of small, sharp images to form a mental picture of your surroundings that's much better than anything you actually see at any one moment in time. (Nielsen & Pernice, 2010, p. 6)

Human vision has essentially three parts: a small central area with very high resolution, called foveal vision, and the vast majority of the visual field with very poor resolution, called peripheral vision. There is also the parafoveal region surrounding the fovea. The portion of the retina used in this type of vision contains rods, and is not used for fine spatial discrimination in everyday life. Although these rods do not permit the color-sensing vision that is available with the cones of the foveal region of the retina, they have the useful property of responding to very low illuminance, particularly nighttime vision.

The high-resolution area of your vision covers roughly 2 to 5 degrees of your visual field—roughly the same size as a thumbnail at arm's length. This translates to one or two words on a printed page (please see figure 1 for an example).

Figure 1: Simulated area of foveal vision. Focused on the word "The"

Believe it or not, this is as much as you can clearly see at any given time. All other objects and the environment in which they exist are blurred because they fall within your parafoveal or peripheral vision rather than foveal vision.

Fixation and Saccades

With a minute amount of focused area for us to see with (foveal vision), and such a large amount of blurry area for us to perceive with (parafoveal or peripheral vision),

human eyes are (by necessity) constantly roving about in their frame of vision trying to understand our surroundings. So how can it be we can actually perceive our surroundings so precisely?

The human eye can see and sense everything around it through two basic actions: fixating on an object, or moving to the next object which the viewer wishes to see. In the words of Yarbus (1967): “The human eye can only be in one of two states: In a state of fixation or in a state of changing the points of fixation” (p. 106).

If humans can only focus on a small area at once and all other areas of vision are unfocused and blurry, how is it that humans are able to accurately perceive their surroundings?

> To stitch together small areas of good visibility, into a larger, a sharp mental image, a person’s eye moves across the items of interest. There’s one more important thing to know about this process: The eye’s multiple observations don’t happen as one smooth, panning movement—the way they would if we were filming a scene with a video camera on a tripod with great shock absorbers. Instead, the eye moves in spurts and rests between each movement. Of course, this happens so fast that you’re not aware of it (well, now you may be painfully aware of it), but psychologists have run countless experiments for more than 100 years to nail down the details of this movement. (Nielsen & Pernice, 2010, p. 6)

When the eye is resting on something, this is called a fixation. The eye's rapid movements from one fixation to the next are called saccades. Each saccade lasts only between one-tenth and one-hundredth of a second.

> The main function of saccades is to change the points of fixation, to direct the most sensitive regions of the retina (the fovea) to a particular element of the object of perception. The nature of saccades is responsible for much of the refinement of perception. The high velocity and correspondingly short duration of the saccades usually permit the eye to remain in a state of fixation for 95% of total time. (Yarbus, 1967, p. 129)

During this ultra-fast movement, optical images gathered on the retina are blurred so much that humans are effectively blind. Since we cannot actually see what the eye is moving across during the saccade process, we only see during periods of fixation—while the eye is holding still. Fixations typically last between one-half and one-tenth of a second, also a very rapid process.

In fact, when watching a video recording of an eye tracking session, the first thing most people note—or react to—is just how fast and erratically the eye seems to move. To analyze exactly what happens during recorded sessions, researchers almost always need to watch replays in slow motion or use software systems which can automatically plot these movements.

Neilsen & Pernice have conducted literally *thousands* of eye tracking tests over the years. In their own words:

> Even [when noting visual results at a highly reduced speed], we need to rewind [these videos] several times to follow and understand just small segments of the user's viewing paths. (Nielsen & Pernice, 2010)

Because people are virtually blind during saccades, it is not necessary to analyze what the viewer is "seeing" during saccadic motion (Yarbus, 1967, Neilsen & Pernice, 2010, Regan, 2000, Just & Carpeter, 1976, Poole & Ball, 2005). As a result, I consider only fixations when discussing the results of attention during this eye tracking study.

The difference between looking and seeing in visual perception

In the course of this thesis, there are points when individual viewers did not look at a particular design element or elements. Did they purposely ignore something, or simply miss seeing certain items something during the question and answer period? It is unclear.

If viewers did not look at a particular design element, how could it possibly have impacted their cognitive processes? This can be explained by considering the difference between foveal and peripheral vision. The eye tracking equipment used in this research can record what parts of the screen each viewer's foveal vision fixates on, but it cannot and does not record peripheral or parafoveal vision. Because foveal vision is the only high-resolution part of the human visual system, only screen elements which receive fixations can be seen by viewers with sufficient detail to read text or notice fine components of visual design. This is why viewers only appear to see the certain screen elements they fixated on. When research subjects did not fixate at all on particular items,

it can be argued that research subjects failed to perceive enough information from other parts of the screen to fully understand that item's content.

However, through peripheral vision, viewers sometimes still manage to perceive—in a rough, low-resolution manner—design elements upon which they did not fixate. Even though peripheral vision is not good enough for reading or interpreting specific details, it is sufficient for perceiving both the general shape and some color of screen elements. That said, the peripheral vision does not provide explicit detail. It is not until we fixate the we extract detail.

Consider this example: viewers can tell that large images appear on the screen even if they don't happen to fixate on them. They may not be able to tell who appears in theses images, but they can tell whether it is a photo containing humans or other normal objects. (Of course, in some cases a tree or other inanimate object may look like a human body when viewed peripherally). This is the distinct difference between high-resolution viewing (foveal vision) and low-resolution viewing (peripheral vision).

To demonstrate this phenomenon in your current setting, consider this second example: If you bring your gaze down to the last words at the bottom of this page, they will come quickly into focus. While your eyes are trained on the last words, mentally consider what's within your visual field without moving your eyes. If your vision is reasonable, you should be able to understand and perceive that there is text at the top of the page within your peripheral vision. However, because your foveal vision is fixed on the last word on the page, you won't be able to read any of these words.

It is unnatural for humans to keep their gaze trained on one element while trying to perceive another. Humans do not spend the majority or even minority of their time trying to see things out of the corner of their eyes. We simply switch our gaze to the object of interest, bringing it sharply into focus.

Peripheral vision allows viewers to be aware of the general layout of an advertisement or artistic composition, even though they are not looking directly at all of the key elements. The elements upon which a viewer does not fixate are those which they do not seem to care about. Only those elements that viewers choose to fixate on are perceived with sufficient detail to accurately see their content.

Visual Attention and the Mind-Eye Hypothesis

With eye tracking technology, it is possible to accurately gauge where a viewer is looking—but knowing where a viewer looks would be worth very little if it does not tell us something about their interests or thought processes.

> Most often, we also divert our attention to that point so that we can focus our concentration (if only for a very brief moment) on the object or region of interest. Thus, we may presume that if we can track someone's eye movements, we can follow along the path of attention displayed by the observer. This may give us some insight into what the observer found interesting, that is, what drew their attention, and perhaps even provide a clue as to how that person perceived whatever scene she or he was viewing. (Duchowski, 2007, p. 3)

This brings us to the mind-eye hypothesis. The mind-eye hypothesis holds that what people are looking at and what they are thinking tends to be the same.

> In general, though, the mind-eye hypothesis holds true often enough for eye tracking to tell us what users pay attention to… People generally do tend to look at the same thing they're thinking about. That's the way the human visual system works, and that's why it fools us into believing that we have a high-resolution image of the world. We can therefore conclude that fixations equal attention: People look at the design elements they are concerned about, and the more they look at something, the more they think about it. (Nielsen & Pernice, 2010, p. 9)

Is this always the case? Certainly not. Creativity itself relies heavily on the ability to conceive of something that does not yet exist, or may not have been previously understood or even conceived of. In these situations, a viewer may find themselves visually scanning an area and imagining the components falling into place, or they may simply imagine the situation as they wish that it could be.

> If taken to the extreme, the mind-eye hypothesis may seem ludicrous. Looking at and thinking about are certainly not always intertwined. You can think about pink elephants without looking at one. And your thoughts may be on freshly deep-fried donuts while you're sitting in your car when the stoplight changes. (Nielsen & Pernice, 2010, p. 9)

Looking will not always indicate understanding or mental processing on the part of the viewer. Many times viewers briefly (or not so briefly) fixate on the visual items

which they are not interested in or feel make the compositions worse (see Chapter 4: Results). In these cases, they may not even be registering the feelings or subconscious patterns that the designers intended the words, images, or colors to evoke—even though they looked right at it.

Looks: Good or Bad?

By itself, eye tracking can do one thing and one thing only: discover what viewers are looking at. But a simple count of fixations alone cannot tell us whether viewers are pleased, excited or confused when they look at certain things and not at others.

For example, viewers may look a great deal at the photo of a refrigerator present in Image #1, because the content is relevant and interesting. Or maybe it is because the contrast, colors and radial lines are so overpowering and difficult to block out. Most of the time, however, these fixations are due to interest.

Alternately, if viewers do not look at certain parts of an advertisement, it could be because these design elements hold no interest for them, and viewers falsely assume they are devoid of content. Viewers may compare images for consistency, but repeated views of repetitive elements may point to a failing of clarity in the design work.

Taken on their own, the ability of certain design elements to attract fixations or to be completely ignored, does not transfer a judgment value of “good” or “bad”. Judgment of the design implications of eye tracking data must include knowledge of viewers’ intents. It is not enough to show the visual imagery and collect the data. The viewer’s reactions and opinions need to be taken into account.

Fixations depend heavily upon the context in which it is presented. In an encoding task (i.e., determining which element is the most visibly appealing part of the image), having a high fixation frequency within a certain area can be both an indication of greater interest in the area of fixation, such as the fridge in the color area, or it can be a sign that the design element in question is heavily complex in some manner, and therefore more difficult to encode (Jacob & Karn, 2003; Just & Carpenter, 1976). However, these interpretations may be inversed in a given task: A large number of single fixations or multiple fixations in a tight cluster can be an index of greater uncertainty in recognizing a target item (Just & Carpenter, 1976).

Several researchers have given their assessments of fixations and the information/ambiguity it can instill. Results may indicate a thing—as well as its opposite. In short, visual identification via gaze patterns may not be enough to ensure that the full understanding of the pieces has been achieved. Related to the overall number of fixations in any given visual piece, more overall fixations can indicate a less efficient search has been conducted visually (Goldberg & Kotval, 1999). When considering the number of fixations within an area of interest, more fixations within the area will certainly indicate that it is more important, and more noticeable to the viewer than other areas (Poole, Ball, & Phillips, 2004). A longer fixation on the part of the viewer might indicate that the object in engaging, or it might similarly indicate a difficulty if extracting information (Just & Carpenter, 1976). Fixations concentrated within a small, confined area, indicate focused and efficient searching on the part of the viewer. While a high density in a small space indicates focus, a low density of fixation across the space reflects a widespread and

inefficient search (Cowen, Ball, & Delin, 2002). Post-target fixations (high numbers of fixations off-target after the target was fixated indicate that the target lacks meaningfulness or competent visibility (Goldberg & Kotval, 1999). Time to the first fixation is also a good way to understand the visual appeal of items, as faster times to first-fixation on an object or specific area of interest will mean that it has better attention-getting properties (Byrne, Anderson, Douglas, & Matessa, 1999).

Fixations tell us information about our viewers, but their saccades do as well. Since the eyes are moving too quickly during saccades for information to be processed, saccades do not give us information about what we've viewed. Regressive saccades (i.e. backtracking eye movements) can imply processing difficulty during encoding (Rayner & Pollatsek, 1989). While regressive saccades can come in all sizes, most are small regressions—perhaps skipping back only 2-3 letters in reading tasks—large regressions, or frequent regressions can be a sign of confusion on the part of the viewer. The number of saccades can also indicate the amount of searching that is occurring—more saccades indicate more searching (Goldberg & Kotval, 1999). Larger saccades also indicate more meaningful cues are perceived, as attention to items is drawn from a distance (Goldberg, Stimson, Lewenstein, Scott, & Wichansky, 2002).

The scanpath chosen/committed by the viewer describes a saccade-fixate-saccade sequence. This gives us a systematic link between the time spent processing what we see (fixating) and time spent searching (saccades)—a higher ratio indicates more time processing or more time searching. The length of the scanpath (distance from fixation to fixation) is also an important consideration, because a longer scanpath indicates less

efficient scanning (Goldberg & Kotval, 1999), and/or less efficient searching (Goldberg, Stimson, Lewenstein, Scott, & Wichansky, 2002). On the other hand, a smaller scanpath (shorter distances between fixations without running over previously viewed ground) indicates a more efficient search and having a greater scanpath density indicates a more direct search (Goldberg & Kotval, 1999).

In many cases, patterns in the participant's viewing are observable. These patterns often take on the form of circular or "cyclic" arrangements. In short observations, this can mean that the items in question are unsure, or hard to define visually or understand.

However, in longer observations, these are quite natural. In the words of Yarbus:

> If the eye movements are recorded for several minutes during perception of an objects, the record obtained will clearly show that, when changing its points of fixation, the observer's eye repeatedly returns to the same elements of the picture. Additional time spent on perception is not used to examine the secondary elements, but to reexamine the most important elements of the picture. The impression is created that the perception of a picture is usually composed of a series of "cycles," each which has much in common. (Yarbus, 1967, p. 193)

Visualizing Eye tracking Results

As eye tracking is a visual study, different methods for visualizing and analyzing eye tracking results are a must. There are three main ways of visualizing eye tracking results. The very best approach is to watch slow-motion gaze replay videos, but that's very time-consuming and not suited for print—a simple seven minute question and

answer period will take 70 minutes if slowed down to 1/10th normal speed. In this thesis, I focus on two static representations of viewers' viewing behavior: heat maps and gaze plots.

Figure 2: Example Heat Map

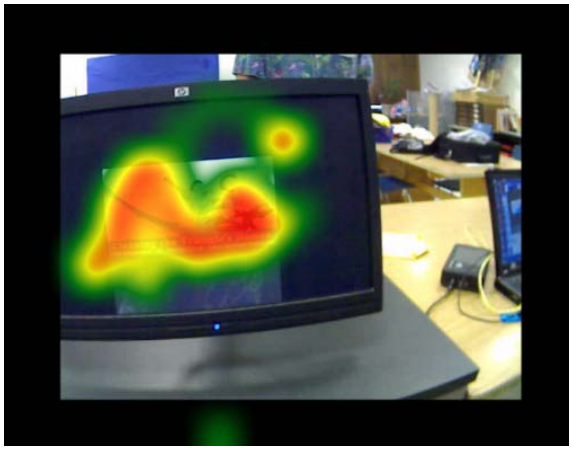
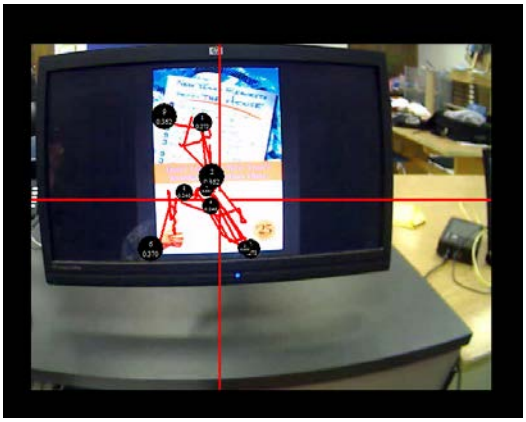


Figure 3: Example Gaze Plot



As you look at them, it's important to remember that they represent movements in time. Viewers' eyes move very rapidly across a page. Time-sensitivity was not an element of this study. Static depictions of gaze patterns or fixation areas will be shown to accurately reflect what happened in viewer sessions.

Viewing the Heat Maps and Gaze Plots in This Study

Heat Maps are the best-known visualization technique for eye tracking studies, although they are difficult to quantify. Heat maps got their name because their colors metaphorically indicate hot zones and cold zones on a page. In a heat map, a screenshot is color-coded by area according to the amount of fixations each part attracts: The red areas are where viewers looked the longest, and might only occur in lengthy viewings, the yellow areas indicate a fair number of fixations, and the green areas indicate the least-viewed areas, or areas viewed during short answer periods. If an area contains no colors (i.e. if the background image shows through); it didn't attract any fixations.

Heat maps can represent either the number of fixations or the durations of viewers' fixations. In practice there is not much difference in the resulting display of these two approaches, especially when averaged across many viewers. Heat maps in this study are based on fixation duration, because the amount of attention allocated to each part of a page contains important information. Thus, the heat maps show how long viewers look at different screen elements, not how many times they look at them.

Heat Maps are typically aggregated across multiple viewers. This visualization lends itself better to larger studies with many participants, because it doesn't depict individual participant viewing behaviors very well, especially in short answer situations.

However, although it's beautiful to get an overview of many people's behaviors in a single image, heat maps also smooth over differences in individual behaviors. People approach the same visual imagery in different ways. Ultimately, a design needs to cater to one viewer at a time. So, there is also much to be gained from visualizing individual

observer's viewing patterns. The creation and identification of these patterns are best visualized in gaze plots.

In a Gaze plot, a single viewer's visual gaze pattern is depicted as a series of dots, each indicating one fixation. The size of each dot represents the length of the fixation, with bigger dots indicating longer looks. The dots are numbered, showing the sequence of the fixations and their duration. Thin lines connect the fixations, indicating the saccades as the eye moved from one location to the next. It is important to remember that humans are blind during saccades, so the viewer didn't see the elements under the thin lines, only those under the dots.

It is possible to draw gaze plots to visualize a viewer's entire viewing of a page; but they can be difficult to follow if the viewer pays close attention to a particular part of the page. Similarly, if certain imagery is compact, the viewing area will seem to simply be a jumble of numbered dots. It's also possible to draw different gaze plots for different parts of a viewer's visit— for example, to see what the person did during the first few seconds on a page. Gaze plots are used in this manner most often. In this thesis, gaze plots are shown to better convey the eye movement during each viewing.

Tasks Determine Looks: Question Types Presented in this Study

The mind-eye hypothesis implies that the way people look at any given artifact—such as an advertisement or Web page—is determined by what they're trying to do with it. In other words, the task the viewer has chosen or been asked to do determines their looks, and the pattern in which their gaze will take.

While conducting this thesis, viewers are trying to do the same individual qualitative tasks: Analyze and make comparisons, justify personal preferences, determine levels of importance, and determine the appropriateness of sizing, etc. Many of these tasks were open-ended. Using open-ended qualitative questions helps us learn where people chose to look when nothing was imposed on them. Some of the questions were quite closed, with yes/no, better/worse, and less/more answers.

Within this study, the following types of questions were presented to participants:

1) Global Judgment Aesthetic response based on what another person would find interesting: This kind of question requires theory of mind about what another population group—the Baby boomer—might look at.
2) Participant analysis of individual elements within a given composition: This question requires comparative decisions that rely on a viewer's aesthetic preference for visual appeal.
3) Reflection: Participant is required to discriminate between and evaluate the parts of a visual image based on his/her own aesthetic criteria.
4) Comparative decision, reflective: Participant must Analyze elements within composition, and then generate decisions based on their reflection of these elements. Have things changed, what is most important, etc.
5) Contemplation: Image must be analyzed and decisions of change (to make an action or no action) made.
6) Reflection to previous images: Participants must analyze an image and its elements before deciding what, if anything has changed.

Sample questions from a novice:

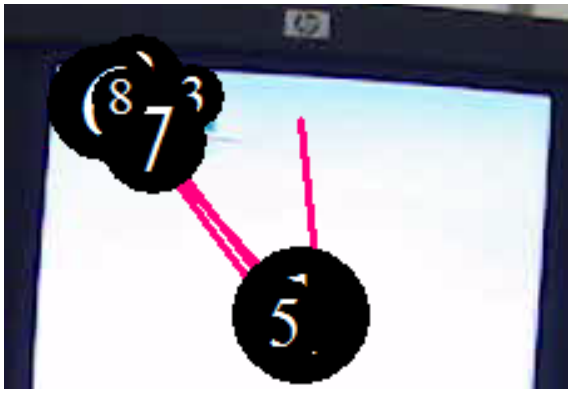
Below you will find an open qualitative question: *If you could change anything, what would you change?*

Figure 4: Qualitative spiral pattern in gaze plot (enlarged)

This novice participant's answer turned out to be the color bar at the bottom. When considering this question, the novice looked at the bar and the text in several different places, determining what they would change, and how it might look. As the novice thought about their answer, they looked at the image within a specific area, and their gaze takes on some circular movements.

Below you will find a reflective comparative question: *Is this logo the right size?*

Figure 5: Reflective comparative line pattern in gaze plot (enlarged)



As the novice participant considers the yes/no possibilities of the question, their gaze moves in a strong linear pattern. As they thing about the logo and compare it to the watermark, up, down and diagonal marks show the vision quickly moving in straight lines.

As to individual approaches, some viewers will circle to the left, others to the right. Beginning points and end points differ from person to person—some will look from the sides, others from the top down, and others from the bottom up. It is not a weakness of eye tracking that people look at the same items differently, but rather it is something you would find no matter what research method you employed.

Conclusion

Eye tracking studies are not new, but technological advancement makes them a more accessible medium every day. By building off the information presented in this chapter, a clear connection should emerge between the work carried out in this thesis and that already carried out in previous expert/novice, artistic creation, or other observational experiments. The eye tracker will allow us to see where the viewers are looking, the

patterns this viewing takes on, and what they are not looking at. The mind-eye hypothesis in conjunction with these patterns will tell us about the search and how efficient it is, what is important to the viewers, and in what order the items were important.

CHAPTER 3: METHOD

Overview

The following chapter will address the methodology used in the completion of this thesis. Because the eye-tracking was an integral component to this research, a laboratory setting was necessary to capture all aspects of the search session and related eye movements, as well as user behaviors to be systematically compared. In a few short sections below, information is provided outlining who participated, how the experiment itself was conducted, and how the resulting data should be considered.

Participants

Participants in this study were 20 active collegiate students between the ages of 19 and 46. Ten subjects were untrained in any facet of art or design. Ten subjects had each undergone 3+ years of design education at the collegiate level. Students with 3+ years of art & design experience constitute a fairly small expert population, but should give a great insight into the trained artistic mind.

Potential participants were selected from East Carolina University, with the expert population gathered from the East Carolina University School of Art and Design, and the novice population pulled from various other departments and majors within the campus.

Active collegiate students with these demographics were recruited:

Table 1: Participant demographics

Age	Gender	Experience
18-29: (85%)	Male: 9 (45%)	0 yrs: 10 (50%)
30-40: 2 (10%)	Female:11 (55%)	3 yrs: 5 (25%)
40-50: 1 (5%)		4-5 yrs: 2 (10%)
		6-10 yrs: 3 (15%)

Participants self-selected to take part in the study, based on emails sent via the school listservs individual requests from other participants, or flyers posted on campus. A cover letter explained the study and the students' participatory role, as well as outlining the confidentiality of their responses [see Appendix B: Participant Cover Letter]. Following the collection of data, information was gathered via eye tracking software and organized by spreadsheet. The researcher engaged in descriptive and interpretive analysis. All written results can be cross-checked with the data sheet supplied [see APPENDIX F: Written Answers Data Table]

Instruments

To conduct this thesis, an ASL Moblie Eye-XG tethered to a Lenovo R500 laptop (1.89gb Ram, 2.53ghz Intel Core 2 Duo processor, Windows XP Professional 2002 SP3) was used to gather this eye tracking data. A high-powered Mac Mini (4gb Ram, 2.3ghz Intel Core i5, Running OSX 10.7.3) hooked up to an HP Compaq L2105tm (21.5"

touchscreen display) was used to show the imagery. Projected images were shown at a full screen resolution of 1920x1080 pixels, and then centered in the screen and fit to height.

The ASL device gathered eye tracking, audio and video signals during the research. The laptop computer tethered to the ASL device recorded each session for review, producing .avi files and .csv excel files for eye tracking fixations. The point(s) tracked in this manner on the screen fell in the center of the fovea of the viewer's eyes, as determined in the calibration process. The system did not track peripheral vision.

Two major eye tracking issues that the system accommodates are drift and head-motion compensation error. Either can result in poor eye gaze capture.

Drift is a weakening of a participant's eye calibration. It can happen because of environmental changes in the test lab, such as light conditions or humidity. I watched for any occurrence of drift and was prepared to recalibrate viewers as needed, although only 2 participants actually needed this process.

For more information about ASL's Mobile Eye-XG or other ASL eyetracker technology, go to their webpage. ASL Webpage for the Mobile Eye-XG. (ASL webpage: http://www.asleye tracking.com/Site/Products/MobileEyeXG/tabid/70/Default.aspx will open in another window)

Research design

To create this study, it was imperative that participants were given the same opportunities in the same environment so that consistent data could be collected. To measure participant behaviors quantitatively, it was important that these sessions were conducted in exactly the same way. For the sake of consistency, a single facilitator conducted all the tests for this study using the same methodology: observation of the participants in a lab setting and following a predefined, specific protocol.

System Logistics

Each testing session lasted between roughly 3 to 16 minutes. Viewers were asked to give their answers, and indicate when they were finished by writing their answers down on a page. All tasks were captured by the eyetracker. During the debriefing process, their recordings were shown to each student. Results and comparisons made between the participants were noted later, away from the subjects. After all recordings were made, software was used to compile recorded times, answers, and eye tracking paths by group. Comparisons within and between each group were then made.

Each viewer session consisted of the following activities, where were always done in the same order:

- Welcome / setup.
- Consent form signed [see APPENDIX B] and random number answer sheet given to each participant [see APPENDIX C].

- Explanation of question/answer requirements (speaking answers and writing answers).
- Calibration of the eyetracker.
- Question set.
- Retrospective—a short session in which test subjects were asked if they were interested in watching part of their test session and receive a short explanation of expected results.
- Thank you.

Participants met in a classroom, and eventually created a queue in a "holding area" adjacent to the room. In the holding area and on the door of the lab where the experiment would take place, a cover letter was presented to students, inviting them to self-select to participate in the study. Individually, they were drawn into a room with the visual material and the eye tracker.

Inside the room, the cover letter was presented to each students individually, inviting the subjects to self-select to participate in the study, “Meeting Eye To Eye: How Trained Designers and Typical Viewers See Advertisements: And Their Implications for Contemporary Design Education” [see APPENDIX B]. Participants were encouraged to read the cover letter completely, and then to sign the sheet if they wished to participate.

The process of the study was briefly explained and contact information was made available to the subjects. A questionnaire consisting of a random number, a space for personal information and 19 answers spaces was given to each participant [see APPENDIX C]. Participants filled out their information and sat for the study.

Participants were fitted with the eye-tracker, which was then individually calibrated for their bodies. They were shown a series of images, and asked questions relating to the design, composition and layout of the pieces, or about an earlier answer they had provided. Data was collected through audio-recorded answers to questions and through visually-recorded eye tracking software within the ASL eye tracking device. Data from this device was recorded simultaneously through video recording media on the tethered laptop for each participant.

Afterward, each participant was asked if they would enjoy seeing their results. All participants were interested, and nearly all reacted first to the speed and jittery nature of their gaze. Finished participant were then released, and asked not to interact with other participants until they had completed their answers

Data Collected

We assigned 19 questions—some very specific and some very open-ended. This resulted in literally thousands of fixations that were 0.2 seconds or longer, and hundreds of thousands of gaze points. The recordings reviewed and retained comprise more than 7.9 GB of data.

Materials and Test Questions

After being fitted with the eyetracker device and having it calibrated, students were shown a series of 6 images. Along with each image came 2-5 questions. Subjects were asked to say their answers out loud, and then to write them down in the space provided.

The facilitator asked questions from a sheet containing all questions with their image cues [see APPENDIX D]. The materials were presented to viewers in a slide format on a black background, with a blank black slide between each item, to act as a visual palate cleanser [see APPENDIX E].

Each image was shown to the participants before the questions were asked, allowing them several seconds to scan the image prior to answering their first question. The facilitator asked questions related to the imagery and participants answered each question in turn before advancing to the next question or image. Viewers manipulated the slide viewing themselves upon the request of the facilitator.

The assigned tasks were a combination of open-ended qualitative questions, in which viewers were allowed to answer simple analysis and comparison questions, and closed qualitative questions, in which viewers were asked to determine the appropriateness of changes in element sizing or color use with simple yes/no and more/less answers.

Qualitative and Quantitative Studies

Traditionally, questions for participants can be divided into qualitative and quantitative (sometimes abbreviated at “quant”) approaches. Quantitative questions measure data numerically, whereas qualitative questions aim to collect richer insights and observations.

For example, the sample reflective qualitative question “Does the color work better or worse?” showed that 60% of novice felt the orange and blue was better color

combination, while 60% of experts felt the orange and blue was worse. The sample participant analysis of individual elements question might show the watermark of the letterhead was considered to be the most important thing on the page to novices, because bigger is better, specifically: it is “the biggest thing on the page,” the “most central thing on the page,” it “is given the most space on the page,” and has been “given the most room”. Both can offer some truly interesting insights, but different questions are better suited to achieve different results.

Measures

In this study, results were qualitatively measured. Participant’s bodily behavior as they viewed imagery for the first time or explained answers were used in addition to eye movements, gaze patterns, and fixations as viable data. This study also focused on what participants looked at, how much they looked at each of the elements, and what they did not look at. Finally, this information was gathered and used to determine why participants did or did not look at individual items. Participant comments were used as a reference to understand and determine what they looked at, and why they viewed these items.

In addition to qualitative measures, some basic quantitative measures often employed in eye tracking were used: fixations prior to verbal answer, either/or answers, and answer time.

Time

To measure the length of time it took each participant to answer questions, recording began after the questions was asked and the participant addressed the image

visually. Time was not stopped until the viewer had finished answering the question in full. Recorded timing did not stop if the participant changed their mind or were not finished answering it in full.

The built-in recording system was used to determine timing, start/stop times for questions, and the length of response times.

Miscues

When answering questions, participants fixations were used in addition to their gaze plots to determine items of importance. The importance of what a viewer looks at as a function of what they "see" has been outlined above in the mind-eye hypothesis. However, it should not be overlooked that the notion of miscues, elements that attract the viewer's eye and attention at the wrong time, are important. Miscues happen.

But counting every miscue is extremely difficult, if not impossible. You simply cannot tell whether someone is looking at something because they are just interested or because they are erroneously drawn to it.

> Recognizing miscues is even more difficult than recognizing errors. Because it is so time-consuming and error-prone, we recommend that only very advanced usability teams bother with this. It would probably be difficult for many design teams today to deeply study and use feedback regarding miscues. Most teams are not quite primed for this, because they are still learning and trying to respond to basic usability findings without eye tracking. Miscues should probably only be pursued by advanced

> design teams that have already found and fixed problems pertaining more serious usability issues—such as misclicks (clicking the wrong links or buttons) and unsuccessful tasks. (Nielsen & Pernice, 2010, p. 35)

Due to the difficulty of determining miscues in this test, the best methods have been made to determine if a lack of understanding, or an environmental element may cause a miscue. However, there is no way to know if all instances of miscues within these test results have been completely addressed.

How to read the results

All figures in this thesis incorporating gaze plots and heat maps are video stills captured from novice and expert responses to the questions. Two examples from each group will be shown, each with a gaze plot and heat map. In the figures shown in Chapter 4: Results, each viewer's fixations will be represented by black dots (larger dots for longer fixations and smaller spots for shorter fixations—exactly 20 pixels in diameter for every 0.2 seconds of fixation). Thin hot pink lines connecting these dots will represent a viewer's saccades, and any fixation with a duration shorter than 200 milliseconds (0.2 seconds) will not be shown. Rather than showing a straight line between fixations, I have chosen to include the gaze path to better assist in the accuracy of determining how each population is approaching the works.

Each fixation will be given a number, based on the order in which the viewer fixes their gaze. The dot labeled "1" will be each viewer's first point of fixation, and the second fixation of every viewer will be labeled "2", and so on. By following these

numbered items in order, you will be able to more accurately follow the gaze path, fixations, and possible mental processes of each viewer.

In figures in which the gaze pattern is substantially long (comparatively), I have included a short breakdown of gaze pattern and fixation by dividing the gaze plot into 2 sections. These will appear in the overall gaze plot heat map section. By breaking down one section (i.e. turning a 12 second gazeplot into a 1-6 second plot and a 7-12 second plot), a greater understanding of the gaze pattern can be seen without the clutter of 30-50 fixation points.

In reviewing this material, my hope is by including several visualizations of the data, it can be helpful to see how each viewer or each population approaches each piece of design. Specifically: in what order (by following the numbers with your own eye), by which points of interest (which fixation dots are largest, or where are multiple dots clustered), or by overall gaze pattern (does the gaze plot itself show an interesting pattern of linear, curvilinear, or spiraling patterns?).

Conclusion

Within this study, accurate novice and expert populations have been identified and allowed to self-select, creating a workable pool of individuals to participate in this study. By taking the same approach (or as accurately as possible) across these populations, using the same logistical methodology with participants, and rendering all data for this experiment in the same fashion, the data should be as accurate as it can be

made. In chapter 4, the results of this experiment will be shown, building from the solid foundation created in this chapter.

CHAPTER 4: RESULTS

Overview

The previous chapters provided the background for this experiment, which is to use eye tracking to study visual performance, attention (fixations), and gaze patterns between novice and expert populations.

The following results are split into 3 distinct sections:

1) **A comparative data section** in which Average times (arithmetic mean, median, and mode if one exists) as well as a summary of data (any relevant data that will help the reader to interpret the image data provided)
2) **A section of figures** in which two examples from both novice and expert populations are shown with gaze plots and heat maps. This data is graphical in nature, with images chosen on their closeness to the mode or mean times.
3) **An overall interpretation section** in which analysis of the gaze plots and heat maps take place. This analysis includes interpretations based on data and images. This section is optional. It may also contain

breakdowns of gaze plots divided into 2 sections if view times are over eight seconds.

Overall Questions

Average Time to answer questions:

Novice: 7:30 (Mean 7:30, Median 7:30)

Experts: 9:28 (Mean 9:28, Median 9:34)

Summary of Data: There are roughly two minutes difference in average answer time between novices and experts. Trained artists used greater art/design-related vocabulary, seemed to take more time explaining their answers, and used their hands to explain more. Each of these things seemed to extend answer times. Novices were able to make snap decisions quicker. Perhaps this difference is based upon a lesser understanding of aesthetics on the part of non-artists, or a greater need for artists to express themselves. It may also be noted that many artists answers seemed to be "unsure" in nature about their work, and this may have caused them to answer reluctantly.

One artist noted about their answers: "It's hard when I have several answers I could give… [I'm] trying to narrow it down".

Image 1: Boom Magazine Advert #1

Average Viewing Time:

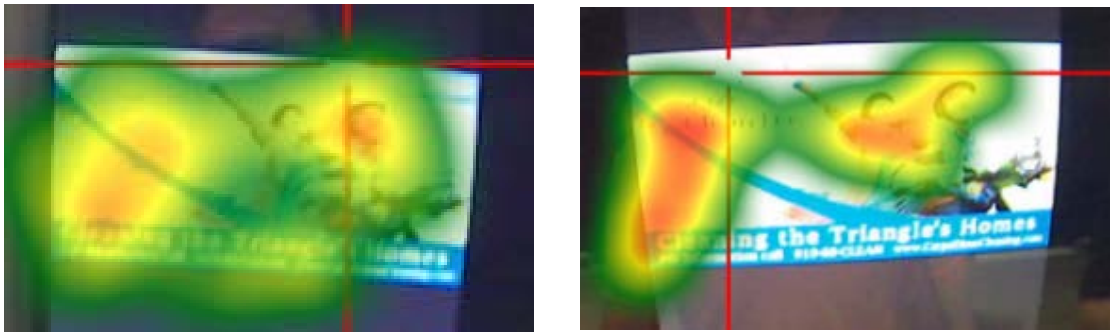
Novice: 13 sec (Mean 13 sec, Median 13 sec, Mode 14 sec)

Experts: 10 sec (Mean 10 sec, Median 11 sec)

Summary of Data: The image in this piece is dominated by photography covering 2/3rds of the image area, with less than 1/3 dominated by text and a heavily varied and textured color area that is the signature for the company.

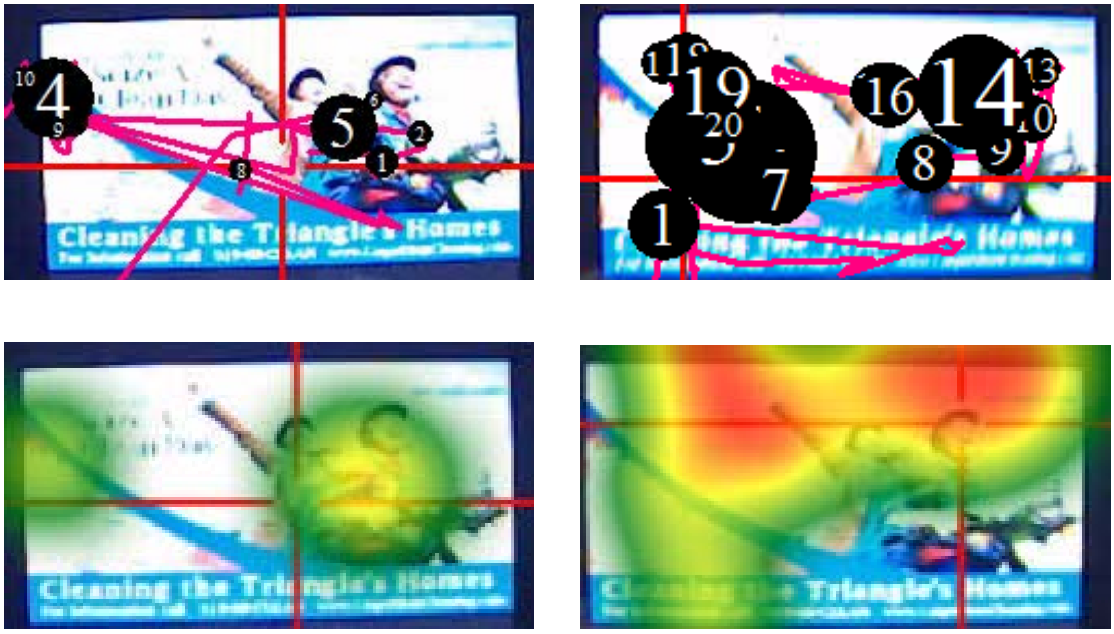
Novice gaze patterns and heat maps

Figure 6: Novice gaze plots and heat maps when viewing Image 1 for the first time



Expert gaze patterns and heat maps

Figure 7: Expert gaze plots and heat maps when viewing Image 1 for the first time



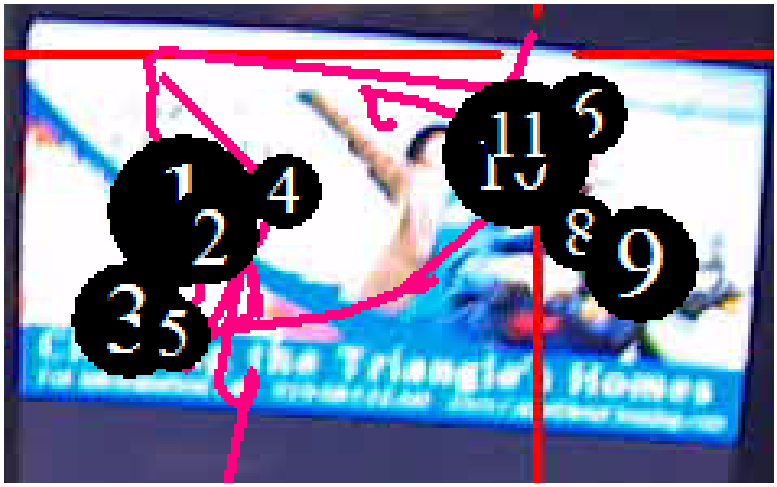
Overall gaze patterns and heat maps

Novices and experts both viewed this piece with similar approaches—driving to areas of high color, back to humans, and returning to areas of high color when inspecting this image. While facial expressions did factor heavily into the viewing styles of both experts and novices, the highly colored and highly contrasted left area was a major draw.

Because this initial viewing was so long, I have provided the 14-second entries into seven second segments for viewing closer below.

The gaze plot images are connected via gazepaths, and the differences in views for experts and novices begins to be pronounced. Novices spent shorter amounts of time on many, many more positions, moving quickly over the piece in speedy bursts in much more rounded paths. Experts seemed to jump from major point to major point in smaller rounded paths, seeking more of a back-and-forth straight visual path.

Figure 8: Novice 1 viewing, seconds 1-7

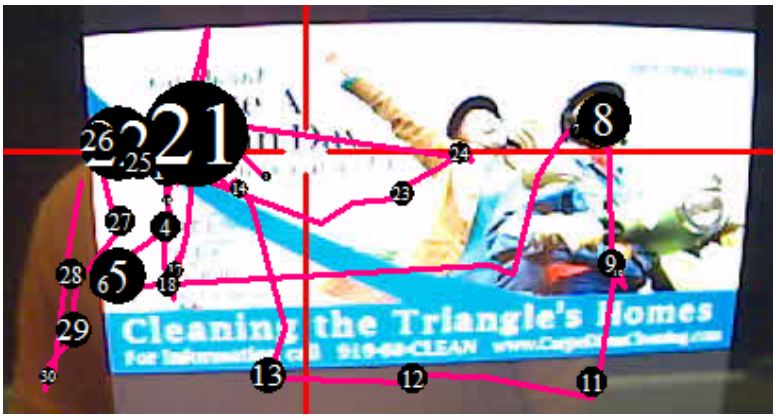


In the first seven seconds of the first novice example, the novice quickly runs to the text and down the color area with some significant pauses, and then cycles back into the text before quickly returning to the color areas and ends this section moving into the figures, in this case focusing mainly on the male.

Figure 9: Novice 1 viewing, seconds 8-14

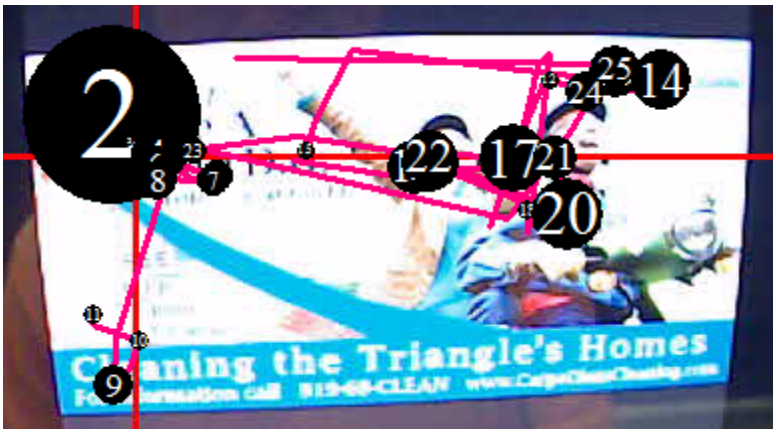
Within the second seven seconds, the viewer circles the picture again, taking some time on the text, the female's face, back to the color area, cycling through the text again, and the to the logo area in fixation #5. From here, the novice scans back and forth over the footer, and settles for a lengthy stay back at the color areas.

Figure 10: Novice 2 viewing, seconds 1-7



In the second novice example, a similar circular pattern begins evolving. A new behavior: small, frequent jumps around the image, also emerges. Starting in the text area, the novice moves to the color areas. This viewer jumps to the figures in about fixation #8—roughly the same level of importance as the expert and the novices above. Skipping briefly through the figures, the novice dips through the bottom bar, and returns up into the color area and text. After 12 fixations, the novice cycles back to the figures, and then through the color areas to end. For this individual, 30 fixations occur in the first seven seconds.

Figure 11: Novice 2 viewing, seconds 8-14



In the second seven-second jump, a massive fixation at the text is followed by a drop back through the colors, and a short stop in the bottom bar. The novice then cycles around the figures and logo until the end of their search.

Figure 12: Expert 2 viewing, seconds 1-7

In the first seven seconds, the expert viewer is moving through the imagery, beginning in the largest area of color,and across the bottom bar, before exploring back up into the color and text area of the piece. Large fixations occur within the text and color area. The figures here are largely ignored.

Figure 13: Expert 2 viewing, second 8-14

In the second seven seconds, the expert viewer stays briefly in the color areas, and then moves their gaze into the dynamic figures, having several medium-length fixations concentrating on the man and woman's faces, before moving their gaze through the text and returning at last to the corner of the color area.

Question 2: Please examine the image on the screen. This is an advertisement for a magazine marketed to "Baby Boomers". Does this piece effectively target that group?

Average Time to answer questions:

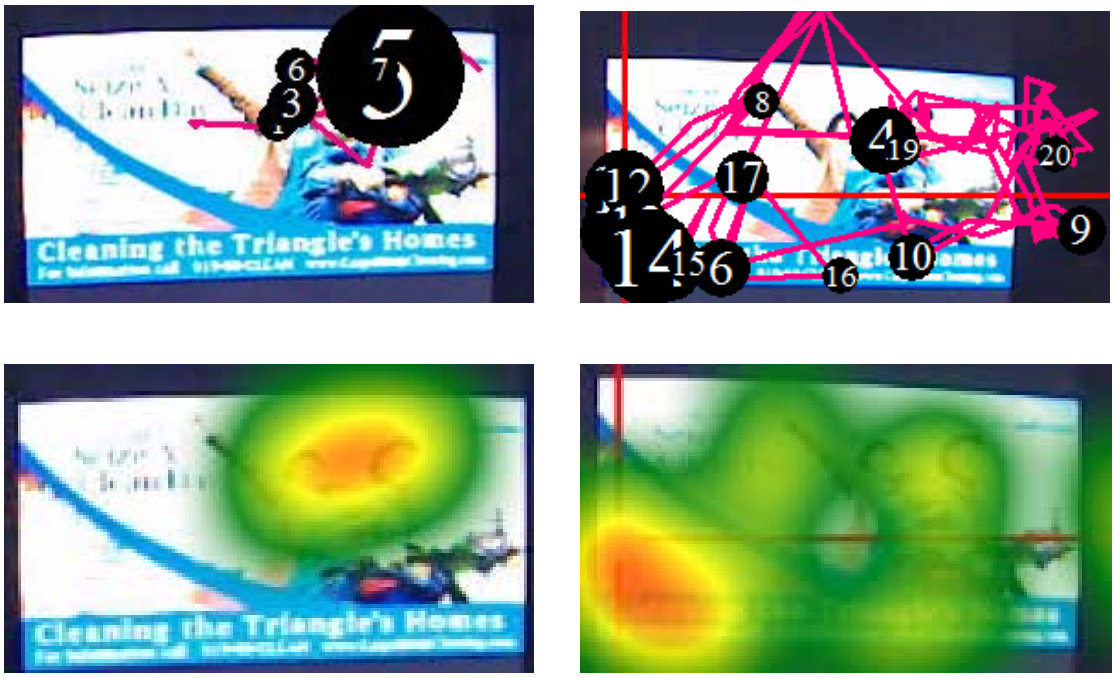
Novice: 6 sec (Mean 6 sec , Median 5 sec, Mode: 3 sec)

Experts: 14 sec (Mean 14 sec, Median 7 sec, Mode: 5 sec)

Summary of Data: Both 80% of Novices and 80% of Experts agreed that this piece effectively marketed to this target group. Reasons voluntarily given for this being improperly targeted included: "I don't think a free fridge cleaning will appeal to baby boomers.", and "These people don't look like my grandparents."

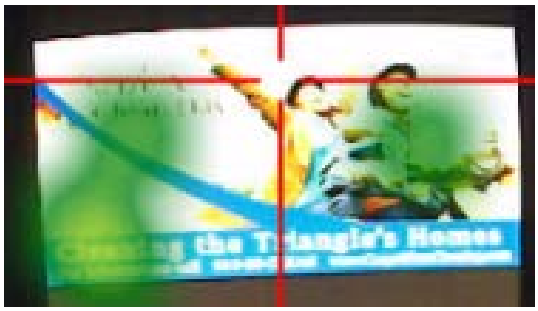
Novice gaze patterns and heat maps

Figure 14: Novice gaze plots and heat maps when vieweing question 2



Expert gaze patterns and heat maps

Figure 15: Expert gaze plots and heat maps when answering question 2



Overall gaze patterns and heat maps

After seeing this image in the initial viewing period, novices and experts seemed split on how to approach this question. Novices spent a good portion of their time looking at the people, occasionally viewing the surroundings to ensure that the context clues made sense. The novice in example #2 felt unsure of their answer, and took longer to return an answer. The eventual "No" answer was based heavily on the inclusion of a "fridge cleaning". The experts seemed to focus on contextual clues to tell them whether the ad was properly targeted or not—looking to the text provided within the advertisement, the moped, and the importance of the bottom bar. Color areas retain a high fixation rate.

Question 3: Which part of this piece is the most visually appealing?

Average Time to answer questions:

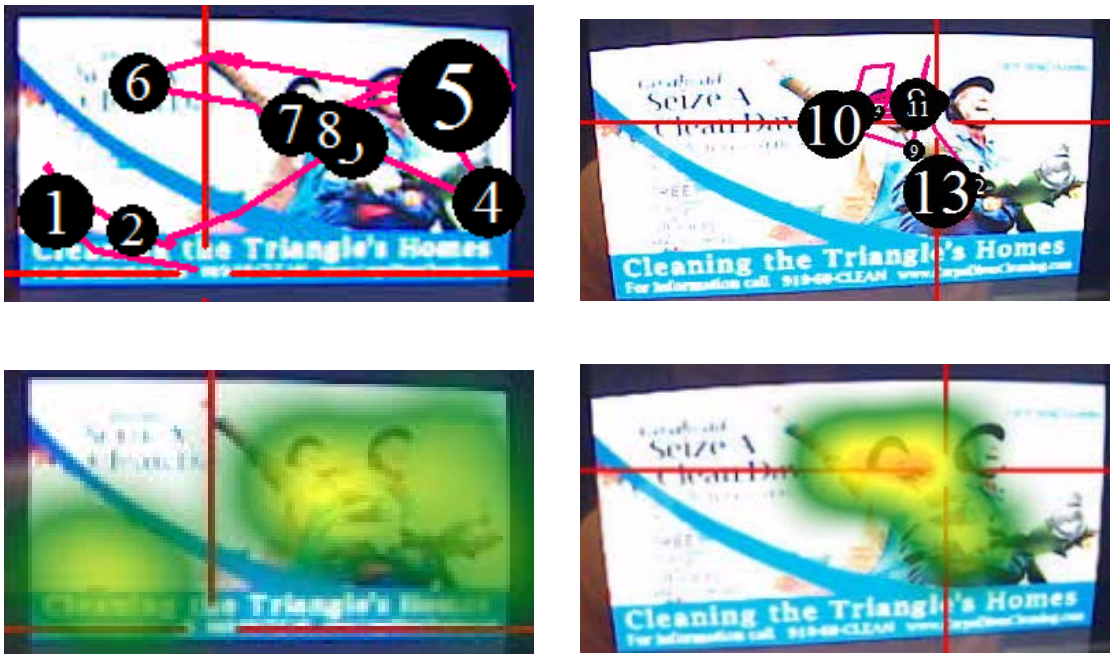
Novice: 5 sec (Mean 5 sec, Median 5 sec, Mode 4 sec)

Experts: 8 sec (Mean 8 sec, Median 7 sec, Mode 3 sec)

Summary of Data: The populations differed in their approaches and their reasoning with this image. Novices cited the couple 50% of the time as the most appealing, color areas 40% of the time, and the moped 20% of the time, (1 novice explained that the moped and the people were each "most important"). Experts, on the other hand, noted the couple 60% of the time, the moped 20% of the time, and color areas 20% of the time, while only 10% noted the logo as the most appealing, (1 expert also explained that the moped and the people were each "equally important").

Novice gaze patterns and heat maps

Figure 16: Novice gaze plots and heat maps when answering question 3



Expert gaze patterns and heat maps

Figure 17: Expert gaze plots and heat maps when answering question 3

Overall gaze patterns and heat maps

While the couple in this image was very important to both groups in determining which was the most visually appealing, experts found the couple to be more visually appealing than novices. Perhaps this intimates a more empathy-related approach. Novices, on the other hand were heavily influenced by the color areas. Perhaps this indicates a greater attention-getting factor in the color. Viewers may be familiar with people, but bright colors areas also seem to be a strong drawing factor. Another explanation may have to do with the longer viewing times of the experts. Perhaps by viewing the colors for longer periods of time, viewers become less entranced by them.

No one felt that the text used in this piece was visually appealing.

Experts took roughly 3 seconds longer on average to determine the most visually appealing element of the advertisement. Their gaze plots show longer gaze paths and a great deal of saccadic movement when answering this question. Even though answers from experts took longer to achieve, the overall number of fixations are quite low in comparison to those of novices.

Question 4: Why?

Average Time to answer questions:

Novice: 7 sec (Mean 7 sec, Median 7 sec, Mode 7 sec)

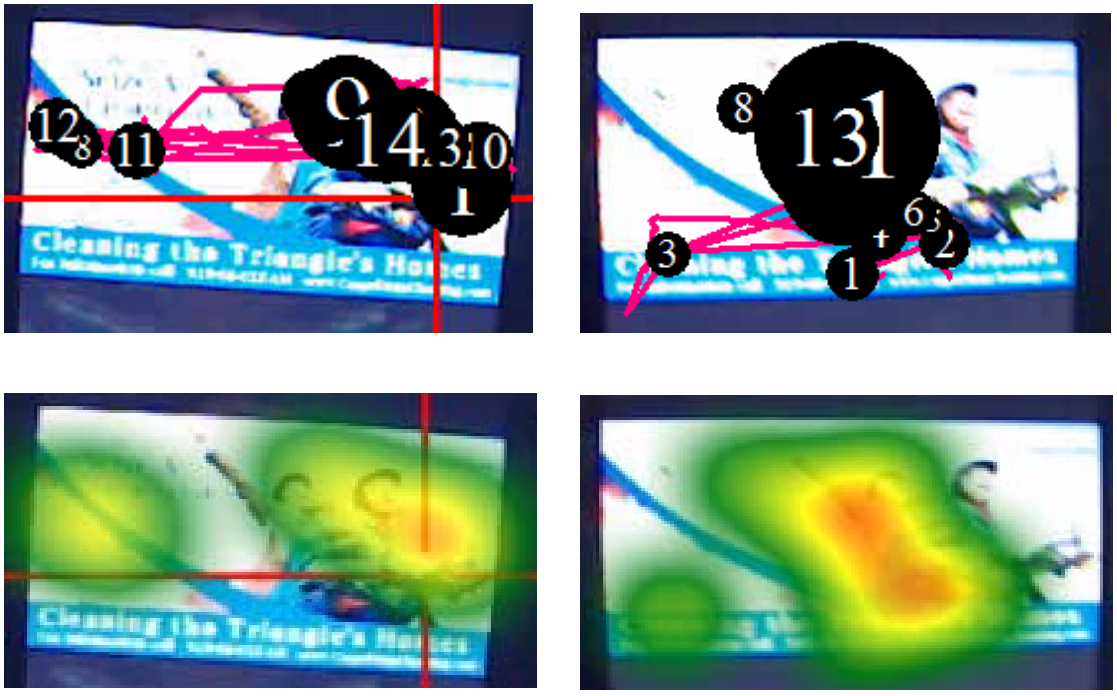
Experts: 9 sec (Mean 9 sec, Median 11 sec, Mode 13 sec)

Summary of Data: When asked to verbalize their decisions, the answers were surprisingly similar. Every participant that noted the moped (3 of 20) was the most visually appealing stated that the *color* of the moped influenced their decision. Those who chose the color areas (6 of 20) as the most visually appealing stated that their decisions were based on the colors themselves—with answers including statements such as: “it was the most striking,” and “it is the most colorful,” to because it had the “brightest colors and most vibrant patterns,” and that the color “stands out the most”. One expert noted that the logo was the most appealing due to its “clean design”.

Just over half of the participants (11 out of 20) noted that the couple stood out the most. Six of the eleven participants said that the reasons for this depended mainly on the expression (facial and body movement) of the female rider which drew viewers to this portion of the piece, while four participants noted the attraction to the couple was design related, stating: “the composition directed [my] eye to them,” that “[She] is in the visual center,” “[the couple] gives the most variation, and room for the eye to rest,” or that “[this] is the calmest area of the piece”. One person mentioned that the image was “simply not something one sees every day.”

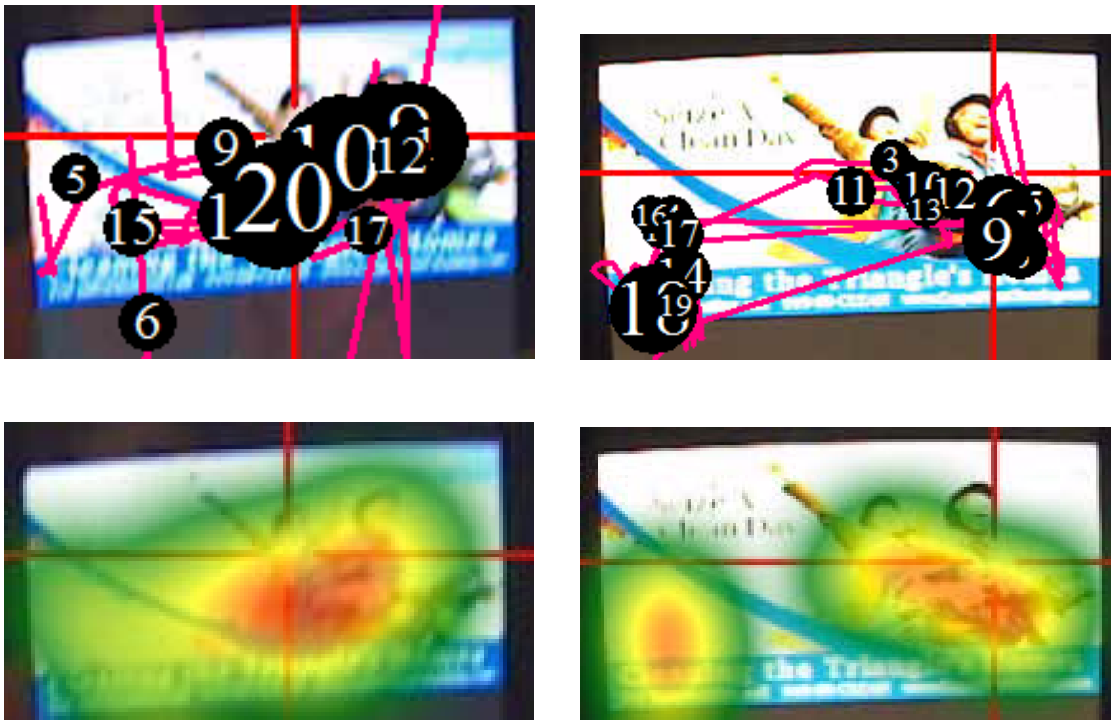
Novice gaze patterns and heat maps

Figure 18: Novice gaze plots and heat maps when answering question 4



Expert gaze patterns and heat maps

Figure 19: Expert gaze plots and heat maps when answering question 4



Overall gaze patterns and heat maps

Looking at answers to this question, the couple and the color areas seem to attract the greatest portion of attention. The couple's faces and expressions were also intensely important to determining why viewers felt that the couple was most important. While cycling appears in both pieces, it is highly pronounced in the expert views, most likely due to the longer answer times.

Image 2: Boom Magazine Advert #2

Average Viewing Time:

Novice: 8 sec (Mean 8 sec, Median 8 sec, Mode 10 sec)

Experts: 6 sec (Mean 6 sec, Median 6 sec, Mode 6 sec)

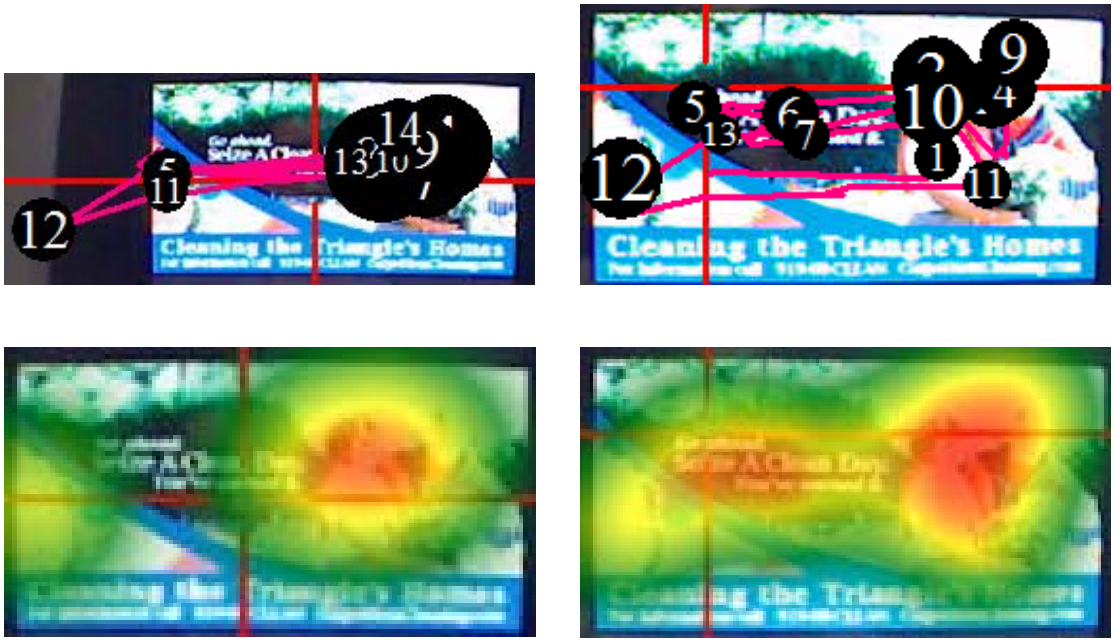
Summary of Data: This image follows a similar format as the prior image, but now hosts a female and male who are roughly 10 years younger than the previous. The image is not nearly as dynamic in body expression, and relies much more on implied line—the visual direction of where the subject is looking or directing their attention.

Novice gaze patterns and heat maps

Figure 20: Novice gaze plots and heat maps when viewing Image 2 for the first time

Expert gaze patterns and heat maps

Figure 21: Expert gaze plots and heat maps when viewing Image #2 for the first time



Overall gaze patterns and heat maps

In viewing both the novice and expert viewing patterns of the new image, similarities and divergences in viewing style continue to express themselves. Both novices and experts began with the human figures, circling around the piece in spiral patterns. Both novices and experts looked for the expressions on the faces, particularly at

the excited female figure, moved over to the flowers, color areas and text, ending with a return to the figures. This spiral pattern seems indicative of a searching pattern, a way of getting to know the image and identifying its major elements.

When viewing each group individually, similar to the gaze patterns of Image #1 (Boom magazine advertisement #1), Novices spent their time with multiple fixations across numerous elements of the piece, producing more fixations in a shorter amount of time. Novices made 15 & 17 fixations in the examples above while viewing this piece, while experts made 12 & 14 fixations when viewing the same piece for the first time. Similar to the results shown in Image #1, novices are using multiple viewing areas with vastly different lengths of fixation while experts are using fewer fixations with similar fixation time for each fixation, and longer views compared to the novice population. Experts are also traveling in much straighter lines,

Question 5: Please examine the image on the screen. This is an advertisement for a magazine marketed to "Baby Boomers". Does this piece effectively target that group?

Average Time to answer questions:

Novice: 4 sec (Mean 4 sec, Median 4 sec, Mode 3 sec)

Experts: 8 sec (Mean 8 sec, Median 5 sec, Mode 5 sec)

Summary of Data: Novices were able to answer this question much faster than the experts—in some cases even in half the time as their expert counterparts. Novices

agreed 80% of the time that this piece was targeted properly, and 90% of experts agreed that this piece was properly targeted. Each individual who felt the first ad was improperly targeted felt that this ad was properly targeted.

Reasons voluntarily given for why this was not properly targeted were “everyone likes to garden, not just baby boomers,” and “This doesn’t look like a cleaning ad.”

Novice gaze patterns and heat maps

Figure 22: Novice gaze plots and heat maps when answering question 5

Expert gaze patterns and heat maps

Figure 23: Expert gaze plots and heat maps when answering question 5

Overall gaze patterns and heat maps

In determining the effectiveness of this advertisement to the target, participants across the board looked to the couple to make their strongest determinations. Visual color areas within the flowers and color area on the left were also strong draws for both novices and experts.

One novice jumped around the piece with short fixations and long saccades, mainly focused within the bottom bar. Experts across the board seemed to have a harder time with this image as opposed to the first. While contextual clues seemed to hold a great importance for experts, this image had very low fixation rate (3 & 7 fixations in the examples above for experts over five seconds, as opposed to 10 & 13 fixations in the

examples above for novices in seven seconds). Expert gaze patterns moved over the entire piece looking at portions of the surrounding areas (possibly fixating for less than 200ms) heavily before answering.

Question 6: Which part of this piece is the most visually appealing?

Average Time to answer questions:

Novice: 7 sec (Mean 7 sec, Median 6 sec, Mode 3 sec)

Experts: 11 sec (Mean 11 sec, Median 9 sec)

Summary of Data: With a less visually dynamic piece (i.e. less movement and body language on the part of the models), eyes seemed to wander through this piece slightly more, and participants in both the novice and expert populations noted the flowers as an extension of the woman's vision (implied line).

Participants noticed the colors in these pieces more frequently, following the viewing eyes of the subjects. Seven subjects noted the color areas were the most visually appealing, six saw the flowers as the most visually appealing, five noted that the old couple were the most appealing, two felt that the bushes in the background were the most visually appealing, while two individuals noted that the logo and the text areas (respectively) grabbed their attention.

Experts gravitated to the color areas and the couple, with 50% noting the color areas as the most important and 30% noting the couple. 10% agreed with the flowers, and

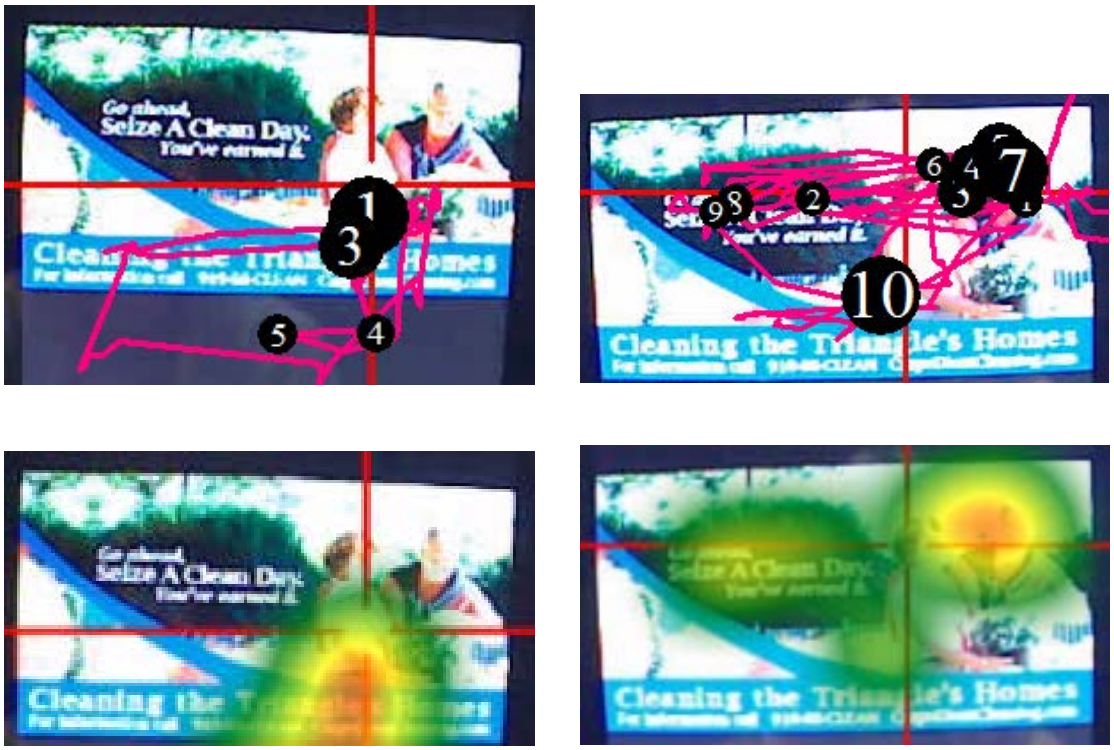
a further 10% noted the calmness of the bushes were important. Novices, on the other hand, seemed to follow the visual cues of the design, with 40% agreeing that the flowers on the bottom were the most important. 20% agreed that the color areas were important, and a further 20% agreed that the couples were visually appealing. The bushes and the text of the piece each garnered a 10% share.

Novice gaze patterns and heat maps

Figure 24: Novice gaze plots and heat maps when answering question 6

Expert gaze patterns and heat maps

Figure 25: Expert gaze plots and heat maps when answering question 6



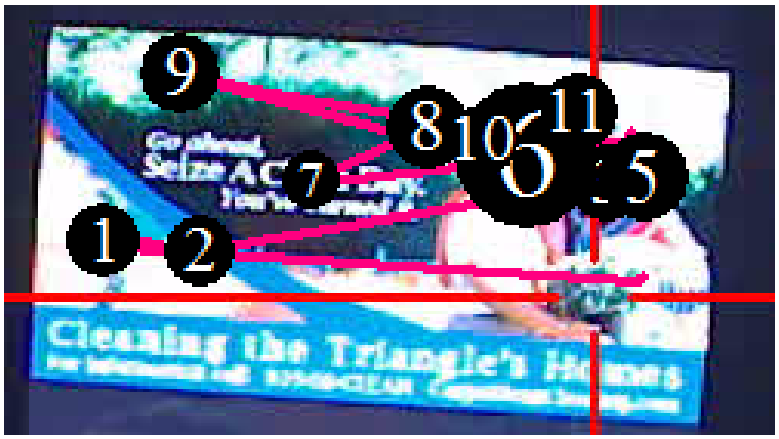
Overall gaze patterns and heat maps

Experts took several seconds longer to answer this question. While the mean time for novices hovered around six seconds, the mean for experts landed at nine seconds—half again as long as the novice population.

Answers from Image #1 suggested that the actual text message within the advertisement might not be as important as the visual impact of the elements within an advertisement. Most people seemed to skim over these portions of the pieces, but within this advertisement only 5% of the total participant population felt that the message was important.

Novices may have felt that a certain choice won out quickly, while experts felt that they had several factors which needed to be taken into account. Novice #1 shows a quick determination, with a heavy cluster of answers in a short, tight area—a clear indication of interest within a small area. Novice #2 had a longer answer, but with a multitude of fixations.

Figure 26: Novice 2 viewing, seconds 1-4



In the first four seconds of viewing, the novice completed 11 fixations. Moving from the color areas into the figures, the viewer transitioned their gaze from person to person. Viewing the couples faces in four fixations, the novice spent the longest portion of this interval targeted (fixation #6) upon the face of the female—most likely viewing her expression. After leaving the couple, the novice moved to the text area, up into the sharp contrast of where the bushes meet the sky, and then to an area of visual interest withing the bushes to the left (the location where the bushes are mirrored in the image). After viewing the bushes, the novice moved back to the female's face and ended on the logo in the upper right.

Figure 27: Novice 2 viewing, seconds 5-9

In the second four seconds of viewing, the novice completed 10 more fixations. The novice returned to the bushes (roughly the same spot from fixation #8 in the first four seconds of viewing), and went directly to the couple and the flowers. Fixation #2 at the female's face is followed by pursuing the implied line her eyes create, taking the viewer to the flowers. After a short pause, the viewer goes to the color area behind the female (flowers) for the longest pause of this piece. From fixation #4 (the flowers behind the female) the novice travels up and down between the couple's faces and the flowers.

Experts in this viewing traveled around the piece quite a bit before confirming their answers. Expert #1 (who found the flowers to be the most visually appealing), kept his gaze on the flowers, as well as the color areas behind the model and at the left portion of the image, all without seeming to touch on the couple at all.

Expert #2 (who found the couple to be the most visually appealing), moved their gaze across the piece quite a bit before answering. This individual was unsure of their answer, and the gaze path here shows a strong searching pattern with few fixations.

Question 7: Why?

Average Time to answer questions:

Novice: 5 sec (Mean 5 sec, Median 5 sec, Mode 3 sec)

Experts: 15 sec (Mean 15 sec, Median 11 sec)

Summary of Data: When answering questions related to why they made their choices in the previous question, massive differences begin appearing in the populations.

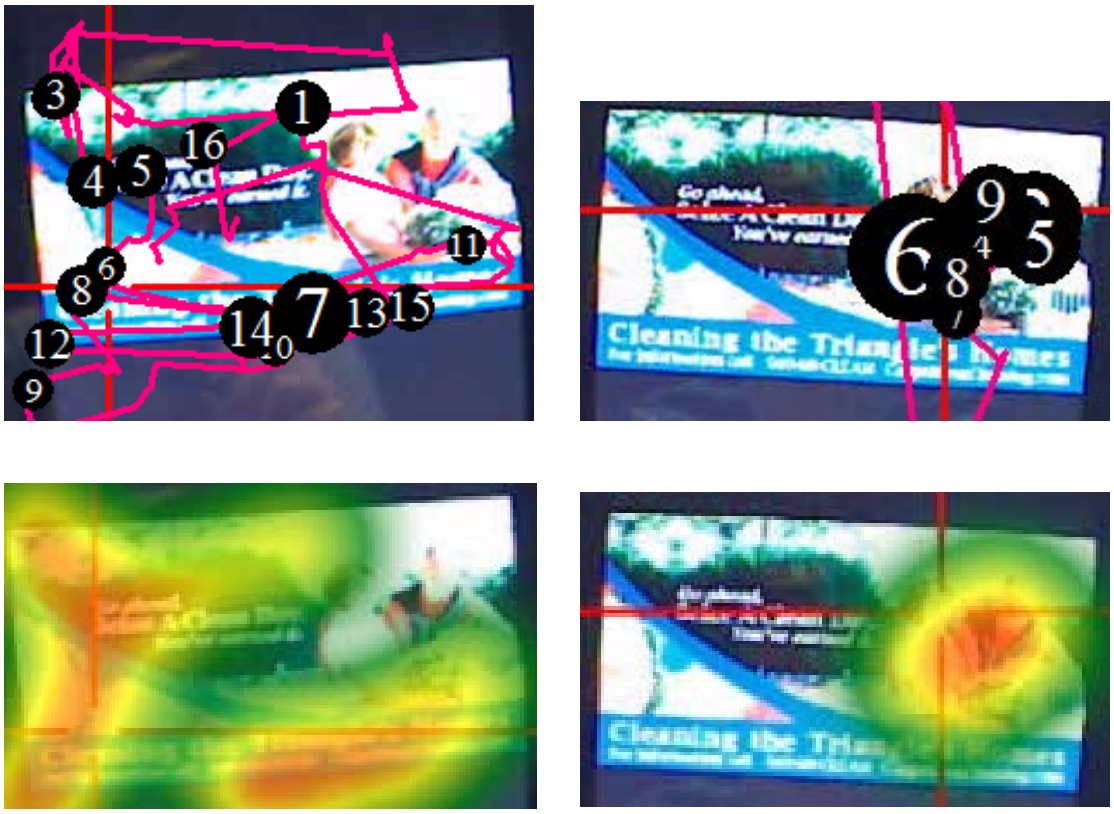
Novices were very quick to answer their questions, most answering within three seconds of the question, but running with mean and median times of five seconds. Experts, on the other hand, needed longer to articulate their answers—with mean times of roughly 15 seconds (three times as long), and median times of 11 seconds (two to four times as long as novices).

Novice gaze patterns and heat maps

Figure 28: Novice gaze plots and heat maps when answering question 7

Expert gaze patterns and heat maps

Figure 29: Expert gaze plots and heat maps when answering question 7



Overall gaze patterns and heat maps

Novice answers surrounding the flowers included statements such as: “[they were] the first thing I saw,” “the colors contrasted so strongly,” “visual cues within the

whole piece seemed to point to the flowers," and "the people are interacting with the flowers". Experts felt that the flowers were attractive because they had "bright colors and that really fit well with the feel of the advertisement". In describing their reasoning, both experts and novices felt that the flowers were appealing due to their high color and contrast as well as the seeming connections within the composition of the piece—things *felt* right with the use of colorful flowers within the overall composition

Novice answers surrounding the couples included statements such as: "their expressions grabbed my attention," "the colors of their clothing really stood out," and "the visual difference between the focused people and the blurry background forced me to look at them". Expert answers surrounding the couples included statements such as: "the composition of the piece is directing you to the people," "humans attract attention," and "they are happy and have sunlight on their faces." Both groups felt that the humans in the advertisement demanded visual attention and that the expressions of the couple were an integral part of that importance.

Novice answers surrounding the color areas included statements such as: "the colors really stood out" and "[the color area] really pops visually". Expert answers surrounding the color areas included statements such as: "The area is really colorful, and it ties in well with the flowers of the piece," "the texture in the color area [is visually appealing]," "the color areas are more appealing than the photo," and that the "color and vibrant patterns draw my attention".

One Novice stated that the text was "central to the space" and therefore important.

Novices stating that the bushes were visually appealing noted that “the trees look weird”. Experts stated that the bushes represented “a calm area that was not so busy”.

As noted with the answer above: “the couple is looking at the flowers,” within both populations, the expressions of the couple and object of their gaze (the flowers) seemed to be of importance. In design literature it is widely known that viewers look in the direction that the eyes of any human depicted within an image are looking. However, neurobiologists have also shown that these are the results of mirror neurons.

These studies show that the perception-action cycle (the idea that perception and action are heavily related if not interconnected—perception as a means to action and action as a means to perception) reveals very similar coordination patterns when occurring between two people as when occurring within one person.

> How does the individual cognitive system succeed at this cross-individual coordination? One suggestion is that we engage in perceptual-motor-simulation (Barsalou, 1999a) or prediction (Wolpert & Flanagan, 2001): When watching a motor action, humans implicitly generate the action internally. As recent evidence for this, Flanagan and Johansson (2003) had participants perform or observe a sequential manual action of stacking blocks. Participants who observed the action did not passively follow the movements, but rather seemed to “simulate” the motor activity itself with anticipatory eye movements that in fact matched the eye movements of the actor. Then authors suggest that the cognitive system actively predicts and simulates action, even when just Observing the actions of others.

> This perspective on motor simulation and prediction resonates with the recent discoveries of a mirror neuron system (Decety & Grèzes, 1999; Rizzolatti, Fadiga, Gallese, Fogassi, 1996). A subset of neurons in both nonhuman primate and human premotor cortex seems to fire both when performing an action and when observing others perform the same action (see Rizzolatti & Craighero, 2004, for a review). This shared mechanism for perceiving and predicting action may be an important component for coordinating one's behavior with others. (Spivey, Richardson, & Dale, 2009, p.241)

As Spivey, Richardson, & Dale point out, one essentially cannot help but act out in reaction to these perceived actions:

> As argued by ecological psychologists (e.g., Gibson, 1979; Turvey, 1992), part of understanding a visual scene necessarily involves mapping one's potential behaviors onto the actions afforded to your body by that environment. And as argued by proponents of embodied cognition (Barsalou, 1999b; Glenberg & Kaschak, 2002), part of understanding a sentence necessarily involves perceptual-motor simulations of the events described in that sentence. (Spivey, Richardson, & Dale, 2009, p.242)

Other facets of this can include the idea of emotional contagion—that the perception of an action should activate action representations to the point where the perceived action and the represented action are similar (i.e. seeing someone cry may very well make your eyes tear up) (Knoblich & Flach, 2001).

In viewing answers to this question, the effect of having the models within the image looking at an item certainly cause viewers to consider this item with heightened awareness, and a greater amount of visual weight (as noted by fixation amounts over time).

Image 3: Zestworld Letterhead #1

Average Viewing Time:

Novice: 7 sec (Mean 7 sec, Median 7 sec, Mode 9 sec)

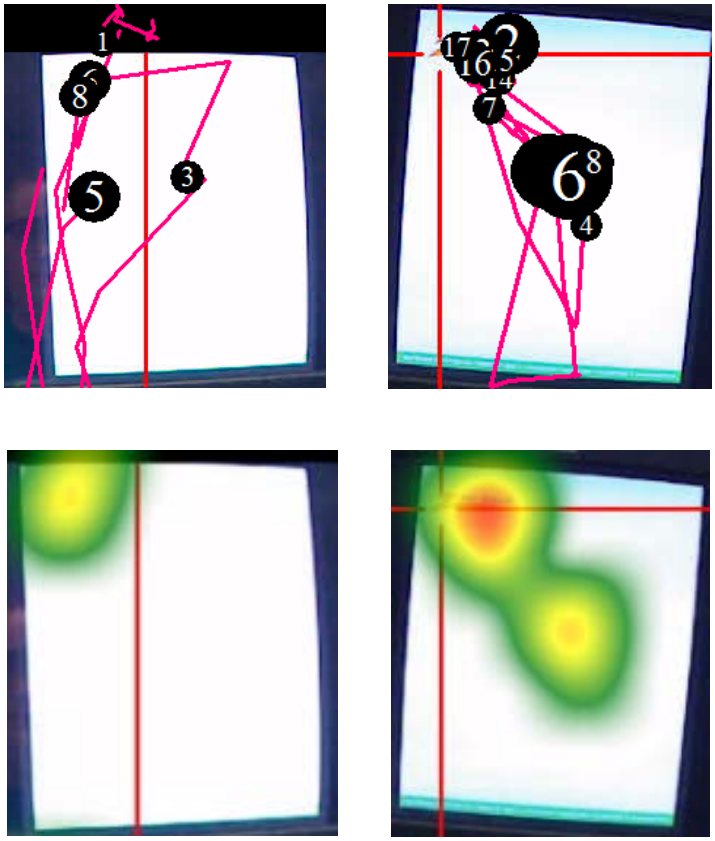
Experts: 8 sec (Mean 8 sec, Median 8 sec, Mode 8 sec)

Summary of Data: The first two examples in this study included pieces with lots of visual objects and lots of colors. The third image, a letterhead goes in the opposite

direction. This piece includes a strong visual logo at the top of the page, a broad watermark, and an information area below.

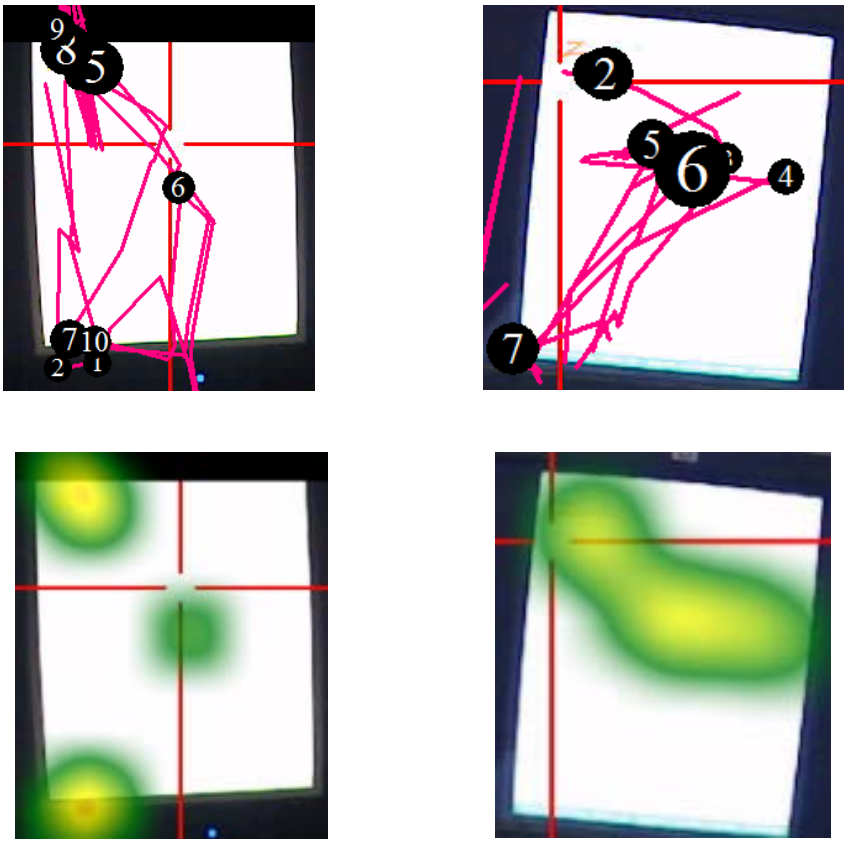
Novice gaze patterns and heat maps

Figure 30: Novice gaze plots and heat maps when viewing image #3 for the first time



Expert gaze patterns and heat maps

Figure 31: Expert gaze plots and heat maps when viewing Image #3 for the first time



Overall gaze patterns and heat maps

When viewing this image for the first time, novices and experts alike seemed to use similar gaze patterns, viewing the logo in the upper left, the top or center of the Z watermark, and touching on the lower left of the bottom bar.

Both novices started with the logo, before moving down into the watermark with fixation(s) #3 or #4. They then cycled back through the piece to the logo between fixation(s) #5 or #6—and in the case of novice #2 cycling further between the logo and watermark. Expert #1 viewed from the bottom bar up to the logo for several fixations,

dropping briefly to the watermark, and then cycling through the bottom bar and the logo twice more. Expert #2 viewed from the logo (2 fixations) down to the watermark (4 fixations) and then down to the bottom. Further gaze patterns show movement from there, but not fixations of 200ms or more. With a similar amount of time to view this image (eight seconds), novices managed to make 8 & 17 fixations in the examples above while viewing the image, while experts made 7 & 10 fixations in the examples above.

The faded colors of the watermark may account for the great number of fixations here, or the visual interest could also have caused such a large number of fixations.

Question 8: Please examine the image on the screen. This is a company letter stationary for a company called Zestworld. What is the most important thing on this page?

Average Time to answer questions:

Novice: 6 sec (Mean 6 sec, Median 6 sec, Mode 3 sec)

Experts: 19 sec (Mean 19 sec, Median 4 sec, Mode 2 sec)

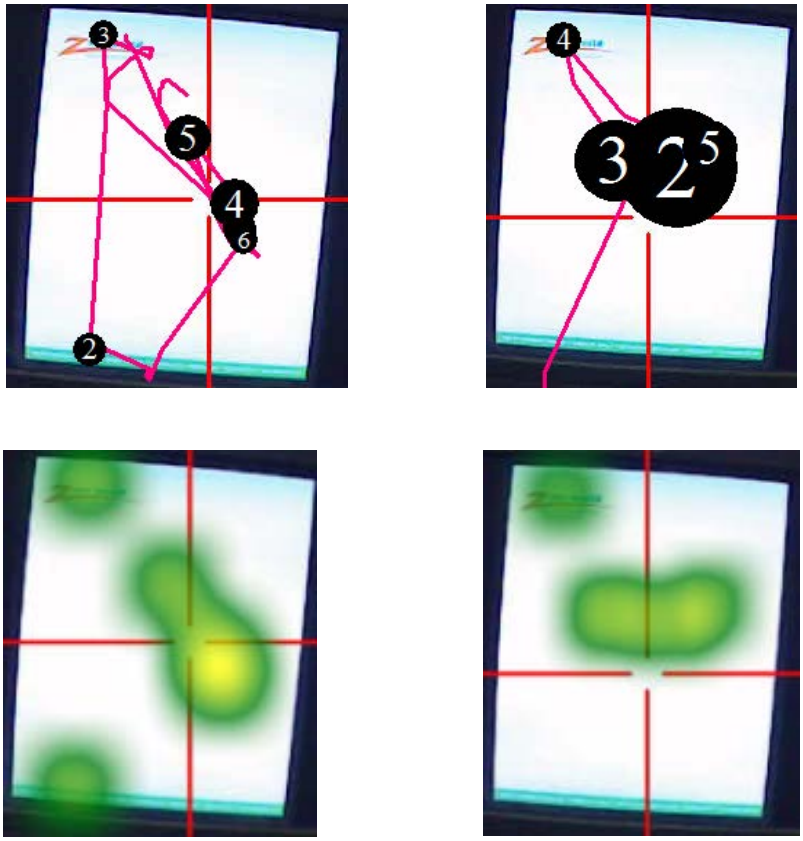
Summary of Data: Nine participants (45% of the total population) found that logo was the most important, with six experts and three novices in agreement. Seven participants (35% of the total population) found that the watermark was the most important thing on the page, with four experts and three novices in agreement. Four novices (20% of the total population) felt that the contact information at the bottom was

the most important part of this design. No experts felt that the contact information at the bottom was important.

The time-based numbers on this piece show a statistical disparity. While most experts came to their conclusions quicker than novices (often in two seconds, but with a median value of four seconds), a single individual within the expert population was indecisive, requiring almost a minute and a half (85 seconds) to come to a decision. With fewer elements to consider, experts found the answer to this question quickly.

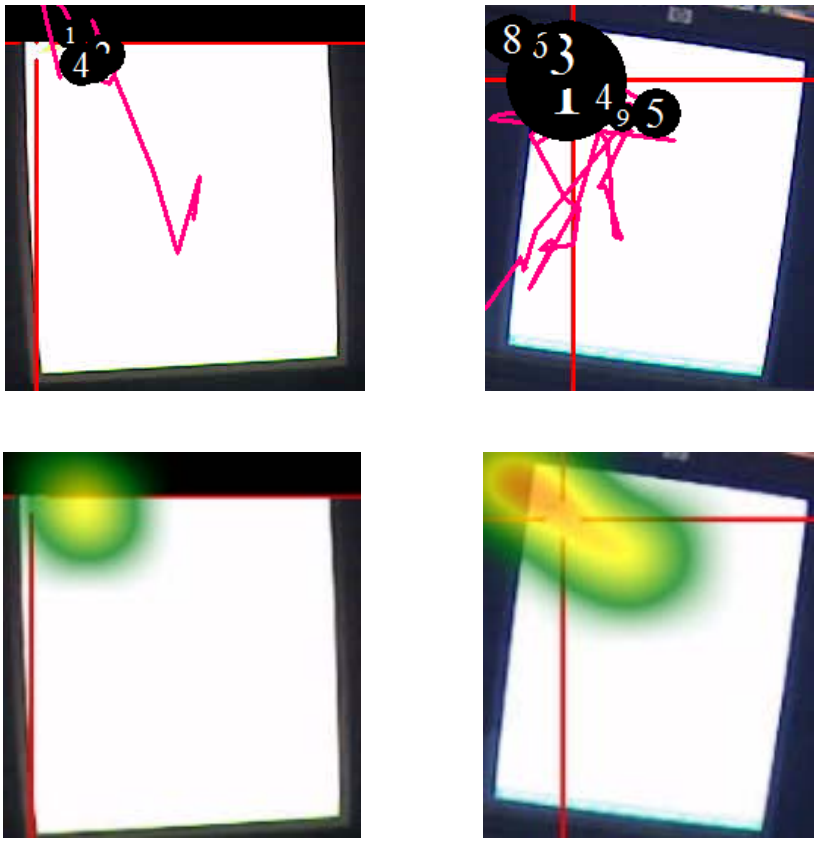
Novice gaze patterns and heat maps

Figure 32: Novice gaze plots and heat maps when answering question 8



Expert gaze patterns and heat maps

Figure 33: Expert gaze plots and heat maps when answering question 8



Overall gaze patterns and heat maps

When viewing the gaze patterns for this piece, novices and experts alike seemed to keep their attentions on the top of the letterhead, keeping their eyes focused on the logo, and either the top left or center of the Z watermark. Little or no fixations were given to the bottom bar, and even less attention to the tail end of the Z watermark.

Novices viewing this piece gave immediate attention to the watermark, moving just for a moment to the other parts of the piece before cycling back with multiple fixations on the watermark.

Experts viewing this piece began with the logo, and kept their fixations very close to it. Gaze patterns do indicate that the eyes of both experts moved through the piece before answering, although they had nothing to do with the bottom bar, and little if anything to do with the watermark beyond the top corner.

Question 9: How do you know?

Average Time to answer questions:

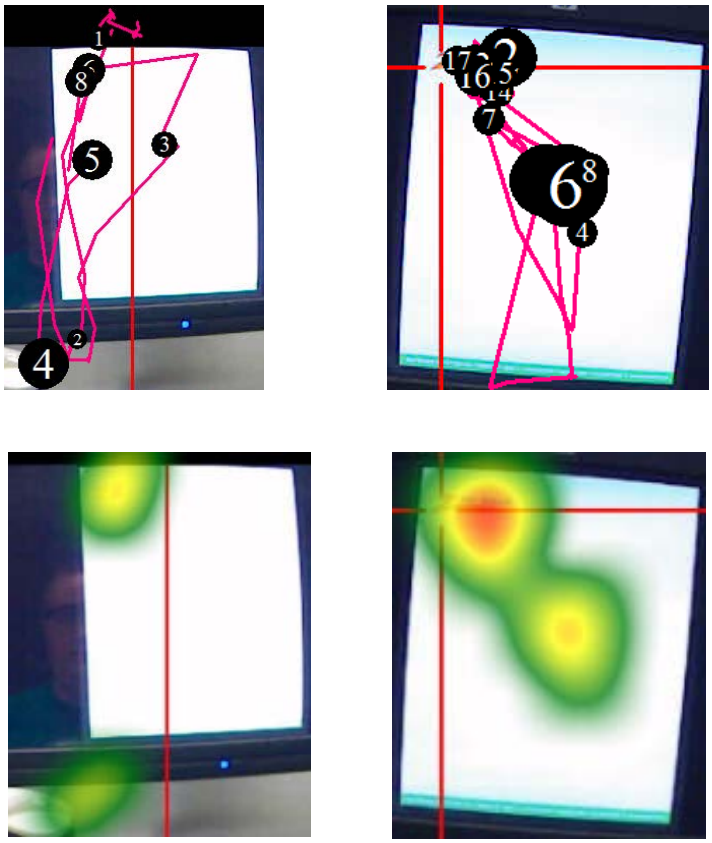
Novice: 6 sec (Mean 6 sec, Median 5 sec, Mode 5 sec)

Experts: 12 sec (Mean 12 sec, Median 14 sec)

Summary of Data: When the participants were asked how they knew which part was important, the differences between the populations were evident. Novices were able to articulate their answers quickly and precisely. To the contrary, expert answers took 2-3 times as long to articulate as their counterparts.

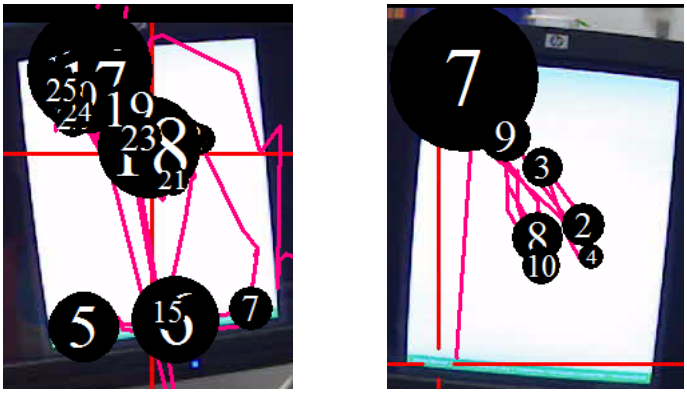
Novice gaze patterns and heat maps

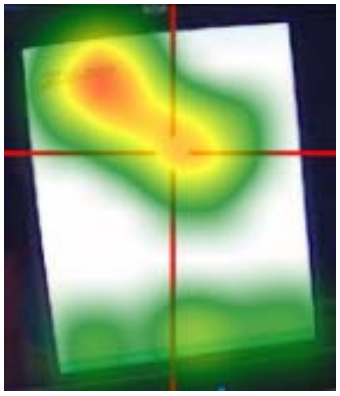
Figure 34: Novice gaze plots and heat maps when answering question 9

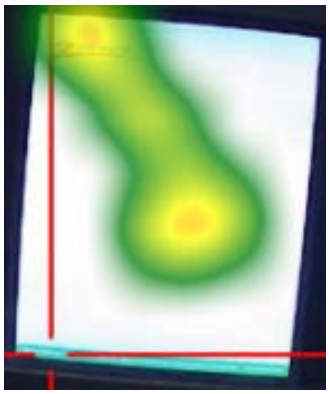


Expert gaze patterns and heat maps

Figure 35: Expert gaze plots and heat maps when answering question 9







Overall gaze patterns and heat maps

When relating how they knew that the logo was the most important feature, commentary seemed to connect its importance with its level of visual dominance and its level in the top-down visual hierarchy of the piece. Novice participants stated that they knew the logo was the most important because it was "placed at the top," was the "most prominent," and because "without this information, you wouldn't know who [this piece] is for". Experts gave similar comments, stating that they knew the logo was the most important element because "it is the boldest part," "[it is the] most attention-grabbing piece," was the "most prominent part with the boldest colors," it "first attracted [my] attention," contained the "most prominent lettering," and was "visually dominant".

When relating how participants knew that the watermark was the most important feature, commentary from both populations noted the size attribute as the main reason for its importance. Novice participants stated that its importance was known because of its "repetition. There are two of them in the piece," because it "can be seen from everywhere," and that it was "centered on the piece, and the largest thing on the page". Experts noted that its importance was apparent "because of its size and it's being centered

on the page," its "clear, but perfect spacing," and "its size and being the most transformed element in the space". One participant stood out, noting the fact that its color allowed for visual emphasis, but "if this [color] was too strong, it'd be hard to read text on the end product."

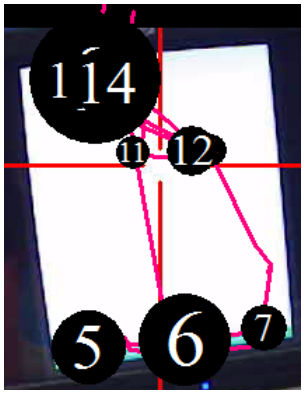
When relating how the novices knew the information at the bottom was the most important feature, commentary centered heavily around the informational aspect of the piece. No experts found this information to be important, although it should be considered that 40% of the novice population felt it to be the most important. Both novices noted that "[the bottom bar] is where the company information is located". One participant candidly noted his reasoning for knowing the bottom was the most important element: "[I have a] lack of knowledge of this company. But, at least with this information, I could learn more about the company."

Novice gaze patterns for this piece used a fairly similar format to how they answered the previous question. Beginning in the logo or watermark area, novices cycled back and forth through the watermark top and the logo over their six- to eight-second answers. The familiar spiraling patterns of viewing are evident in the gaze patterns of saccades and fixations.

Experts took twice as long in their answering on average, and their gaze patterns ranged across the letterhead. Experts typically began viewing from the top down, with the logos. Experts had saccades that visited the bottom bar, and about half had fixations there. Fixations clustered heavily in the logo area and watermark, however.

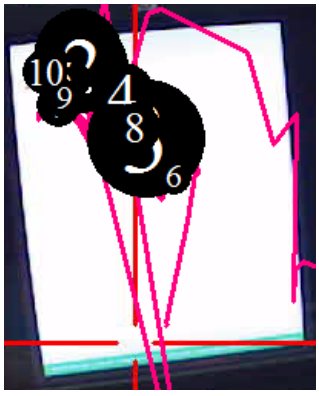
Expert #1 had a slightly longer answer. This expert chose the watermark as the most important part of the piece, and used this question as an opportunity to explain their answer: “[I chose it] because it fills the space, and its translucent. When you think Zest, you don’t think overpowering.”

Figure 36: Expert 1 viewing, seconds 1-8



In the first eight second segment of their answer period, expert #1 cycled around through the entire layout. Beginning in the logo area, this expert had two fixations before moving to the watermark, and then to the bottom bar in the lower left. Fixations 4-7 occur at the bottom bar, and then the expert cycles back to the top and returns to the watermar. Most of these fixations are not short, but rather 200-500ms in length.

Figure 37: Expert 1 viewing, seconds 9-16



In the second eight second segment expert #1 cycled through the upper portion of the layout four separate times, moving from the logo to the watermark and back. Gaze patterns over this segment show one time when the eye wandered off screen to the right, and one time when the eyes wandered down to the paper during this answer.

Question 10: What would you change?

Average Time to answer questions:

Novice: 8 sec (Mean 8 sec, Median 6 sec, Mode 4 sec)

Experts: 19 sec (Mean 19 sec, Median 15 sec, Mode 16 sec)

Summary of Data: When considering what they might change if the piece were in their possession (experts to adjust the creative side, and novices to instruct the artists/designers), each population fell back on their level of skill and visual sense to come to a conclusion. It is important to note that the idea that "nothing" was an acceptable answer, was made available to both populations by way of a short explanation after the question was asked.

Novice participants knew what they would like to see adjusted, and were able to give quick answers, with four seconds being the most used timeframe. Experts, on the other hand, had much more knowledge to parse through, and much more vocabulary in which to describe the decisions that they would made. Experts responded most often in

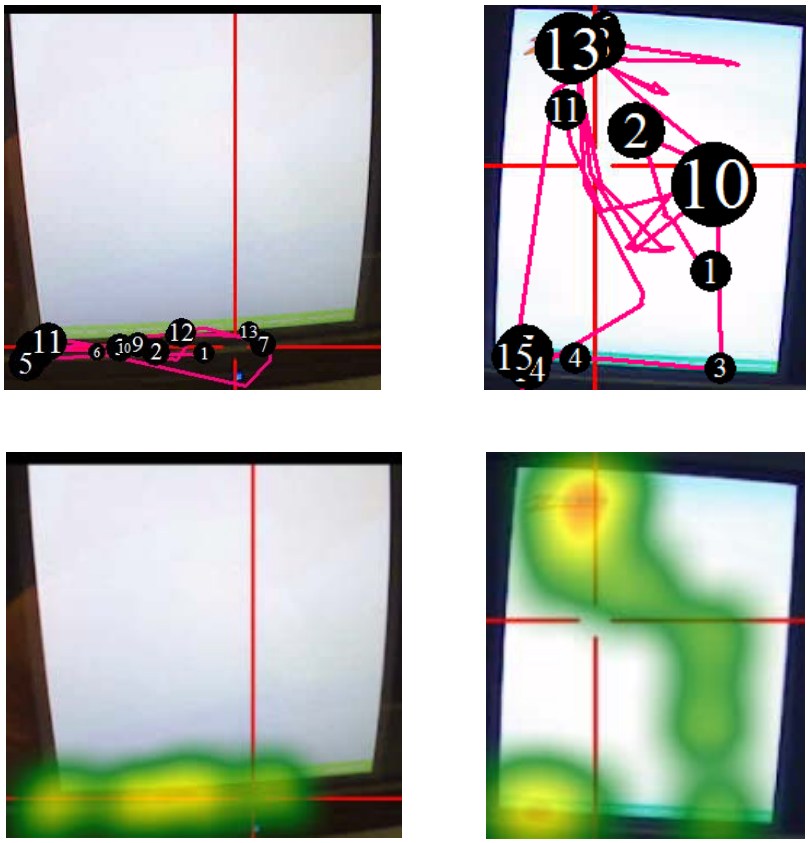
16 seconds, causing them to consider the piece for up to five times the length required of the novice populations.

Novice populations seem to clump together with their answers: 50% (5 participants) answered that they would change nothing, 30% (3 participants) felt that the watermark should change its color (including 1 person who felt that the watermark was the most important thing on the existing page). One individual felt that the information should be brought up from the bottom, and one individual felt that the type on the bottom needed to be more legible, respectively.

Expert populations considered the piece with all of its parts individually. The largest group (three participants, 30% of the expert population) felt that the bottom bar color needed the most attention. They stated that the color should be adjusted with explanations like: “change the bottom green color,” change the bottom green to black for better legibility,” and “change the green bar—It is distracting, too bright, and it is hard to read the information there”. Two individuals (20% of the expert population) felt that the logo needed some care, with one suggestion that the font at the top should be adjusted, and that another suggestion that the Z itself was already overdone and should be considered for a redesign. One individual noted that the bottom bar needed adjustments to legibility by changing the font face, size, or color. A single individual felt that the watermark needed a size adjustment so that it did not bleed off the edge of the page. One expert was unsure of what they would change, and gave no answer.

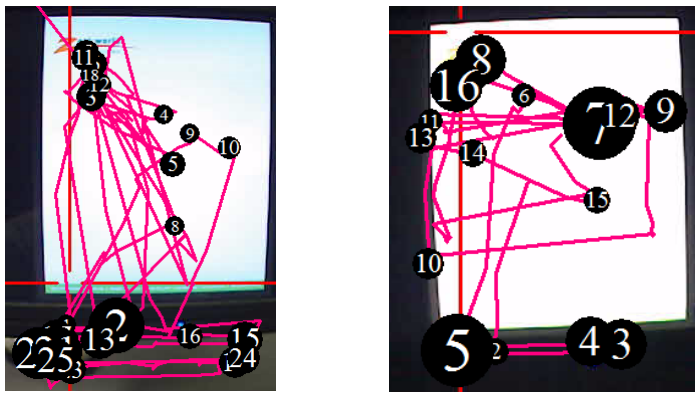
Novice gaze patterns and heat maps

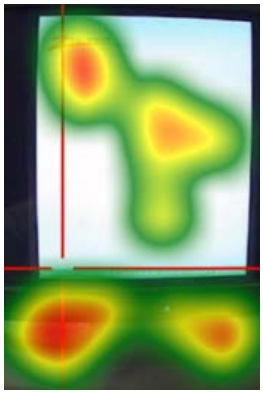
Figure 38: Novice gaze plots and heat maps when answering question 10



Expert gaze patterns and heat maps

Figure 39: Expert gaze plots and heat maps when answering question 10





Overall gaze patterns and heat maps

When viewing this piece, novices managed to gather a fair amount of fixation in their time. Novice #1 managed 13 fixations in four seconds, and novice #2 took their time, gathering 15 fixations in eight seconds. Experts, on the other hand, spent more time moving than fixating. Expert #1 made 25 fixations in 16 seconds, and expert #2 made 16 fixations in 10 seconds.

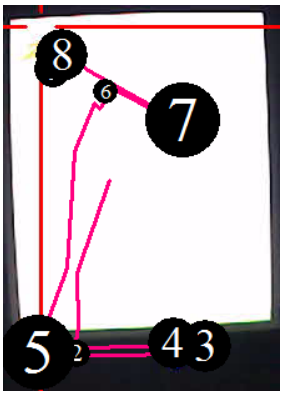
Novice #1 wanted to change this letterhead to have more readable type. When viewing this piece, all 13 fixations happen in a side-to-side sweeping visual group. There is no spiral in this gaze path. Novice #2 ultimately decided not to change anything. In coming to that final decision, novice #2 paid adequate attention to the logo, watermark, and bottom bar. Beginning in the watermark, Novice #2 moved down to the bottom bar, up to the logo, and then began cycling up and down through these paces.

Expert #1 wanted to see the bottom bar color adjusted. Beginning in the logo, the expert moves down through the watermark and into the bottom bar. Once within the bottom bar, they cycle up to the logo once or twice, but manage to take 14 fixations

within the bottom bar before deciding on an answer. Head movement in this period causes the fixations on the bottom to seem out of synch with the graphic.

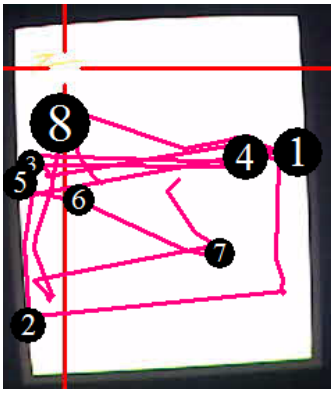
Expert #2 wanted to see the Z watermark truncated to a smaller working size—so that it did not bleed off the edge of the page. Let's look at this expert's gaze trail:

Figure 40: Expert 2 viewing, seconds 1-5



In the first five seconds of viewing, the expert began by fixating on the logo. Diving down into the bottom bar, the expert moved back and forth in straight lines with several 200-500ms fixations. Sliding up into the watermark at fixation #6, the viewer dropped to the point where the top bar of the Z meets the diagonal slant. At this point, the fixation is long, but the viewer cycles up to the logo—possibly for comparison.

Figure 41: Expert 2 viewing, seconds 6-10



In the second five second segment, the expert viewer seems to cement their idea. Moving from the logo, the expert fixates on the location where the Z watermark top bleeds off the edge of the letterhead. From here, the gaze drops down to the bottom bar of the Z, but leaps over to the left edge of the Z watermark—where the diagonal bar comes down to meet the bottom bar of the Z. Up to fixation #3 (left edge of the Z top bar), back to fixation #4 (diagonal bar of Z meets the top bar), back to #5&6 (left edge of the Z top bar), over to the middle of the watermark at fixation #7, and back up to the top bar at fixation #8. Ten of the 16 fixations are used to visually feel out the form as they consider changing it.

Question 11: Is the logo on this the right size?

Average Time to answer questions:

Novice: 7 sec (Mean 7 sec, Median 6 sec, Mode 4 sec)

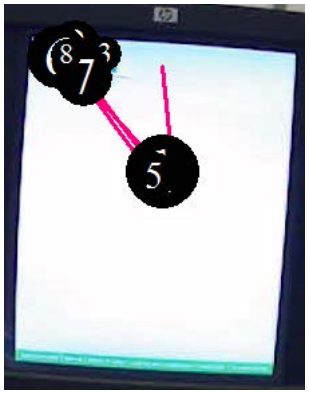
Experts: 13 sec (Mean 13 sec, Median 12 sec, Mode 12 sec)

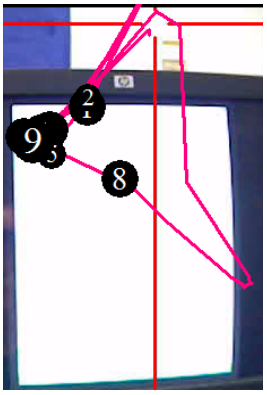
Summary of Data: The novice and expert divide on answering times was again very pronounced in this question. A single novice was able to bang out her answer in exactly one second, although most novices took roughly 6-7 seconds to answer. Most experts took roughly twice as long to answer their questions, with most clustering around 13 seconds to answer. The experts found themselves comparing elements of the piece before answering.

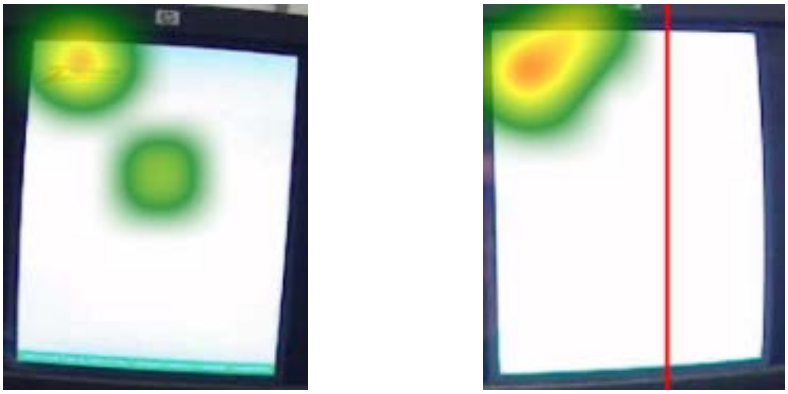
Overall, participants found that the logo properly sized, with three out of every four participants (75%) agreeing that the size was correct. No participants felt that the logo was too big, but four novices felt that the logo was too small. A single expert agreed that it should be larger, stating that the logo was "too small."

Novice gaze patterns and heat maps

Figure 42: Novice gaze plots and heat maps when answering question 11

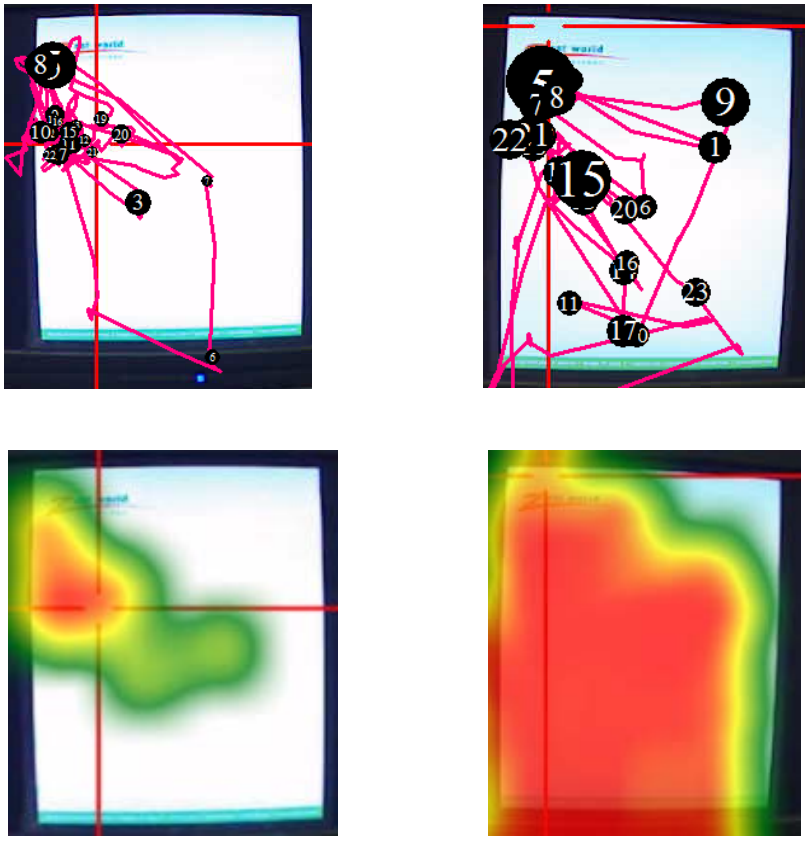






Expert gaze patterns and heat maps

Figure 43: Expert gaze plots and heat maps when answering question 11



Overall gaze patterns and heat maps

This question was intended as a strictly comparative question, requiring a yes or no answer. However, nearly every single person (16 out of the entire 20 person population), asked me a clarifying question:

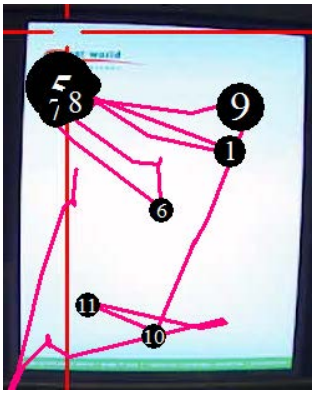
"Do you mean this logo or this logo?"

During this question, the viewer would invariably point between the logo in the upper left corner and the watermark. This was observed even those who had chosen the watermark by name, or chosen the logo by name in previous questions.

In answering this question, novices and experts had their actions in common. To answer this question, both populations took a comparative approach, cycling back and forth from the logo to the watermark. Novices came to their conclusion with only 1-2 fixations on the watermark required. Experts, on the other hand, took between 14-16 fixations on the watermark before coming to their conclusions.

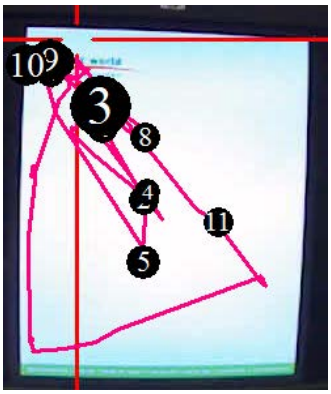
Examining expert #2's gaze pattern, the following approach becomes apparent:

Figure 44: Expert 2 viewing, seconds 1-6



In the first six seconds of viewing, the expert began by looking at the watermark. From here, they had four fixations at/near the logo before cycling back to the middle of the watermark. The next two fixations return to the logo, with a lengthy fixation after cycling back to the top of the watermark. At the end of this segment, the expert had fixations at the bottom of the watermark before their gaze traveled to the bottom corner and moved back toward the top of the watermark.

Figure 45: Expert 2 viewing, seconds 7-12



In the second six seconds of viewing, the first five fixations fall within the watermark—possibly comparing size and spacing. The expert then cycles back to the logo area for two fixations, back to the watermark for fixation #8, then cycles back to the logo for fixations #9-10. The last fixation (#11) drops down to the watermark, although a gazepath is coming back up to the logo as they answer their question.

Image 4: Zestworld Letterhead #2

Average Viewing Time:

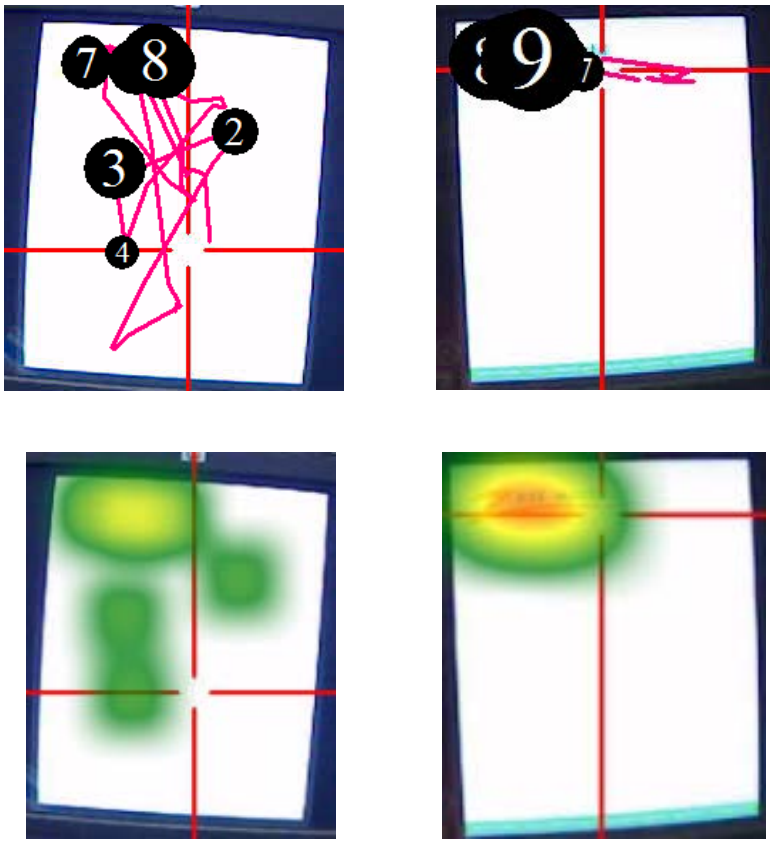
Novice: 4 sec (Mean 4 sec, Median 4 sec, Mode 5 sec)

Experts: 4 sec (Mean 4 sec, Median 4 sec, Mode 4 sec)

Summary of Data: This piece was added to the questionnaire as a comparative piece. Rather than a standard logo size, the logo here has been increased to cover roughly 60-75% of the width of the page.

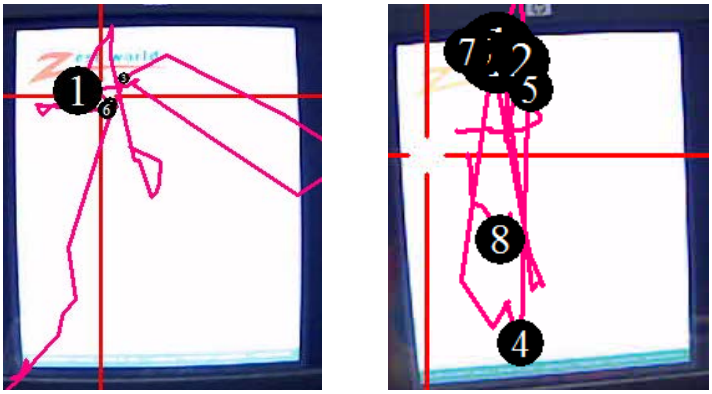
Novice gaze patterns and heat maps

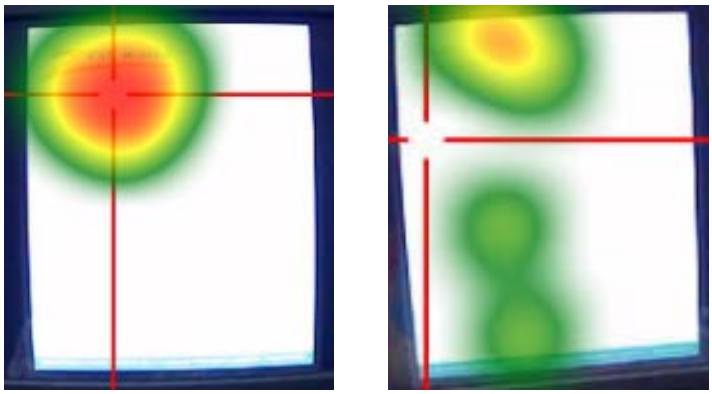
Figure 46: Novice gaze plots and heat maps when viewing Image #4 for the first time



Expert gaze patterns and heat maps

Figure 47: Expert gaze plots and heat maps when viewing Image #4 for the first time





Overall gaze patterns and heat maps

When reviewing this image for the first time, searching patterns show themselves. Both novices and experts took on circular search patterns, although nearly all fixations were clearly within the area of the logo change. Gaze patterns did give short forays into the watermark or down towards the bottom bar, but few if any fixations occurred on those paths.

Question 12: This is basically the same letterhead. What has changed?

Average Time to answer questions:

Novice: 4 sec (Mean 4 sec, Median 3 sec, Mode 3 sec)

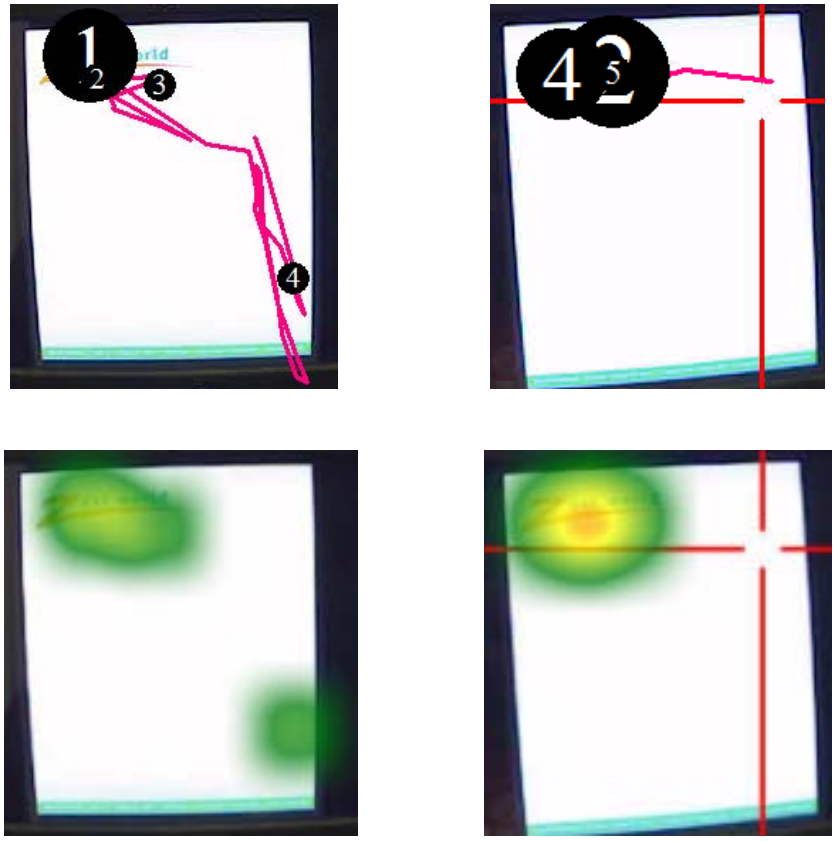
Experts: 4 sec (Mean 4 sec, Median 2 sec, Mode 2 sec)

Summary of Data: Experts and novices both answered this question quickly, with experts answering in 1-2 seconds (one outlier of 14 seconds) and most novices

answering in 2-3 seconds. Participants understood this question, and found themselves prepared to answer immediately.

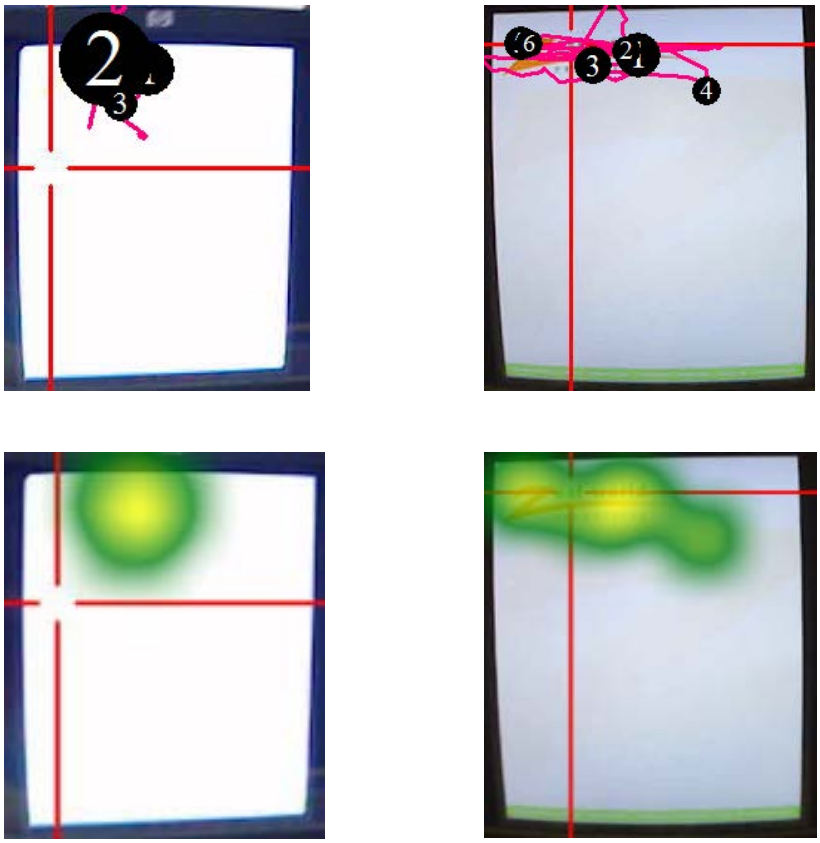
Novice gaze patterns and heat maps

Figure 48: Novice gaze plots and heat maps when answering question 12



Expert gaze patterns and heat maps

Figure 49: Expert gaze plots and heat maps when answering question 12



Question 13: Does this seem more effective or less effective with the larger logo?

Average Time to answer questions:

Novice: 4 sec (Mean 4 sec, Median 3 sec, Mode 2 sec)

Experts: 12 sec (Mean 12 sec, Median 2 sec, Mode 2 sec)

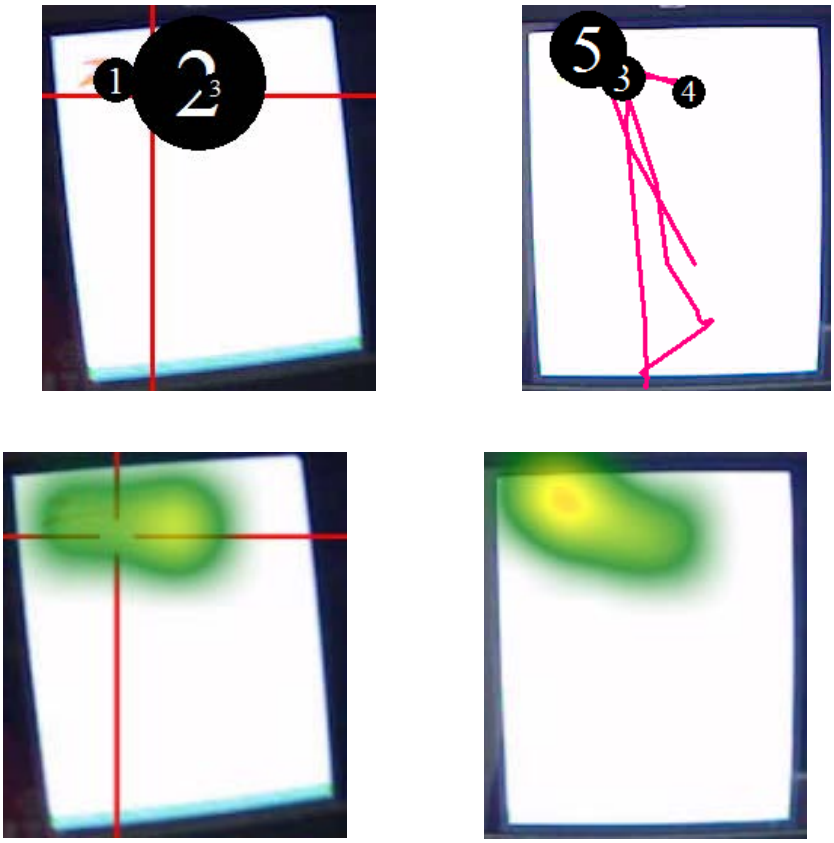
Summary of Data: Having already completed the previous question outlining their knowledge and understanding of the two letterheads, most people found the larger logo to be more effective than the smaller-sized logo. Novices came to their decisions much faster (roughly four seconds)

Novices viewing the new logo proportions felt that it was less effective 40% of the time, more effective 50% of the time, and a single participant noted that it was equally as effective at either size. Three novices who felt that the previous size was proper reversed their decisions, noting that the new size was better.

Experts viewing the new logo proportions felt that it was less effective 40% of the time, more effective 40% of the time. Two experts were of two minds on the subject: although both felt that the smaller logo was properly sized, one noted that the new layout was “more attention-grabbing, but less appealing,” while the other noted that the new layout was “less appealing, but had a stronger presence”. Three experts who felt that the logo size was proper before reversed their decisions upon seeing the larger logo presented here. One expert who had previously felt that the logo was too small noted the new size as effective, saying: “a bigger logo is more powerful.”

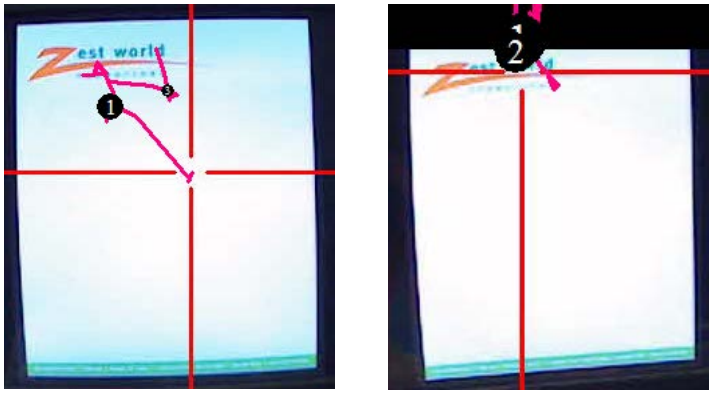
Novice gaze patterns and heat maps

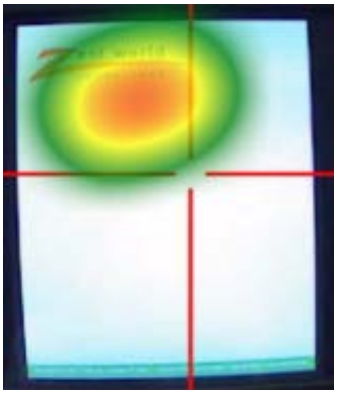
Figure 50: Novice gaze plots and heat maps when answering question 13

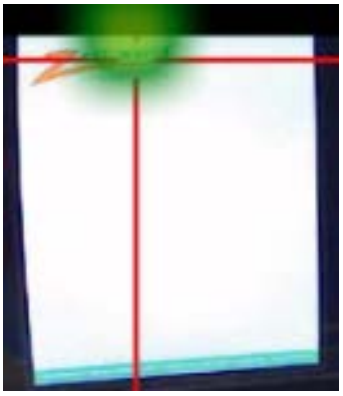


Expert gaze patterns and heat maps

Figure 51: Expert gaze plots and heat maps when answering question 13







Overall gaze patterns and heat maps

Having become familiar with this piece, the layout did not seem to need to be explored. After answering the previous question, both novices and experts did not need much time to decide if this was more effective or less effective.

Image 5: Carpe Diem Advert #1

Average Viewing Time:

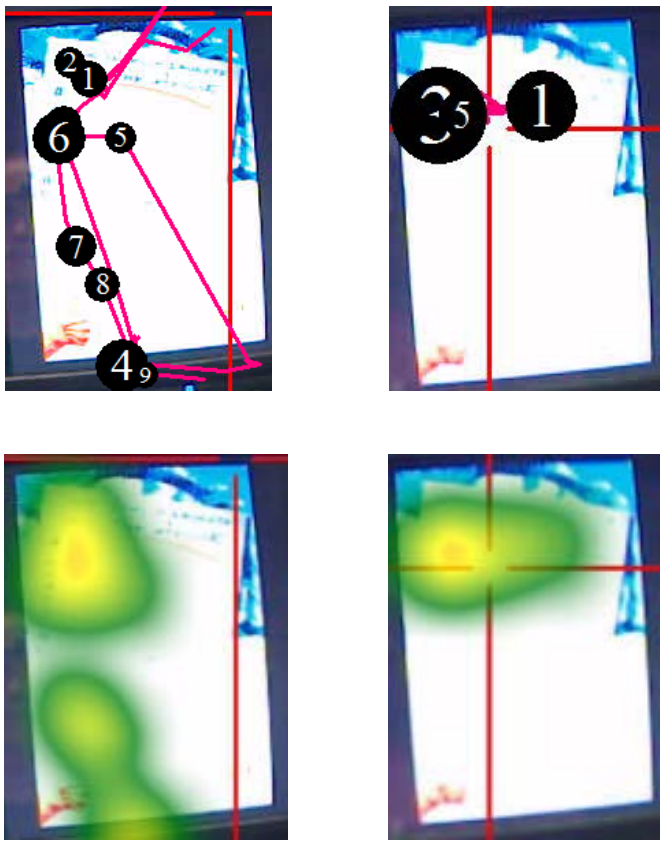
Novice: 6 sec (Mean 6 sec, Median 6 sec, Mode 6 sec)

Experts: 7 sec (Mean 7 sec, Median 6 sec, Mode 6 sec)

Summary of Data: This advertisement contains large areas of text, color, and some reduced-sized imagery. For this image, novices had 9 & 5 fixations in the examples above in 6 seconds while experts had 12 & 10 fixations in the examples above in seven seconds.

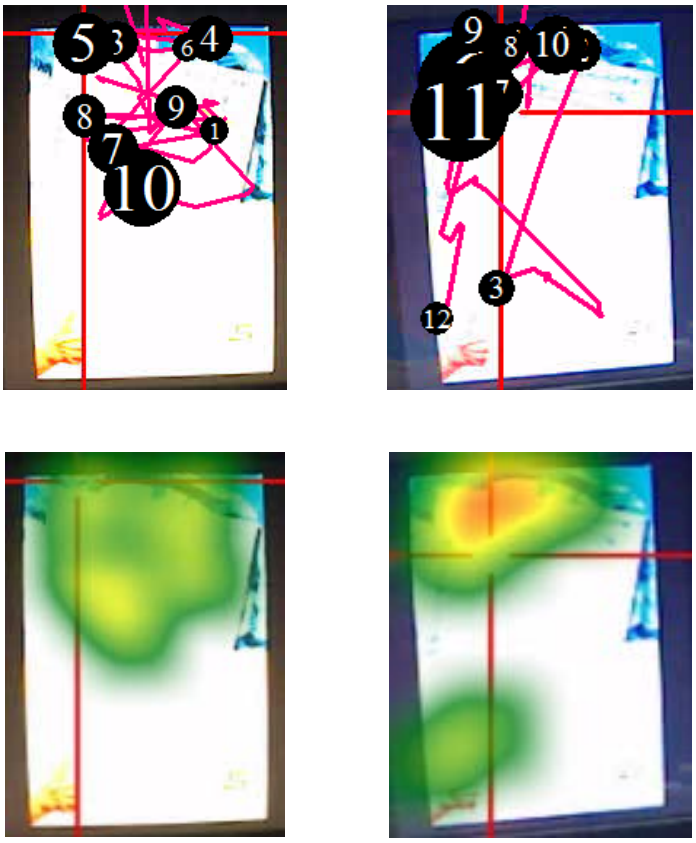
Novice gaze patterns and heat maps

Figure 52: Novice gaze plots and heat maps when viewing Image #5 for the first time



Expert gaze patterns and heat maps

Figure 53: Expert gaze plots and heat maps when viewing image #5 for the first time



Overall gaze patterns and heat maps

In viewing this image for the first time, both novices and experts were immediately drawn to the top, particularly to the accent line under the word “House”. Circular gaze patterns are intermingled with side to side visual patterns.

Novice #1 kept their area of focus tightly around their initial view, moving back and forth over the accent and headline. Novice #2 explored the piece in a circling pattern, moving down through the piece with short fixations.

Experts moved through this piece with a crisscross of gaze patterns and fixations.

Question 14: This is an advert for a magazine layout. What's the most important thing on this page?

Average Time to answer questions:

Novice: 8 sec (Mean 8 sec, Median 11 sec, Mode 11 sec)

Experts: 30 sec (Mean 30 sec, Median 19 sec)

Summary of Data: This image had several large color areas and text areas. Novices and experts both had outliers in the timing on their answers which distorted the mean times here. A single novice participant answered this question in two seconds, dragging down the mean times. Experts ranged all over the board, with median times of 19 seconds, but this number was pulled higher based on two individuals who required 41 seconds and 69 seconds respectively.

Novices viewing this advertisement found that five participants (50%) felt the $25 coupon sunburst was the most important, three participants (30%) felt the information in the yellow bar was the most important, a single participant (10%) felt that the list held the most importance, and the remaining novice (10%) found the entire coupon area to be of high importance.

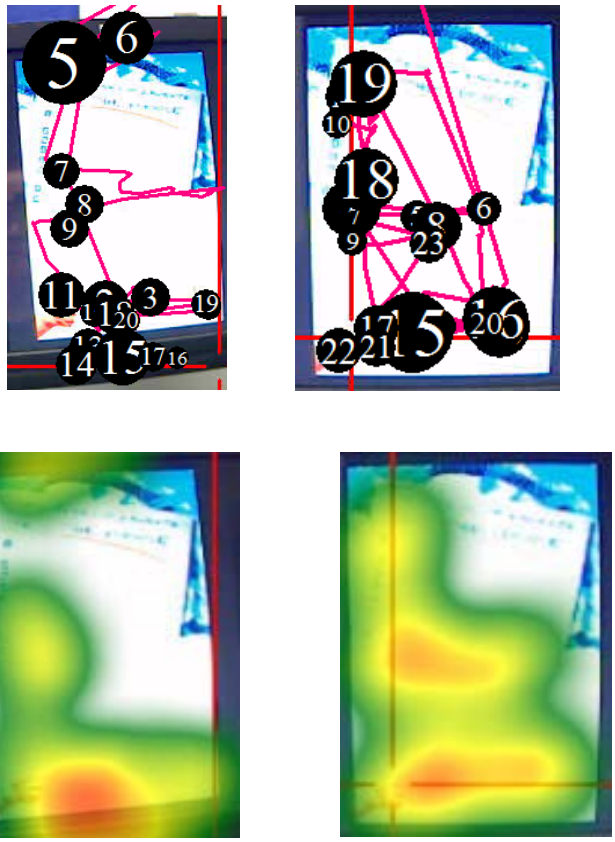
Experts viewing this advertisement found that many different things called out to them: two participants (20%) felt that the yellow bar was the most important, three participants (30%) felt that the entire coupon area was the most important, a single

participant (10%) felt that the $25 coupon sunburst was the most important, and two participants (20%) felt that the list at the top was the most important portion of this piece.

One expert participant noted that “Everything here seems to draw attention.”

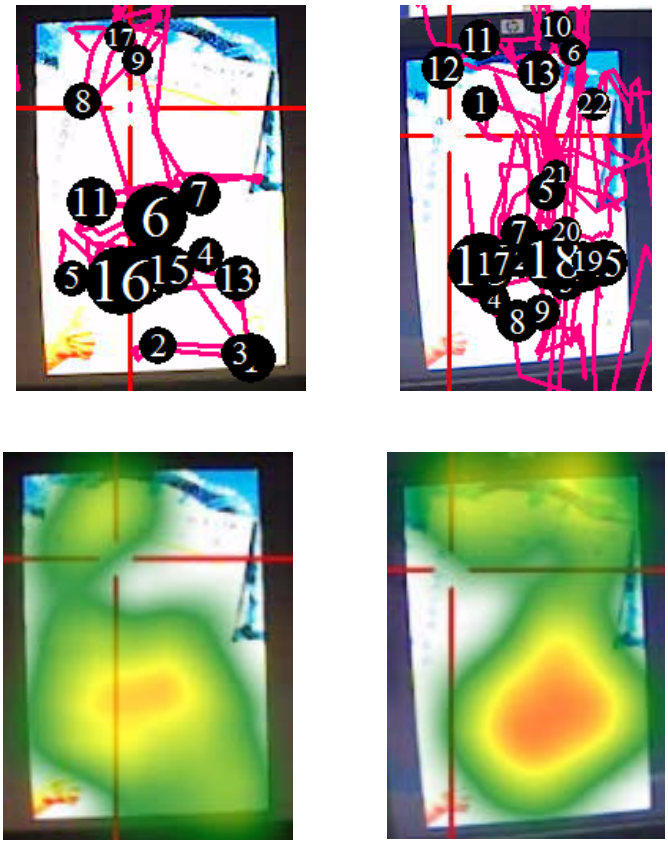
Novice gaze patterns and heat maps

Figure 54: Gaze plots and heat maps when viewing question 14



Expert gaze patterns and heat maps

Figure 55: gaze plots and heat maps when viewing question 14



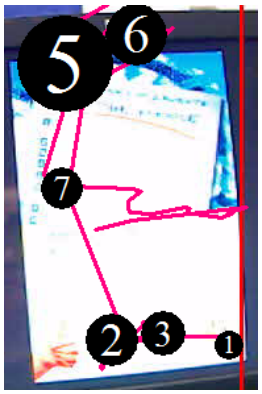
Overall gaze patterns and heat maps

In viewing this piece, novices and experts again diverge on the number of fixations in a given amount of time, with novices having 20 fixations in the examples above within 14 seconds & 22 fixations in the examples above within 12 seconds, and experts having 16 fixations in the examples above in 16 seconds and 20 fixations in the examples above in 22 seconds.

With the absence of photos, bright color areas remain a draw, but text begins to take on a heightened importance. Experts also had extended visual paths to follow.

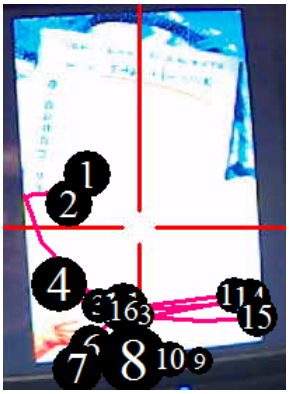
Looking at the novice gazepaths, the follow approach for novice #1, who felt the yellow color bar was the most important, becomes apparent:

Figure 56: Novice 1 viewing seconds 1-7



In the first seven second segment, the expert began their gaze on the $25 starburst, and then jumped to the left side of the logo and then moved back across the logo with two fixations at #2 and #3. From here, their gaze pulled them up into the top corner for three fixations on the upper edge of the image. Dipping down into the text list, the novice viewed across the text and then into the yellow color bar.

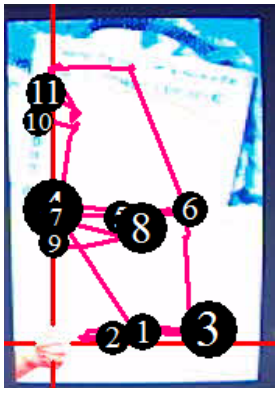
Figure 57: Novice 1 viewing seconds 8-14



In the second seven second segment, the novice returned to the text list before dropping down into the yellow bar. Once inside the bottom text for fixations #3 and #4, they dropped to the glove area and skimmed the bottom of the image back and forth over fixations #6-10. Moving up into the bottom text again, the novice's gaze shifted to the right for the $25 starburst, back to the yellow color bar, and then cycled back to the $25 starburst for fixations #14 and #15 before ending back in the yellow bar.

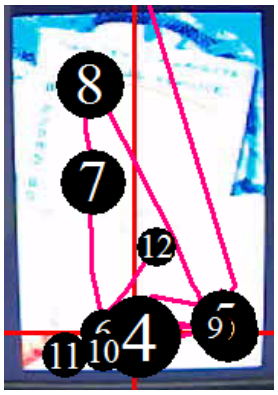
Novice #2 felt that the $25 starburst was the most important thing in the advertisement. Let's examine the gazepath used in their answer:

Figure 58: Novice 2 viewing seconds 1-6



In the first six second segment, the novice's gaze begins in the logo area, sweeping back and forth until coming to rest at fixation #3 over the $25 starburst. Moving from the starburst to the yellow bar for fixations #4-9, the novice then moved their gaze up to the list at the top for fixations #10 and #11.

Figure 59: Novice 2 viewing seconds 7-12

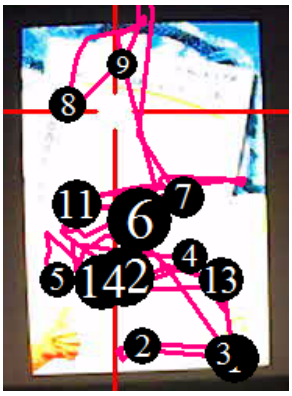


In the second six second segment, the novice returned to the logo area, then back to the $25 starburst, cycling repeatedly back to the logo area for fixations #3 and #4, and the $25 starburst for fixation #5 and to the logo area for fixation #6. The novice moved up into the text list for fixations #7 and #8 before diving back into the $25 starburst. From

the starburst, the viewer jumped to the logo at glove at fixations #10-11 before ending on the color bar with fixation #12.

Expert #1 felt that the note title was the most important part of the image. Let's examine the gazepath used in their answer:

Figure 60: Expert 1 viewing, seconds 1-8



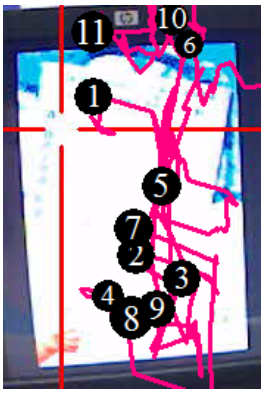
In the first eight second segment, the expert moves his gaze to his first fixation on the $25 starburst. Leaving the $25 starburst, expert #1 moved to the logo area and then returned to $25 coupon before moving up to the yellow bar at fixations #4-7. Moving from the yellow bar, the expert's gaze path moves up through the note title before gaining fixations there in #8-9. From here, the expert moves into the yellow bar with fixations #11-14.

Figure 61: Expert 1 viewing, seconds 9-16

In the second eight second segment, the expert moves down to the bottom of the page, viewing the logo area in fixations #2-4. Rising from the bottom, the gaze patterns fixate very close to the note title, spidering out and back in very short segments.

Expert #2 felt that the coupon area was the most important part of the image. Let's examine the gazpath used in their answer:

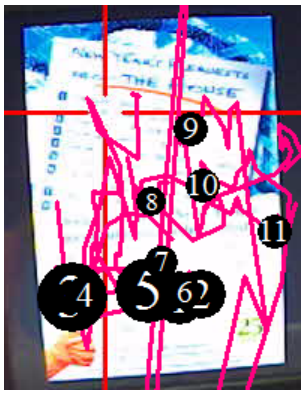
Figure 62: Expert 2 viewing, seconds 1-11



In the first 11 second segment, the expert brought his gaze up to the note title. Dropping to the yellow bar for fixations #2-3, and after dropping down into the bottom text for fixation #4, the expert looked at the text list at fixation #5. They jumped up to the

top of the images to fixation #6, and then cycled down to the text list for fixation #7 before falling into the bottom text with fixations #8-9.

Figure 63: Expert 2 viewing, seconds 12-22



In the second 11 second segment, the expert's gazepaths were all over the place examining the image—a possible reason that this answer was so long in coming.Staying within the bottom text area for fixations #1-7, the expert cycled back and forth among the points of interest. Moving up into the color bar for fixation #8, they rose into the text list in fixations #9-10 before dipping back into the colro bar area with fixation #11.

Question 15: How important is the logo on this page?

Average Time to answer questions:

Novice: 5 sec (Mean 5 sec, Median 4 sec, Mode 4 sec)

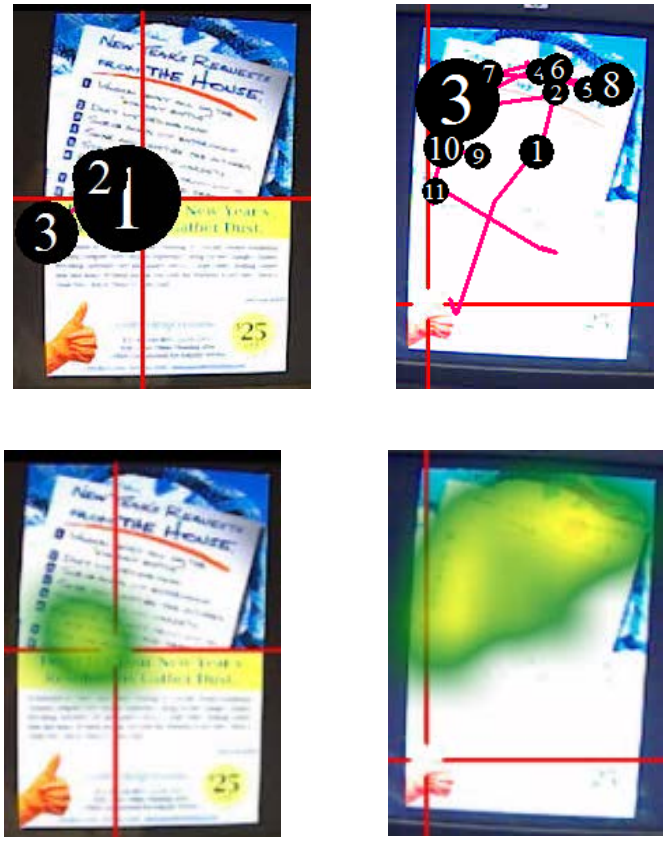
Experts: 15 sec (Mean 15 sec, Median 9 sec)

Summary of Data: Across the board, every participant noted that the logo was not important to this piece. Novices were able to come to their decisions much faster, often declaring their answers within 2-5 seconds of being asked the question. Experts took far longer, typically between 5-30 seconds.

. Experts viewing this piece found the logo to be “not important” 100% of the time. Novices viewing this piece found the logo to “not important” 90% of the time, with a single novice noting it as “minimally important”.

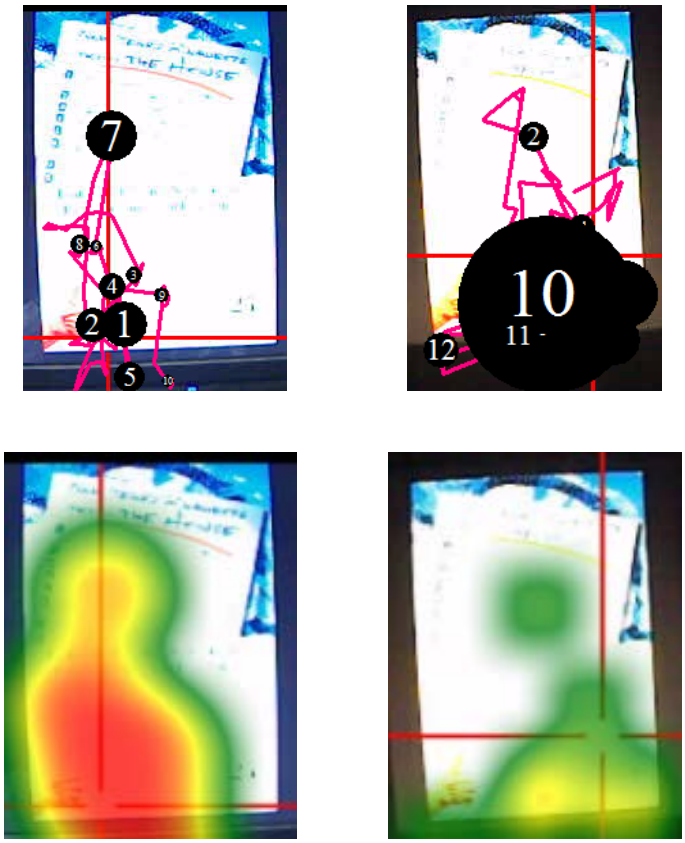
Novice gaze patterns and heat maps

Figure 64: Novice gaze plots and heat maps when answering question 15



Expert gaze patterns and heat maps

Figure 65: Expert gaze plots and heat maps when answering question 15



Overall gaze patterns and heat maps

When asked about the importance of the logo on this page, novices were occasionally found to lean in to look at the screen more closely before viewing this piece. Experts gave their answer but were very likely to explain the reasons behind their answers. Experts often took the context of the logo into account, comparing the size of the logo to the area in which it was housed. Experts were also found to view the piece in its entirety before verbalizing their answer. This slower judgment allowed them to revisit the piece and compare the logo sizing within the composition.

When the logo was described to the participants, 70% of novices and 75% of experts fully focused their attention on the logo, zooming in with multiple fixations during the time in which the facilitator asked the question. During this close examination, gaze stayed heavily within the confines of the logo area, with swift and repeated side-to-side movement as they examined the logo. This shows us that during questions about specific items within a composition, fixations and gaze points remain within the item to better understand its edges. This is a clear indicator of the validity of the mind-eye hypothesis

Question 16: Is the logo the proper size, and why?

Average Time to answer questions:

Novice: 7 sec (Mean 7 sec, Median 6 sec, Mode 6 sec)

Experts: 24 sec (Mean 24 sec, Median 16 sec)

Summary of Data: After such a strong viewing of the logo in comparison to the piece, one might expect a quick answer. However, while novices kept their answers and explanations between 3-16 seconds, experts found their answers ranging from 5-42 seconds. Again, experts expounded on their reasoning, comparing it to the whole of the piece and bringing evidence based on the composition to aid their deductions.

Novices viewing this advertisement felt very strongly regarding the logo, with six participants (60%) noting that it was not properly sized, stating: it was “too small,” “too

aggressive," "too near the bottom," that it "should be bigger," and "does not draw attention," even going so far as to candidly note "I didn't even know that was there". Four participants (40%) noted that the logo was properly sized, with two stating that it was "just the right size," and a single participant stating that it was "perfectly sized for its position".

Novices who felt that the logo was improperly sized felt it was not important because it wasn't prominent enough, wasn't large enough, or visible enough. As with earlier discussions of the letterhead, what seems to make an item important relies on its size, visual prominence, and relation to the space. As this logo was small, moved down into the coupon area at the bottom, and clearly placed around highly contrasting pieces, it was clearly not important. Comments show that novice populations felt that logos *are* important, and should therefor take a center-stage approach rather than simply another branded element. By the time they realized who this advertisement represented, they had already read the message and made some decisions.

Experts viewing this advertisement felt similarly, with seven participants (70%) noting that it was not properly size, stating: it was "not necessary to the advertisement," "does not draw attention," "too small & too quiet. It is lost in the ad," that the "top was too distracting [for the logo]," and two participants simply noting that it was "too small". Within the expert population, three participants (30%) felt that it was properly sized, noting that it was: "good for its location," but reluctantly noted "needs contrast" and was a "good size for copy, but not for an advertisement".

Experts felt that the piece needed more emphasis than it was given—clearly lacking in size, contrast, and prominence. In this way, experts agreed with the findings of the novices, although it took them longer to make clear decisions on their part. Those who agreed that it was proper for its location only seemed to do so grudgingly and based on the appropriateness of its location. If this logo had been placed at this size at the top of the piece, it would face similar scrutiny with much more vocal reactions.

In the interpretation of this piece, experts and novices stand shoulder to shoulder.

Novice gaze patterns and heat maps

Figure 66: Novice gaze plots and heat maps when answering question 16

Expert gaze patterns and heat maps

Figure 67: Expert gaze plots and heat maps when answering question 16

Image 6: Carpe Diem Advert #2

Average Viewing Time:

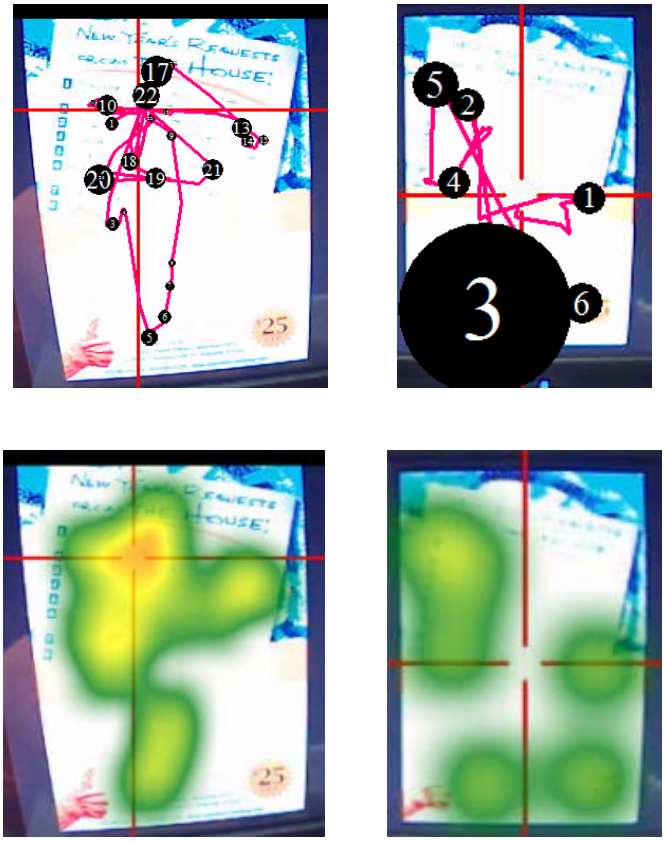
Novice: 4 sec (Mean 4 sec, Median 5 sec, Mode 5 sec)

Experts: 5 sec (Mean 5 sec, Median 4 sec, Mode 4 sec)

Summary of Data: This advertisement is an exact copy of the previous one, with a coloration difference to the $25 starburst, the color bar and the text inside the color bar. The bar and starburst are now an orange color pulled from the orange glove. The text is an dull, dusty blue chosen to be equilluminate with the orange bar.

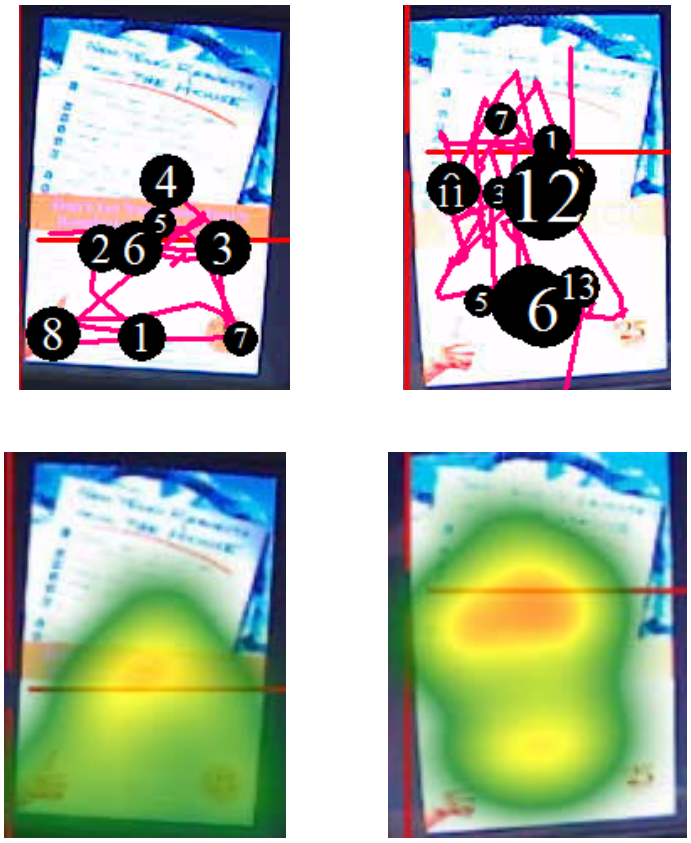
Novice gaze patterns and heat maps

Figure 68: Novice gaze plots and heat maps when viewing Image #6 for the first time



Expert gaze patterns and heat maps

Figure 69: Expert gaze plots and heat maps when viewing Image #6 for the first time



Overall gaze patterns and heat maps

Viewers who observed the image changes—going from the yellow bar to a black screen and then abruptly changing to the orange bar—all reacted similarly: a physical push back or jerk away from the screen. They were not expecting such a shocking adjustment or such a clashing of colors. The dusty blue and the muted, rust orange had an equilluminate tone, and this color incongruity causes the text to "vibrate" visually. The similarity in tone is not easily observable on the screen, as the dusty nature of the blue is quite bright—however, when printed in grayscale, the bar itself becomes one solid tone.

When exposed to the new images, both novices and experts began a circling search of the image. Novice #1 began long saccades and extremely short fixations, while novice #2 re-examined the text at the top, the bar, and the bottom—spending a fair amount of time fixating on the glove in the lower left. Experts moved their gazes around the composition, re-examining all the bits, but spending several fixations each on the new orange bar.

Question 17: This is basically the same layout. What has changed?

Average Time to answer questions:

Novice: 3 sec (Mean 3 sec, Median 2 sec, Mode 2 sec)

Experts: 8 sec (Mean 8 sec, Median 5 sec, Mode 1 sec)

Summary of Data: Every single participant noted the color change immediately, and even with the physical reaction noted above, all participants were able to give their answers quickly.

Novices answering this question were able to give their opinions within 1-2 seconds on the whole (70%) while three individuals (30%) took slightly longer with a visual sweep requiring 6-9 seconds. Every novice (100%) concluded that either a "color change" had occurred, or that the "yellow has changed to orange".

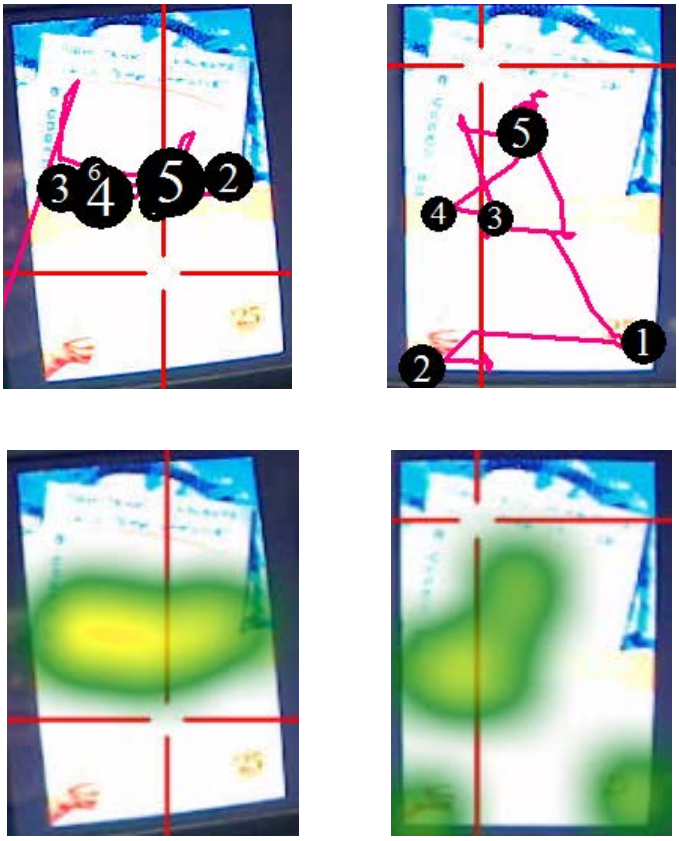
Experts answering this question took longer to achieve the verbalization of their answers. Two outliers within the expert population finished their answers within 10 and

17 seconds, causing the mean times here to be skewed. Expert answers were slightly divided, with five participants (50%) stating that the “color bar” alone had changed, and five participants (50%) stating that a “color change” had occurred, or that the “yellow changed to orange”. With the longer scanning times (10 and 17 seconds), decisions were equally split between “color change” and “orange bar” replies.

In the words of one expert describing their answer: “The orange bar is so repulsive, and [the design] makes it so that you can’t really read what’s on it!”

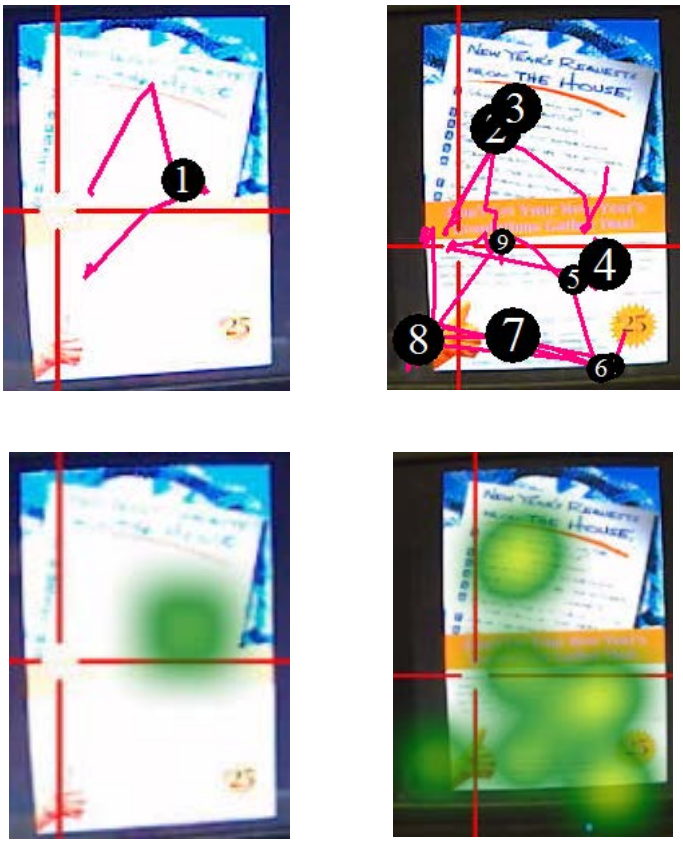
Novice gaze patterns and heat maps

Figure 70: Novice gaze plots and heat maps when answering question 17



Expert gaze patterns and heat maps

Figure 71: Expert gaze plots and heat maps when answering question 17



Overall gaze patterns and heat maps

Viewing this piece, not only was the color bar a draw, but the $25 starburst and orange glove were strong draws as well.

Novices answered quickly (within two seconds or less), whilst having 5-6 fixations. Fixations during this time stayed within the color bars or orange color areas, such as the glove and the $25 starburst. Experts explored the composition again, visiting the major points with either gazepaths or fixations.

Question 18: Is this layout more or less effective?

Average Time to answer questions:

Novice: 3 sec (Mean 3 sec, Median 3 sec, Mode 3 sec)

Experts: 8 sec (Mean 8 sec, Median 6 sec, Mode 9 sec)

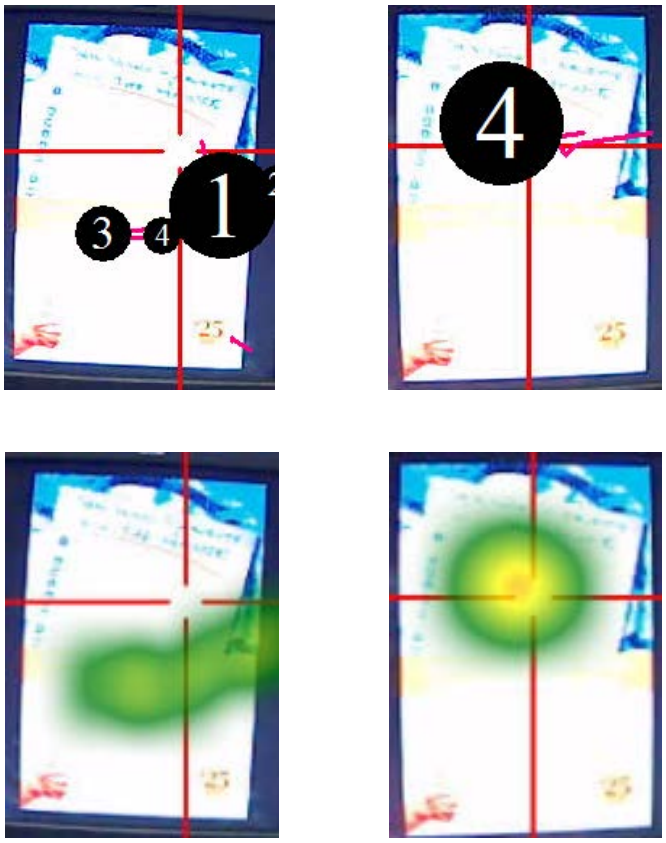
Summary of Data: Times for this question were fair across the board, with one minor exception: a novice who refused to look at the screen during this process. The novice answered immediately without raising his eyes from the paper. Obviously, no eye tracking data is gained from this participant. What is gained, however, is an additional question: Did this individual refuse to look up because they knew their answer immediately, or did they refuse to look up because they were so displeased by the color combination?

Novices viewing this piece were split. Six novice participants (60%) felt it was less effective with the orange, three novice participants (30%) felt it was more effective with the orange, and a single novice participant (10%) felt that it was equally as effective whether it was orange or yellow.

Experts viewing this piece were split in exactly the same proportions: six expert participants felt it was less effective with the orange, three novice participants (30%) felt it was more effective with the orange, and a single expert participant (10%) felt this it was equally as effective whether yellow or orange.

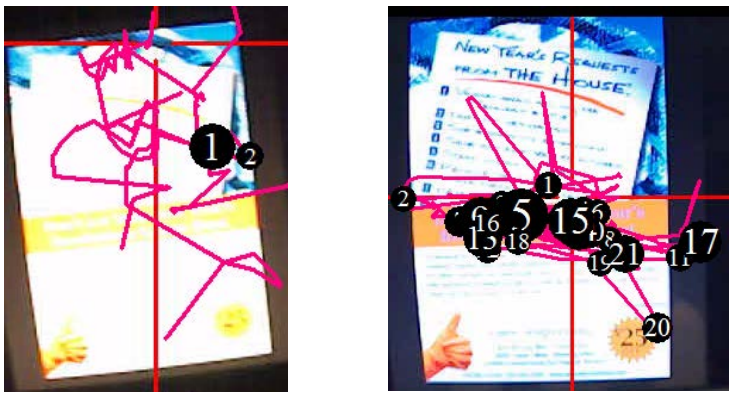
Novice gaze patterns and heat maps

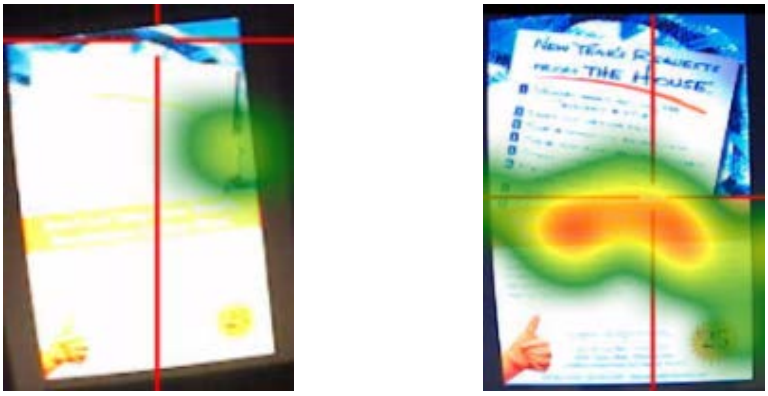
Figure 72: Novice gaze plots and heat maps when answering question 18



Expert gaze patterns and heat maps

Figure 73: Expert gaze plots and heat maps when answering question 18





Overall gaze patterns and heat maps

After viewing this image for the first time, and noting what differences had taken place from the previous question, participants may have had a good idea if the colors were more effective or not by the time this question was asked.

With novice views occurring in three seconds, they were able to come to their decisions without many fixations. As a result, novice gaze patterns tended to look directly at the bar when making their decision, or a few brief fixations to assess the whole image. Experts viewed the piece by revisiting most, if not the entire composition through their gazepaths or fixations. Both groups focused on the bar or central areas when coming to their decisions.

Question 19: Do the colors work better or worse?

Average Time to answer questions:

Novice: 2 sec (Mean 2 sec, Median 2 sec, Mode 1 sec)

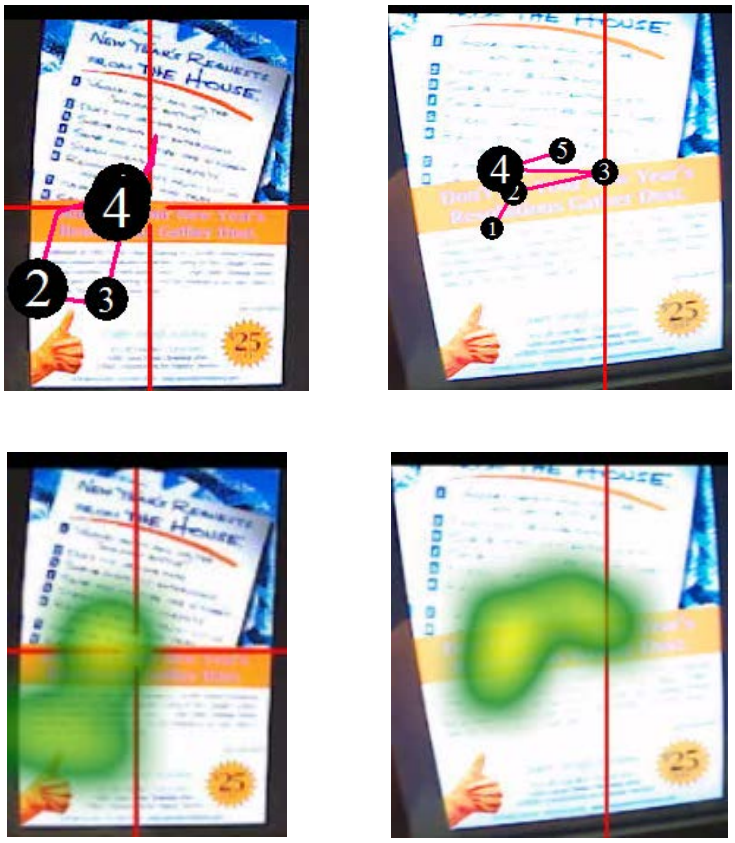
Experts: 4 sec (Mean 4 sec, Median 1 sec, Mode 1 sec)

Summary of Data: After being asked a direct question regarding the effectiveness of the new color, most participants were very fast to provide their answers. Both novices and experts answered quickly (Novices averaged 1-3 seconds with a single outlier of eight seconds, while experts averaged just over one second with two outliers of 8 and 10 seconds). Outliers seemed to review the advertisement again, especially the orange bar before verbalizing their answers.

In responding, participants did not reverse their opinions, pointing to a clear correlation between "more effective" and "better", and between "less effective" and "worse". Those who felt the color changes were less effective felt that the colors were working worse. In answering the question, one expert stated: "It is too hard to read the words." Those who felt the color change was more effective felt that the colors were better. In answering the question, one expert stated: "[It is] better. More attention grabbing." The two individuals who felt that it was equally as effect both decided that the orange color was working better. One expert who felt it was equally effective stated that "the colors look better".

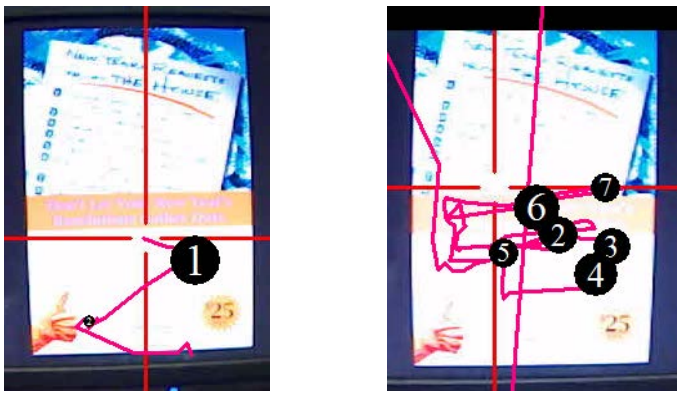
Novice gaze patterns and heat maps…

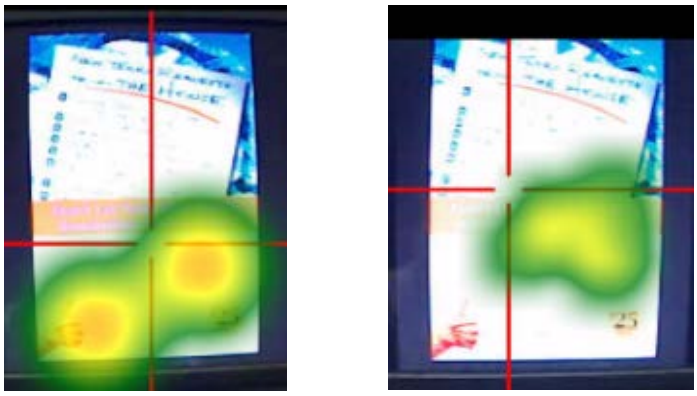
Figure 74: Novice gaze plots and heat maps when answering question 19



Expert gaze patterns and heat maps

Figure 75: Expert gaze plots and heat maps when answering question 19





Overall gaze patterns and heat map

With both experts and novices, the orange bar was a major influence on this question. Novices kept their gaze back and forth within the orange bar in an effort to gauge the effectiveness of the colors. The experts, on the other hand, spent their time comparing the orange in the bar to other orange elements for comparison purposes. While the bar itself was one of the major color changes, it was not the only change. Experts' comparison of the elements surrounding the bar (i.e. in context) allowed them to better consider its effectiveness, and was also the cause of the lengthier answer period. Novices were able to view the bar to determine the quality of the color quickly with visceral reactions and only minor observations of the bar and color, giving them a shorter, stronger reaction and speedier answer.

In this composition, the orange and blue cause the sensation of equiluminant colors. This means that the colors have approximately the same value or lightness and darkness. The "What" system of the brain identifies the hue distinction between the shapes, but the "Where" system does not identify a value or light-dark distinction. Viewers cannot locate the relation of the shapes of color in space. One may hypothesize

that the participants' gazes returned often to the orange and blue bar in order to locate the relations between the blue and orange areas. (Color Vision & Art)

Question 20: What is the most important thing on this page?

Average Time to answer questions:

Novice: 5 sec (Mean 5 sec, Median 5 sec, Mode 3 sec)

Experts: 20 sec (Mean 20 sec, Median 12 sec, Mode 5 sec)

Summary of Data: When revisiting the question of importance, experts and novices once again diverged in the timing of their responses. Novices typically answered within 10 seconds or less (half falling in 5 seconds or less). Experts found themselves markedly longer, with one expert participant taking 21 seconds to answer the question, and another expert participant taking 46 seconds to answer. Although the layout was the same as the previous image, the color differences alone may have caused a few participants to re-evaluate their approach.

Novices reviewing the image to determine the most important thing settled on quite a few items: four participants (40%) chose the $25 off sunburst, three participants (30%) chose the orange banner, and one participant each chose the orange glove, the colorful side areas, and the orange bar respectively.

Experts reviewing the image to determine the most important thing settled on only a few items: three participants (30%) chose the orange glove, three participants (30%)

chose the coupon area, and three participants (30%) chose the banner area. A single participant felt that the area at the bottom was now the most important element.

Between the original yellow bar and the orange color changes, no layout changes occurred—however, this did not stop people from feeling that major differences were now in play. Only three novices kept their original choices of the most important element asked in the 14th question. Only three experts kept their original choices of the most important element asked in the 14th question.

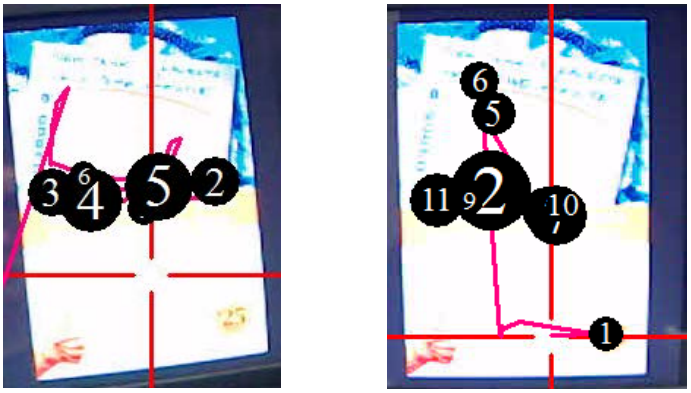
Table 2: Items of importance by participant- yellow bar and orange bar differences

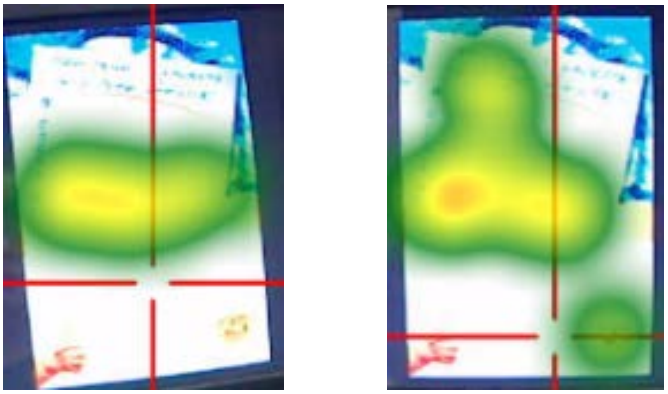
Participant #	M / F	Novice/Expert	Yellow banner answer	Orange banner answer
366	F	Novice	Yellow Bar	Orange Bar
361	F	Novice	$25 coupon	Orange Bar
367	M	Novice	$25 coupon	Color areas
353	M	Novice	List at the top	Orange Bar
363	M	Novice	Yellow Bar	$25 coupon
364	M	Novice	$25 coupon	$25 coupon
365	M	Novice	$25 coupon	Banner text
351	M	Novice	Bottom	Thumbs up glove
362	M	Novice	$25 coupon	$25 coupon
352	M	Novice	Yellow Bar	$25 coupon
348	F	Expert	Yellow Bar	Orange Bar
350	F	Expert	List at the top	$25 coupon

354	F	Expert	Coupon	$25 coupon
356	F	Expert	Coupon	Thumbs up glove
359	F	Expert	Coupon	$25 coupon
360	F	Expert	What ad is for/ who it is by	Orange Bar
349	F	Expert	Note title	Orange Bar
358	F	Expert	$25 coupon	Thumbs up glove
357	F	Expert	Yellow Bar	Thumbs up glove
355	M	Expert	List at the top	Message at bottom

Novice gaze patterns and heat maps

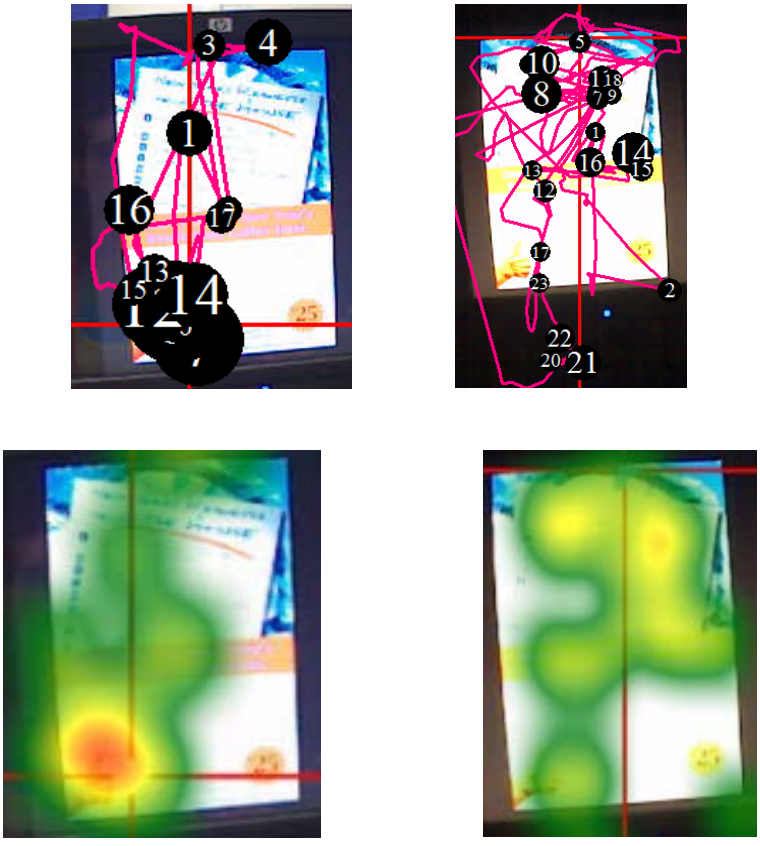
Figure 76: Novice gaze plots and heat maps when answering question 20





Expert gaze patterns and heat maps

Figure 77: Expert gaze plots and heat maps when answering question 20



Overall gaze patterns and heat maps

When revisiting the layout after the color change occurred, novices gravitated heavily toward the orange bar, although their gazepath did wander throughout the piece with occasional fixations. Experts were far more likely to re-evaluate the piece, using their time to visit multiple locations within the piece before answering.

Although only a few elements within the piece changed colors—pieces that were identified by all participants—70% of participants found they needed to change their answers regarding which element was the most important.

Conclusion

Chapter 4 has examined the physical evidence—fixations, saccades, gazepaths and body language (on the first look at Image #6)—as well as the written answers given in this experiment. Although the amount of time used in answering questions was different from individual to individual within a population, and between the novice and expert populations themselves, disparities in the amount of fixations within a given time, the thoroughness and efficiency of the search, etc. began to show. Although this experiment was in no way time-based, it is clear that certain activities (cycling, etc.) were more likely to occur in longer answer periods as opposed to short. Based on verbal answers and graphic displays, differences between the populations clearly stand out.

CHAPTER 5: DISCUSSION

Overview

The purpose of this study was to investigate if typical viewers look at pieces of design in the same way that trained artists and designers do, and to see if typical viewers are troubled, excited or influenced by the same things trained artists are. Based on this study's findings, recommendations could be made to enhance the educational opportunities forwarded to students—allowing them a greater opportunity to produce the kind of conceptual work which might get them hired by an artist or designer, as well as the kind of practical work which would satisfy clients in the field.

This chapter will draw from the Results section to generate conclusions based on this study. For clarity, this chapter will be presented in two separate parts. The first part discusses the conclusions of the project and includes any considerations of the limitations of the study. The second part suggests recommendations for future research and application of the findings to collegiate art and design education based on the findings.

Part One: Conclusions

Overall, the objectives of this thesis were met. The first goal of this study was to determine whether or not trained designers and non-artists (experts and novices) were

looking at the same things. The second goal of this study was to determine if experts and novices looked at things in the same way—and to note the results and implications whether they looked similarly or dissimilarly. The third goal of this study was to create recommendations for collegiate design education in an effort to better prepare students for client work in the field, or to better prepare students to get hired by other artists/designers. The Results chapter within this paper provide the proper framework for answers to be found and recommendations to be made.

Do trained designers and non-artists look at the same things?

Based on the evidence shown in this study, designers and non-artists are looking at the same things, in roughly the same order of importance. However, the *way* in which trained designers and artists looked at things had some strong differences when compared to non-artists. When asking about visual appeal, both populations gravitated toward areas of bright color, images of people, areas of high contrast, and in their own way, to text.

The importance of humans

As community creatures, humans look to other humans for cues on where to look, how to feel, and what to do (Yarbus, 1967, Feil, 2009, Horstman, 2009), this allows us to easily identify with others whether the human in question is in print, in person, or seen digitally (please see question #7 notes on page 72 for further information on this topic). Viewers gather a great deal of information based on non-verbal communications such as expression, body posture, gestures and movement. Coupled with this, humans have the

innate understanding of implied line (following the pointed finger to its target, following the eyes of an image to see what they are looking at, following an outstretched arm etc.) which allows us to read into the importance of the human's surroundings when seen in person or at a distance. As participants looked at the pieces containing humans, they found themselves making empathic comments such as "she looks like she's having more fun than him," "it's not something you see every day," "[the couple] are both looking at the flowers, so [the flowers] must be important," and "they are having so much fun", etc.

Both novices and experts looked to the couples in Image #1 and Image #2, with large fixations surrounding the faces (see figures #6-8,10-11,13-14,16,18-29). Yarbus noted this similar effect in 1967, stating:

> During a free examination of Repin's picture "An unexpected visitor," we can see that in all 14 records the faces of the people shown in the picture attract the observers' attention much more than the figures, and the figures more than the objects in the room, and so on (Yarbus, 1967, p. 190).

Cognitive and developmental studies have also noted the importance of the eyes as a way to gain greater empathy and understanding between the viewer and the subject of their gaze.

> Typically developing adults fixate the eye region more than other facial features (Adolphs, 2006, Pelphrey, Sasson, Reznick, Paul, Goldman, et al., 2002, Walker-Smith, Gale, Findlay, 1977). Further, the eye region of the face contributes greatly to our understanding of emotion in others (Adolphs, 2006, Ekman, Friesen, 1975,

> Emery, 2000), although other regions have been noted for their role in latency to recognize affect (Calvo, Nummenmaa, 2008). Fixation on the eyes is critical in the perception of emotion and the communication of our own affective state to others (Adolphs, 2006). However, the eye region of the face is more important for perceiving and communicating some emotions (e.g., fear) than others (Adolphs, Gosselin, Buchanan, Tranel, Schyns, et al., 2005). Neuroimaging studies of emotional perception note that eye contact with emotional faces, especially fearful faces, is highly arousing to the viewer (Whalen, Kagan, Cook, Davis, Kim, et al., 2004, Adams, Gordon, Baird, Ambady, Kleck, 2003). (Perlman, et al., 2009)

The importance of color

In order to collect information about the surrounding areas, the eyes gather sensory input for our brains. Color is one form of this sensory input. The cones within the eye function in bright light, perceiving color and sending an electrical impulse to the brain. The greater the input color, the greater the signal to the brain.

Answers given in several questions pointed to fixations within the colorful abstract areas of the compositions (to see fixations within the abstract color areas, please see figures #6-10, 12, 14-24, 26-29, and to see fixations within the color bars, please see figures #53-56, and 62). The flowers in Image #2 were also a very popular color area draw (to see gaze plots and heat maps for fixations in flower areas, please see figures # 20-25, and 27-29). The color bars associated with Image #5 and Image #6 were very powerful draws as well (to see gaze plots and heat maps for fixations in the color bar areas, please see figures #52, 54-55, 57-60, and 62-76). Participants within both

populations noted that bright, vibrant colors attracted their attention, even when participants felt other parts of the image or composition were more important.

The color areas noted above drew numerous fixations for participants in both populations. With these increased fixations came a level of importance. In Image #1, 20% of participants felt that the large color area was the most visually appealing portion of the image. In Image #2, another 20% of participants felt that the large color area was the most visually appealing portion of that image. In Image #6, 35% of participants felt that the orange bar was the most important thing in the image, with four of the seven participants (20% of the entire study population) having replaced their earlier opinions of what was the most important item in the image [see the answers in table 2 located in question #20].

It is interesting to note that Yarbus did not "notice any appreciable influence of color on the distribution of the points of fixation". He concluded that "if the color of an element has no special significance, and is irrelevant to the meaning of the picture under examination, it will have no effect on the character of the eye movements" (Yarbus, 1967, p.183).

The color area within these advertisements are part of the company branding—but have no direct importance to the viewer in relation to the areas of the composition. Yet, they attracted attention as measured by the fixation points as well as by the written/verbal answers to the study questions. This finding is contrary to Yarbus' findings and may warrant further study.

It is important to note that for the most part, Yarbus' participants were viewing natural scenes, illustrations and photographs. The images in this study were pieces of design and advertisements that were built with a goal to engage and inform the viewer, so there is some difference in the expectation of the viewer because the "scenes" were different. Nevertheless, it can be noted that in the advertisements, some of the color areas which attracted the attention in regard to fixations were difficult to interpret. Therefore, if color is used in an indeterminate area or difficult to interpret way, the color area may likely attract attention. The monochromatic areas in Images #5 & #6 did not get many fixations, however. For future research, it would be interesting to see if in-determinate areas of gray would attract as much attention as in-determinate areas of color.

Color affected viewers deeply, and affected their ability to decide on items of importance—often drawing their gaze back to high-color items in the middle of normal exploration. This was especially evident in the final piece (Image #6), the advertisement with the orange bar. Although viewers struggled to look around the piece, participants commented that they felt "visually forced" to return to the orange bar. While the layout in Image #6 was identical to the layout in piece #5, 70% of total participants felt that the item which was most important in the piece had dramatically shifted. By simply changing the colors used in a piece of design, a massive change in items of importance was created.

From Image #1 through Image #6, color was extremely important to viewers, influencing many answers to questions across several different qualitative styles.

The importance of contrast

Contrasting areas allow items to stand out visually and create areas of interest—whether in the case of accent colors, attention-getting signs, and visual breaks for the eyes. Contrast is an important portion of the brain's determining "what" system (Color Vision & Art), helping us to understand where one item/location ends and another begins.

The flowers in Image #2 were found to be the most visually appealing item in Image #2 by five participants (25% of the total study population), often commented on as popping visually because of the color contrast available in such a small area. It should also be noted that the only remark for Image #1 and Image #2 in which the text was said to be visually appealing (question #6), the novice noted that the text was the most visually appealing due to its high contrast.

When contrast was not properly used (several participants noted that the letterhead shown in piece #3 and piece #4 had poor readability at the bottom), it was an immediate draw to the eye of the viewer. While a high number of fixations can be a sign of great interest on the part of the viewer, or areas of importance, it can also be a sign that information within a certain area is difficult to understand (Poole, Ball, & Phillips, 2004). Images #3,4 and 6 all had areas which were difficult to read due to contrast issues, and as a result, attracted both fixations and gazepaths (see figures #31-32, 34-36, 38-40, 43, and 47).

The eye is a dynamic organ, capable of perceiving both high-contrast and low-contrast images either chemically or through the movement of the iris. Contrast is an

important function for the eye and the brain, and so will always be a recognizable facet of any visual image.

A note about text

When viewing an advertisement or piece of design for the first time, viewers are often trying to parse what information they can to learn the most about it in as little time as possible. Text is the most obvious and recognizable form of information and communication that can be seen, so that is where the eyes will go most often at first glance. This may or may not give us pause to include a fixation, however.

When looking at images for the first time, both populations were drawn to give the most fixations similar objects. However, they were most likely to begin their gazepaths within a text area. When viewing Image #1 and Image #2, participants were likely to start within the text areas three out of four times (see figures #7-12, 14, 16-18, 22, and 27). In Images #3 and #4, every design element contained text. Participants started within the text areas via fixation or gazepath 100% of the time (see figures #30-51). Images #5 and #6 also were quite text-heavy, and participants began within the text areas with fixation or gazepath nearly 100% of the time (see figures #52-77).

However much participants felt that text was the best place to begin viewing or fixating, it was most certainly not the most popular item of visual appeal or importance. Visual appeal in most cases fell to the items which “popped” visually, or grabbed people’s attention, drawing the viewer’s eye.

It is important to note that looking to text, unlike color, contrast, or looking to humans, is not a biological function. Biologically, text means nothing to us. It is only through cultural and learned behavior that text becomes important.

Humans are the only creatures known to use written language. It can be hypothesized that looking to text to gather information as a first step is therefore a learned behavior and not a biological necessity. It is certainly possible that only through a previous understanding of the benefits of reading text information that viewers choose to look there first.

Do trained designers and non-artists see things the same way?

Having reviewed what novices and experts are looking at, evidence shown in this thesis finds that the elements of design—figuree, form, color, contrast, and text are well represented. Based on the heat maps and gaze plots produced, it can be shown that both novices and experts are looking at the same things—and in many cases, in the same order.

Chapter 4 investigated the visual behavior of novices and experts when shown advertisements and pieces of design. For 20 individuals answering 19 questions about six individual images, it was shown that novices completed the question sessions in 7:30, while experts completed the question sessions in 9:28, roughly two minutes slower than their novice counterparts. During the 19 questions, both novices and experts found the

following items to be of visual importance: humans, color areas, contrasting areas, and text. Where the two populations differ lies in how they see these items.

Experts were more considered in their answers, using their knowledge and understanding of design to answer specifically and thoroughly. Novices were often quick to answer with visceral reactions, answering questions with quick efficiency and no-nonsense answers.

Experts were likely to jump to items of visual importance with clustered fixations, attending to every visually appealing object with time and purpose. Experts were likely to consider their answers at length, weighing their answers carefully and looking for context clues within the piece before choosing their answers. Experts were also quite likely to explain their answers at length, and often to gesture in the process. Experts seemed to be slowed by text-heavy design pieces, but were much more efficient with image-heavy design pieces.

Novices were likely to move quickly through the piece, scanning inefficiently over many objects whether they were important focal points for the piece or not. Novices were quick to answer questions, and were confident in their answers. Novices had consistent speed with questions across image-heavy and text-heavy pieces alike.

The speed of expertise

Experts (trained artists and designers) have a greater understanding of composition, color and aesthetics. At first glance, this should have given them an advantage over non-artists—allowing them to reach their answers much faster. Over a

series of 19 questions regarding six different pieces of design, however, artist tied or took longer on their response times to almost every single question, in many cases requiring two to five times as long to respond.

In looking at this data, experts came to longer conclusions *because* of their training and expertise. Experts found themselves reviewing the entire work before answering their questions, considering the relationships between individual items, and considering the aesthetics of the piece as a whole. In their answers, they used specific artistic vocabulary, talking about compositional elements, implied lines, color/contrast balance and movement within the piece. Experts took a longer time to parse out the pieces of the individual compositions, decide on the vocabulary to use, and then to choose the proper or most effective answer to the question involved. In the words of one frustrated expert: “There’s so much I can say about this [image] right now, I’m not sure where to begin.”

Novices were often given to visceral reactions. They knew what they liked or didn’t like, and in almost every case, they found the answers easy to come by. With an average completion time of 7:30 for all questions, (the longest answer session for a novice was 11:19, and the longest individual novice answer clocked in at 25 seconds), they easily surpassed the speed with which experts could answer. Rather than get bogged down in questions of aesthetics, proportions, and use of color, novices were able to say what they liked, disliked, or what they might change in a timely manner.

Experts were often given to in-depth answers with explanations. This gave them longer answer times and often required more analysis before answering. Some experts

had so much to say, or were so perplexed by the choices available for answers, that they felt “unsure” about their answer—moving across the piece for extended periods before being able to settle on an answer to a given question. With an average completion time of 9:28, (the longest answer session for an expert was 15:59, and the longest individual answer was 1:25—just over three times as long as the longest novice answer), expert answers took far longer than their novice counterparts.

It is easy to say that the more we know about something the more decisions we can/or have to make: more choices in vocabulary, media, color, mood, psychology, and approach, etc. With an increase in knowledge and an increase in understanding comes an increase in the amount of time needed to assess and answer artistic/design questions to the best of one’s ability

The power of explanation

In answering questions, experts were more likely to explain themselves/their choices when verbalizing their answers. This amounted to roughly five times per expert participant or once every four questions. Novices on the other hand, were only likely to explain their answers 18 times over all participants, or roughly once per session. This extended verbalization time for experts.

In answering questions, experts were also far more likely to physically point to areas of the piece while answering their questions. This amounted to roughly three times per expert participant, or once every six questions. Novices on the other hand, were only likely to physically point 11 times over the entire population, or roughly once per session.

This physical manifestation of the expert's choices also caused extensions in the verbalization of their answers.

While this is not seen as a drawback, it certainly points to the expert's ability to explain and draw attention to the specific areas of their answers. Often, artists and designers are required to defend or explain their work, bringing clients or other viewer's attention to areas of importance, to communicate the advantages/disadvantages, the needs and strengths of the piece. This is a skill which better allows them to assert their expertise whether in a school critique of artwork or when pitching an idea to a client. It is important to note that this study was not a time-sensitive one. No points were given or assigned based on the speed in which an answer could be given.

Efficiency of search

When viewing through the questions, by looking closely at the fixations, saccades, and overall gazepaths, a good overall impression of the search efficiency within expert and novice populations. Based on the evidence presented in this study, it is shown that even with longer answers and longer explanations, trained artists and designers have a more efficient visual search capacity.

In viewing the study, a great disparity was noted in the amount of fixations as well as the length of fixations among the expert and novice populations. More often than not , novices made more fixations within a given amount of time. More fixations overall indicate a less efficient search (Goldberg & Kotval, 1999). This may be due to a sub-optimal layout, or a perceived sub-optimal layout on the part of the non-artists.

This is also apparent in the number of searches in which novices used numerous short fixations with widely dispersed saccades (Goldberg & Kotval, 1999). This pattern (in the figures used in this paper, fixations were be represented by small numbered dots) is most clearly reflected in figures #10, 22, 34 and 68.

Experts tended to have clustered fixations (overall), and fairly straight jumps over short saccades. This indicates a strong interest with the design elements and when coupled with mid-range to long fixations, provides a pattern of jumping from item to item within a strongly visual composition. This was especially accurate for photo-heavy images like Image #1 and Image #2.

In later images (Image #5 and Image #6), longer saccades on the part of experts reflected more searching (Goldberg & Kotval, 1999). When these images included less imagery and more text, scanpaths for experts became longer, indicating a less effective search was taking place.

One possible explanation for this included a fair amount of comparison questions relating to Images #3-#6. In comparison questions, experts tended to view around the piece, searching for context clues before answering. This increased answer time, and thusly increased viewing time, amount of fixations, and gazepath length. Examples of this include Figures #15 and 23.

Unexpected Results

In carrying out this study, a certain amount of unexpected results surfaced: The possible double cognitive mode observed when individual wrote their answers while wearing the mobile eye tracker device, the use of the word "logo" and how the meaning of this word could be misinterpreted, and the use of the word "important" and how the meaning of this word can have connotations that are as individual as the viewer who is perceiving it.

Writing and cognition

As part of this experiment, participants were asked to verbalize their answers and then to write those answers on an answer sheet [see Appendix C]. The reason for this was to be a cue for the facilitator while compiling data. Participants who wore the eye tracking goggles looked down when writing their answers, offering an unintended result: letting us see how their eyes reacted as they wrote their answers.

When writing, you feel that you are closely attending to every stroke of the pen/pencil, and focusing on your writing. In reality, you are not.

Out of 20 participants, 13 had clearly viewable eye tracking results while writing their answers. Of the 13 available, 100% of participants *did not* look at their writing as it was being made, but rather looked at the writing *they had done* when answering questions. The focal point of their eyes followed along behind the pencil tip, reading the letterforms and words they had produced, rather than watching the letter develop at the

point of their pencil tip. This points us to a double cognitive mode revolving around our writing activities.

Participants knew what they wanted to write—each had verbalized their opinions prior to writing their answers. Rather than check their writing as they made it, each participant checked their writing after it was done—possibly in an effort to ensure the correctness of what they had produced. Participants obviously trusted their body mechanics to complete the task at hand, only checking behind to ensure that the task had been completed satisfactorily.

The reason for this is unclear. Most likely, because of the rapid motion of the hands and pen/pencil tip, a viewer's eyes can better understand this motion through our peripheral or parafoveal vision—the part of the eye whose main task is recognize and alert the brain to motion. To recognize that the task was done properly, viewers may need to see the finalized letterforms or words completely, pointing to the need for a finished work to be focused on, rather than an incomplete or in-progress piece of writing.

Chances may be that through years of training and writing (all participants were collegiate students), participants have become used to the writing process, and assured of their ability to complete what they intend.

It would be noteworthy to see if eye tracking similarities exist in the double cognitive mode if the population were of different ages or different levels of mastery in writing. Do learning kindergartners, middle school students, and collegiate students track their writing in the same fashion, or does the distance between the written letters/words

and the gaze increase with mastery? Do professional calligraphers follow their works closely or similarly spaced when they are writing? Perhaps implications may go similarly between the line-making and mark-making of artists. This may warrant further study.

The logo: Semantic differences and the selective use of vocabulary

Question 11 asked participants "Is the logo the proper size?" Sixteen out of twenty participants (within both the expert and novice populations) immediately replied with a question of their own "This logo [the letterhead logo], or this logo [the watermark]?"

The time involved with asking the question or receiving an answer from the facilitator was not counted toward their answer times or included in their gaze patterns, however it certainly pointed out a possible flaw in the materials presented. For many designers and artists, what a logo is and how to identify it are known quantities. This is not always the case, especially when dealing with non- artists.

When presenting questions to participants, care should be taken in the future to disregard semantics in lieu of more clear instructions—even for those experts who should be clearly familiar. This case of wording—"logo"—may have seemed like an innocent and easily recognizable word to those involved in the study, however it caused some misunderstandings on the part of the viewers. It is interesting to note, that even viewers who felt in question #8 that they could frame their answers as "the logo" and "the watermark" ended up asking this question.

In future studies, a better choice of wording, such as “the logo in the top left corner” might clarify the answers of the individual and lower overall answer time.

What does “important” mean?

When examining images during the question process, several questions (specifically questions #8, 14, and 20) centered around what participants perceived as the most important part of a given image. When formulating these questions, I had expected individual participants to choose the most important element of the composition. In reality, participants answered this question based on their understanding of the word “important”. For some, this meant aesthetic visuals, for others it meant size or power, and for some it meant important to close a sale or contact a company.

“Important” is an individual concept gathered around the participant’s assumptions. Without a clearer indicator of what the word “important” meant, participants were left to their own choices to interpret its meaning. Relating to items deemed “important” in both populations, items that were “visually appealing,” “attention grabbing,” bigger, held higher contrast or color areas, or were “spaced in the center of the image” were deemed to be the most important.

A good example of this includes the letterheads shown in Image #3 and Image #4. A good percentage of participants (35%) across both populations felt that the watermark was the most important thing in the piece. Reasons included its ability to “be seen from everywhere,” and that it was “centered on the piece,” and that it was “the largest thing on

the page". Experts also noted that its importance was apparent "because of its size" and its being "centered on the page".

The business concept that "bigger is better" is apparently alive and well. Once again, bright things, and contrasting things appear in the answers, but based upon the results of this study, a strong association is built around size, spacing, and location when determining what can constitute "importance".

Practical application for this includes the strong artistic ties to composition, sizing, color and contrast. While many of these ideas fly in the face of what many graphic design professionals see as good design, the numbers in this study show that large, centered, bright imagery and good contrast seem to draw a great deal of importance on the part of the viewer.

Limitations of the current study

The data provided in this study gives us a great deal to go on. Some weaknesses in this study can be improved upon with attention toward broadening the base of the individual participants as well as through the environment and semantics employed within future studies.

Population issues

This study was small, and built from a population of convenience. Students used in the exploration of this topic fell within certain age ranges, which may not be wholly indicative of results across a larger population. Certainly areas such as heat maps could

gain from having more participants within the study. With most subjects under the age of 30, trends may differ in what non-artists in the working world may find interesting. With this particular age range, questions regarding Baby Boomers may have caused questions or pauses relating to whether they knew what Baby Boomers might like or identify with. Future studies should consider larger, or more pointed populations.

Possible issues with miscues in this study

As mentioned in Chapter 3, miscues are a reality which may cause changes in data gathered or behaviors exhibited. In exhibiting materials for this study, computer monitors were used which were allowed to be manipulated by study participants in order to get the best viewing possible. While this allowed for comfort on the part of the participants, the monitors themselves came with image issues of their own.

The monitor used in this study was 21" wide set at 1920 x 1080 resolution. While this allowed for tall images to be created, it also gave us black bars at the side of the vertical pieces (Images #3-6) and above/beneath horizontal images (Image #1 and Image #2). Furthermore, the monitor itself was reflective in nature, and on occasion the viewer's clothing and face were visible to the participant during the experiment. These two items, including random fixations with image edges were possible causes for miscues and fixations which occur outside the shown images.

While mobile eye trackers allow for the mobility to have experiments in different locations, they can occasionally allow the viewer to be distracted by any item within their

visual range. Not all miscues can be compensated for, and not all visual distractions can be prepared for.

Miscues in this study were minimal, and created no drawbacks or errors that influenced this study. Miscues did no harm to study results, although any miscue could break the gazepath cycle and cause issues determining in what order participants digested the images—but it should be noted that the GazeTracker software compensated for this by numbering fixations. Future testing might be more effective at reducing miscues through the use of projectors on clean surfaces, although this is purely conjecture.

Part Two: Recommendations

Implications for further study

Collegiate students represent those who are in the process of preparing themselves for the workplace, pursuing education, and fine-tuning the skills of a competing, working world. While this study does well to interpret the results of experts and novices, are the reactions of business managers and design business owners in keeping with student populations?

Implications within this study tell us that trained designers and non-artists look for the same things, but see things differently. If training alone can give us marked differences in how experts see pieces of design, does working in the field—eight hours a

day, five days a week—as a designer or business manager cause us to see things *more differently*? Possible differences between working designers and students may exist.

The small number of subjects (20 in this case) may be adequate for this study, but expansion would require a larger number of participants to validate scale similarity across larger populations.

The most obvious direction for future work is to expand this research to include the following possibilities:

1) **More observers.** For accurate information to be further accumulated, a larger sample size should be created. This will allow more scalable results, as well as allowing heat maps to be generated which will be more accurate across larger groups. If this sample were to double in size, a more accurate heat maps would be generated. In Eyetracking Web Usability, Nielsen and Pernice state confront a similar issue when testing web pages. They state:

   > "Our studies indicate that it's best to have eyetracking recordings from 30 users to plot a heat map for a given Web page. This means that about 39 participants need to test the sites because you won't get good recordings from all users." (Nielsen & Pernice, 2010, p. 25)

2) **More Images.** In this study, six images are used to gauge participant reactions and gather eye tracking data. With more images, or more diverse images, greater understanding can be gathered regarding novice and expert gaze patterns. This will further confirm conclusions gathered in this research.

3) **Vocabulary use in questions.** The questions used in this study began with the words “visually appealing” in Images #1 and #2. Through Images 3-6 the word “important” was used. As discussed above this may have caused some individualization of answers, as “important” can have different meanings for different people. In future studies, the vocabulary used should be more consistent across multiple questions to maintain a more homogenous set of results.
4) **Population changes.** The populations gathered in this study are comprised of students only. Certain behaviors—i.e. longwinded explanations of why choices were made or explanations of answers given by experts—may be a byproduct of the learning process and constant critique structure of being a collegiate art student, which may vanish when a more professional population is used. By including more diverse populations, larger age ranges, and persons from different backgrounds, a greater understanding can be gathered which was unavailable for this study. When considering future studies, working designers—those hiring freelance designers or full-time designers—as well as business managers—those approving or receiving final design pieces—would be an excellent population to draw from.

Practical applications

Based on answers given in written form as well as eye tracking data gathered in this study, recommendations for practical applications can be made. Collegiate education in design (both 2-year and 4-year schools) can offer students certifications, degrees, or at

the very least training in practical application. Based on the evidence gathered in this study, the following recommendations can be made to better serve the students.

The human element

Evidence in this study showed that viewers were drawn to humans and especially to faces. Evidence also shows us that the locations in which human images *looked* was also a great draw for fixations. For designers entering the field, having a command over human representation should be heavily considered.

Students should have the opportunity to learn photography and image manipulation software at the earliest stages available to them. Stock photography exists but will not always suit the tastes of every situation—models clothes go out of style, and they cannot fit every situation in which they are needed. A student who has training enough to confidently *create* the human imagery they need, is a student with marketable skills.

With an understanding of photography comes an understanding of art direction—the ability to describe, create, and dictate the photography that the business and creative world will eventually be looking for. These skills may also allow students to move their expertise easily into video production if needed.

Image manipulation software comes in multiple forms, from three hundred-dollar programs like the Adobe Photoshop, to free programs like GIMP, and built-in programs with hardware devices, like scanners. Not every photo will be perfect, and not every photo shoot will be pristine. Image manipulation software allows an individual to cut or

adjust the human graphics they need. Some collegiate programs offer whole courses (or even multiple courses) in image manipulation, while other schools may have a "hands-off" approach, requiring students to learn on their own.

I highly recommend that image manipulation programs be built into low-level design coursework, and that several hands-on projects are used. Schools with a hands-off approach should offer clinics and how-to sessions through clubs and design groups as an effort to build skills from within.

Being able to build the proper photos or peel the best image from a useless background would constitute an excellent way for a school to build off of the evidence within this study.

Contrast

Contrast is one of the central elements of design, and in many ways is more important than color. Contrast is perceived in terms of value, and can therefor occur without color. Through contrast, human eyes are able to see the edges of items clearly, allowing us to delineate an item from its surroundings and giving us a stronger definition of what is being viewed at any given time. Contrast allows things to stand out, attracting both eyes and attention. Just as this black text upon the white paper (or a white screen if that is the case) allows us to more clearly understand its form—so contrast helps us to understand pieces of design by aiding us in readability.

Contrast should be an element of many facets within a successful design education, and a skill which is taught early and accentuated often. Contrast skills should

be part of drawing and design foundation courses, as well as a mainstay of photography and illustration coursework.

A firm understanding of contrast will only enhance the project work of students.

Color use

Color adds an additional layer to contrast. Colors convey emotions as well as simple shades of chroma, making it an effective messaging device. Accent colors in particular—bright changes in a single element used in attracting attention or conveying and emphasized meaning—are an important facet of color. Since color is such an integral part of design work and education, it should also be taught early and often.

Having a course in color theory should be part of any foundation program, as well as being an integral part of several different introduction-level courses. It can easily have integration within drawing, painting, and design coursework as well as computer-aided design classes.

The psychology of color—if not part of a color theory class—should have a place in project work. This would suit itself well as part of illustration, painting, basic design, graphic design coursework, or video design pieces. Part and parcel with that should be a deep understanding of accent color and how that can be used to show greater meaning in pieces or design work.

The importance of color borne out in this study makes itself apparent. If people across both novice and expert populations are giving color such high amounts of visual

importance, and describe it so often with their written and verbal answers, it should never be overlooked.

Text

Within a piece of design, text helps us to convey our message. The message is conveyed through language, and language is the vehicle for ideas to be easily passed from one individual to another.

With individuals beginning their gazepaths or fixations with text, gathering interest with that may not be important. What will be important is to ensure that the message within that text is readable.

Courses in typography should be available to design students in any collegiate design program, although the central tenets of typography—clean type, readability, chunking of information (separating information into easily digestible chunks within a composed image), and typeface choice should be information contained in the teachings of several courses. Project work involving these ideas should be part of basic graphic courses, computer-aided design, video/multimedia, and print production courses.

Readability should be the main concern of any designer, as unreadable text will divert from the information in the piece

Overall recommendations

By looking into the importance of color and contrast across the images presented in this study, the information leads us to some of the central tenets of design: learn and

work with color, learn and work with contrast, and provide a strong sense of dialog with the viewer by including models/photography/illustrations/images, etc. with humans which can engage or lead the gaze of the viewer, and make your text easily approachable and easily readable. Design pieces which can capitalize on 2-3 of these elements at once can stand a good chance of satisfying both clients and artists/designers. When choosing your models or stylized illustrations, make sure that expressions correctly convey the emotion you wish your viewer to understand and share. Follow this by ensuring that optical or implied lines can quickly tie your models to the items within the imagery that you wish to achieve a strong connection with the viewer.

Artists and explanations

Experts in this study were found to be slower in delivering their answers than novices—in many cases two to five times slower. Artists and designers should work toward faster critiquing and faster decision-making regarding which elements of a piece of art or design are working (or not working), and pinpointing those issues through clear communications.

While many schools critique their artists/designers' pieces in a group setting, perhaps by limiting the time to a few minutes per piece they can begin to train artists and designers on improving their time. This can promote understanding and allow students to make recommendations without hampering their ability to draw the proper conclusions.

Artists and designers should be (or become) aware of the fact that in some cases, time *is* of the essence. In situations like that, artists and designers should plan appropriately for the proper amount of time needed when explaining for non-art clients.

Size and space matter

In looking over the imagery from Images #3-#6, especially the written/verbal responses, it is shown that bigger is better in the minds of many non-artists. While the culture of trained designers is to take information and push it out of the way in an effort to gain a better visual proportion, it seems that this slips over the sensibilities of most non-artists. Importance was attributed to images which were larger, centralized, brighter, spaced openly, etc. Marketers spend so much time building their messages for an audience just perfect for their products, when in fact most people seem moved very little by the text place on the page.

This needs to be taken into account. Perhaps more time should be placed in learning how to better build highly graphic compositions with strong use of contrast and color rather than building in subtlety. Few if any viewers identified the text messages as important portions of these design pieces. However, items like the watermark on Item #3 and Item #4 seemed to grab a great deal of attention based around its largely centralized, oversized appearance.

Design work may find a greater connection with everyday viewers by falling back away from its attention on smaller proportions and elegant typography in lieu of more attention-grabbing, more overpowering pieces. I would highly recommend research and

study before pursuing this or even recommending this.

Final conclusion

In this thesis, evidence shows that with training, artists and designers can see imagery differently. With an increased ability to gather information visually also comes a slower response based around the wealth of information available. Even with all this training, however, experts are still looking at the same things which non-artists are looking at.

The information provided in this study points to similarities and differences. Text, color, contrast and imagery choices all point to the strength of design basics within these frameworks. Any piece of design which can accurately deliver its message is successful, while those which are able to connect with viewers in a memorable fashion are ones to be celebrated. This study points out specific results, as well as recommendations for student programs within higher education.

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APPENDIX A: UMCIRB 11-001374

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
1L-09 Brody Medical Sciences Building· Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office **252-744-2914** · Fax **252-744-2284** · **www.ecu.edu/irb**

Notification of Initial Approval: Expedited

From: Social/Behavioral IRB
To: Tyler Dockery
CC: Robert Quinn
Date: 2/14/2012
Re: UMCIRB 11-001374
Meeting Eye to Eye: How trained designers and average citizens see advertisements, and their implications for modern design education

I am pleased to inform you that your Expedited Application was approved. Approval of the study and any consent form(s) is for the period of 2/13/2012 to 2/12/2013. The research study is eligible for review under expedited category #4, 6, 7. The Chairperson (or designee) deemed this study no more than minimal risk.

Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The Investigator must adhere to all reporting requirements for this study.

The approval includes the following items:

Name	Description
Attention - Study Volunteers Needed.doc | History	Recruitment Documents/Scripts
Dockery-Survey-Consent-Letter-v2.doc | History	Consent Forms
Eye-tracker survey | History	Surveys and Questionnaires

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

APPENDIX B: Participant Cover Letter

Dear Participant,

I am a graduate student at East Carolina University in the Art Education department. I am asking you to take part in my research study entitled, *"Meeting Eye To Eye: How trained designers and average citizens see advertisements, and their implications for modern design education"*.

The purpose of this research is to study the differences between trained design students and untrained students. By doing this research, I hope to learn how to better approach the design education of students in an effort to help them train for work in the field. Your participation is voluntary.

You are being invited to take part in this research because your level of design education falls within the bounds of this project. Participants will come from 2 main populations: Design students with 3+ years of education, and students untrained in art or design. The amount of time it will take you to complete this study is approximately 10-15 minutes.

You are being asked to answer questions based on visual images. During this time, your gaze patterns will be tracked with a pair of eye tracking glasses. They will fit and act like a normal pair of glasses. Also during this time, we will record your voice responses to questions to help with our analysis.

Because this research is overseen by the ECU Institutional Review Board, some of its members or staff may need to review my research data. If you have questions about your rights as someone taking part in research, you may call the UMCIRB Office at phone number 252-744-2914 (days, 8:00 am-5:00 pm). If you would like to report a complaint or concern about this research study, you may call the Director of UMCIRB Office, at 252-744-1971

You do not have to take part in this research, and you can stop at any time. If you decide you are willing to take part in this study, please sign the roster sheet to receive a sticker with your randomly-created participant number pre-printed on it.

Thank you for taking the time to participate in my research.

Sincerely,

Tyler Dockery, Principal Investigator

I consent to participate in this study.

Signature:_____

Name:_____ Date:_____

APPENDIX C: Participant Answer Sheet

[rnd#] Name:
Years of Art Training:
M/F: Age:

Answers area:

2:	3:
4:	5:
6:	7:
8:	9:
10:	11:
12:	13:
14:	15:
16:	17:
18:	19:
20:	

APPENDIX D: Facilitator Questions with Visual References

Survey Questions:

1) Please read the participant number you have been given, and state your level of design education

< Boom! Magazine Advert #1 >

2) Please examine the image on the screen. This is an advertisement for a magazine marketed to "Baby Boomers". Does this piece effectively target that group?

3) Which part of this piece is the most visually appealing?

4) Why?

< Boom! Magazine Advert #2 >

5) Please examine the image on the screen. This is an advertisement for a magazine marketed to "Baby Boomers". Does this piece effectively target that group?

6) Which part of this piece is the most visually appealing?

7) Why?

< Zestworld Letterhead #1 >

8) Please examine the image on the screen. This is a company letter stationary for a company called Zestworld. What is the most important thing on this page?

9) How do you know?

10) What would you change?

11) Is the logo on this the right size?

< Zestworld Letterhead #2 >

12) This is basically the same letterhead. What has changed?

13) Does this seem more effective or less effective with the larger logo?

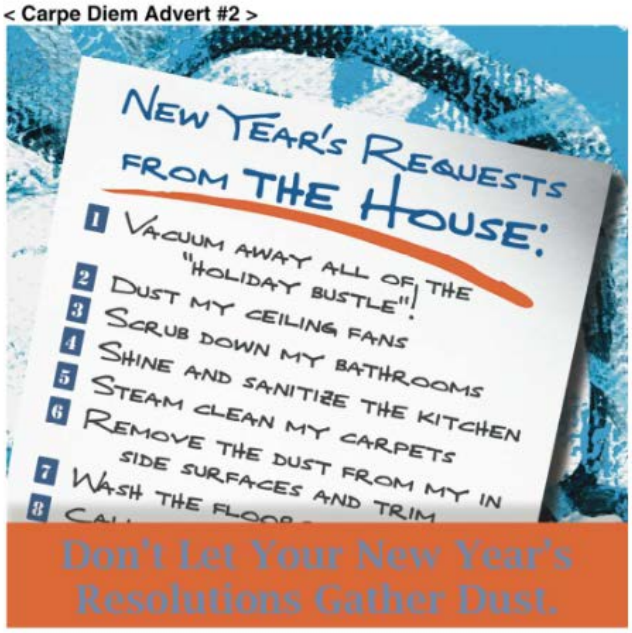
< Carpe Diem Advert #1 >

14) This is an advert for a magazine layout. What's the most important thing on this page.

15) How important is the logo on this page?

16) Is the logo the proper size, and why?

< Carpe Diem Advert #2 >



Established in 1994 Carpe Diem Cleaning is a locally owned residential cleaning company with valuable experience caring for the Triangle's homes. Providing customer care and quality service, Carpe Diem Cleaning creates time and peace of mind leaving you with the freedom to not only "Seize a Clean Day," but to "Seize a Clean Year!"

17) This is basically the same layout. What has changed?

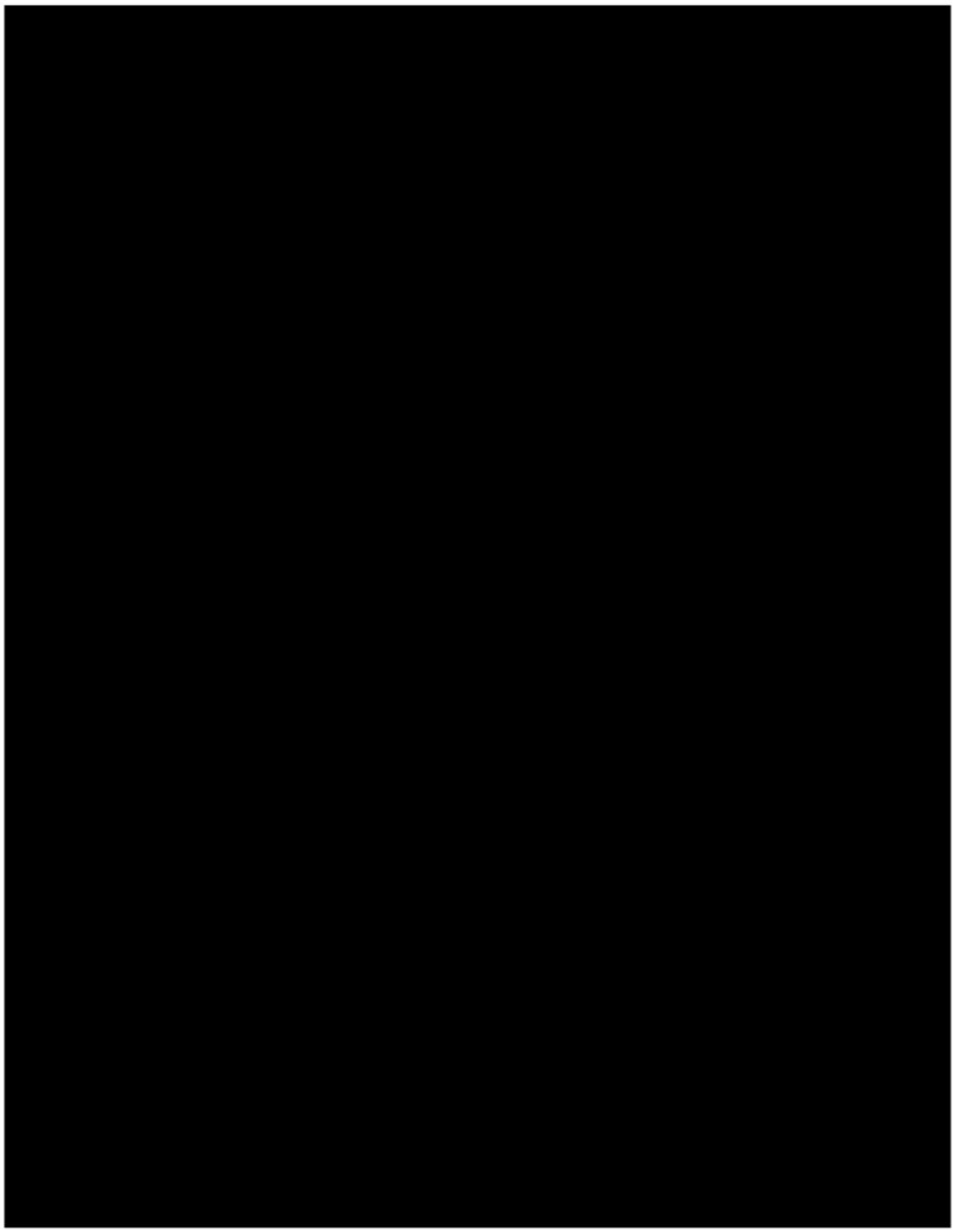
18) Is this layout more or less effective?

19) Do the colors work better or worse?

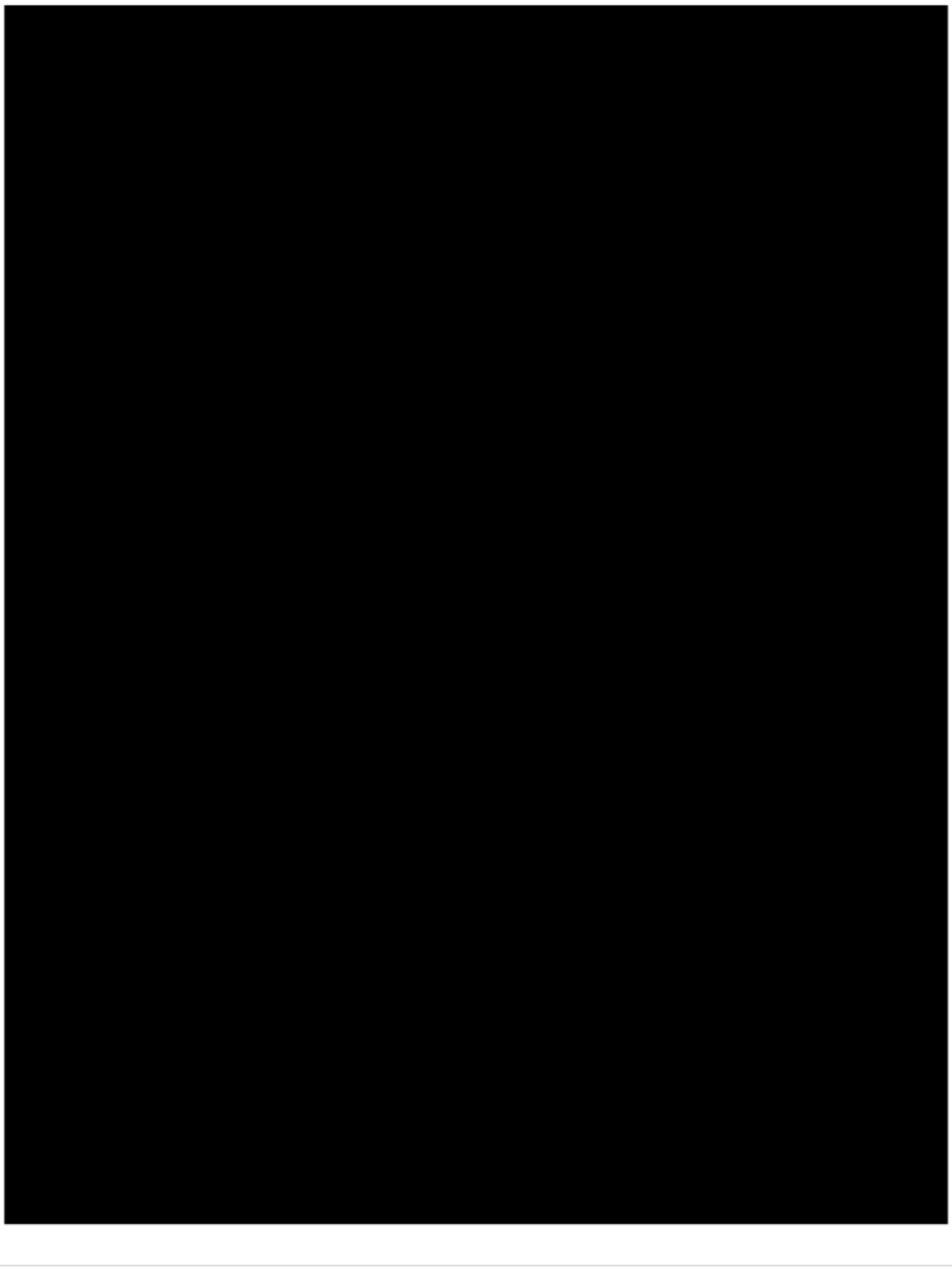
20) What is the most important thing on this page?

APPENDIX E: Participant Survey Images

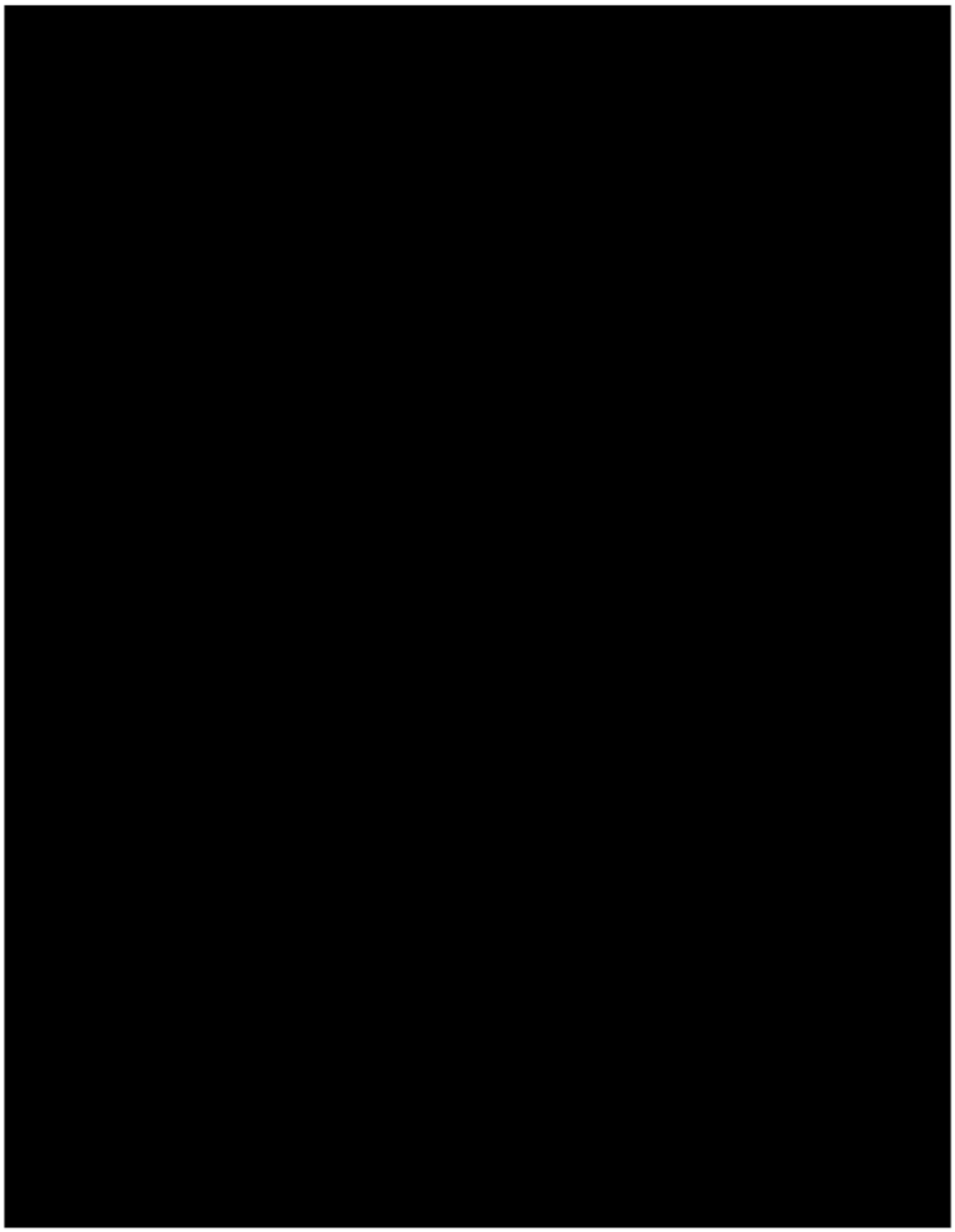
Note: Due to size constraints, all images in Appendix E are shown at 70% of their original size. Each image was set in Adobe Acrobat's Full Screen Mode during presentation to study participants. Actual screen width for viewers was 21".



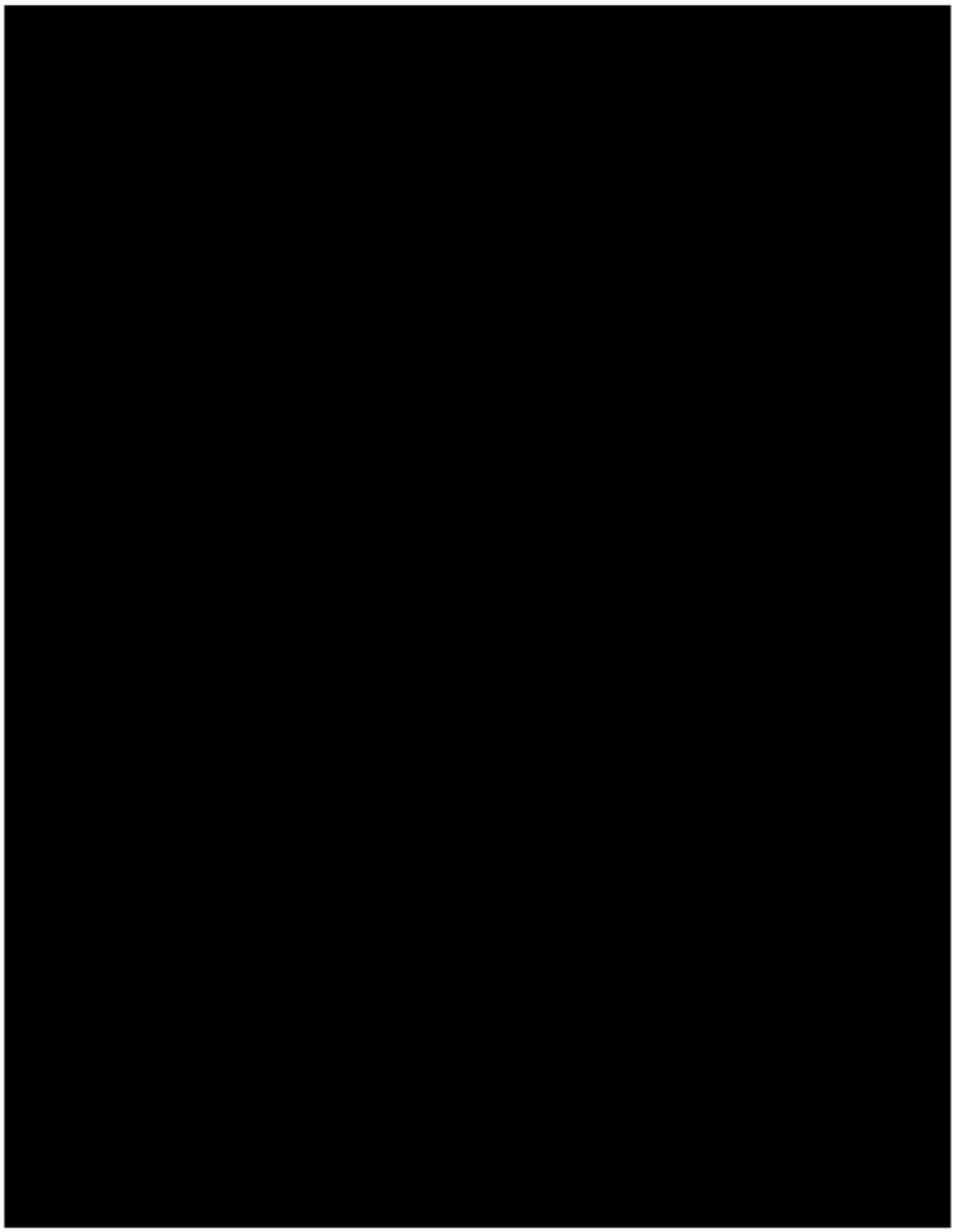

Go ahead,
Seize A
Clean Day.
You've earned it.
CARPE DIEM CLEANING
Add a
FREE
Fridge
Cleaning
call today for details.
Cleaning the Triangle's Homes
For Information call 919-68-CLEAN www.CarpeDiemCleaning.com



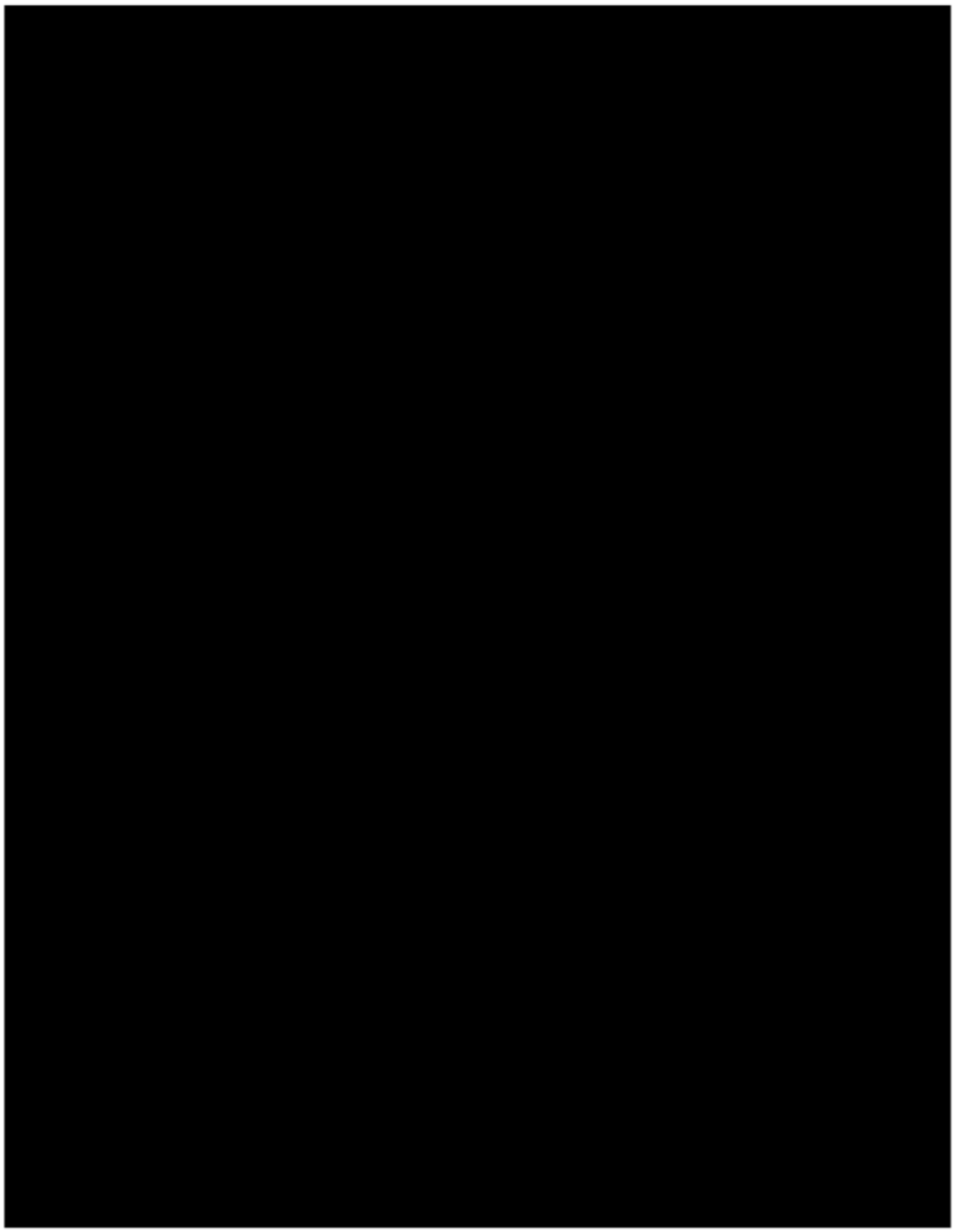

CARPE DIEM CLEANING
Go ahead,
Seize A Clean Day.
You've earned it.
Cleaning the Triangle's Homes
For Information call 919-68-CLEAN CarpeDiemCleaning.com



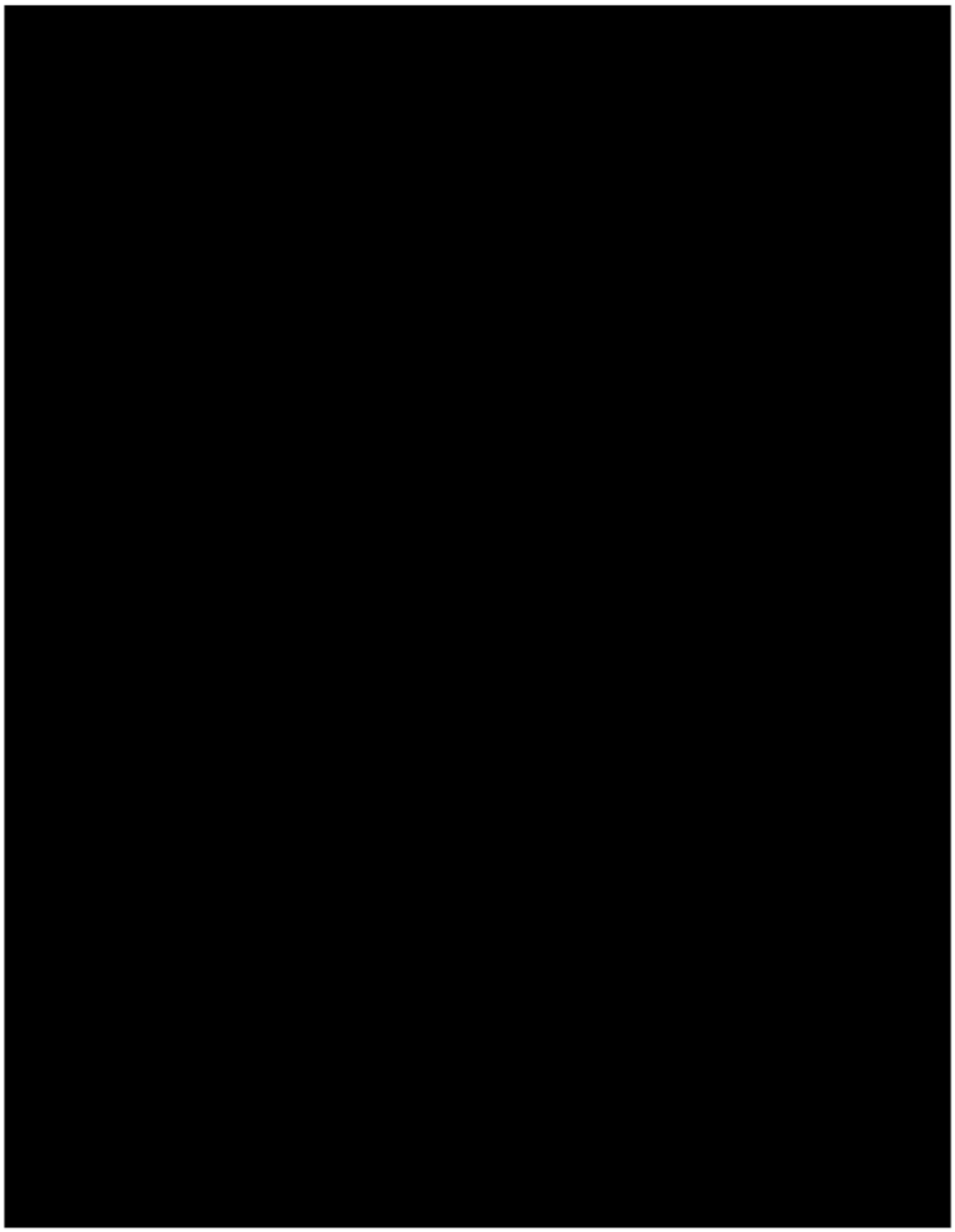

Zest world
PROMOTIONS
8317 Six Forks Road | Suite 105 | Raleigh, NC 27615 | v: 919.847.7700 f: 919.847.7999 c: 919.696.8262 | www.zestworld.net




Zest world
PROMOTIONS
8317 Six Forks Road | Suite 105 | Raleigh, NC 27615 | v: 919.847.7700 f: 919.847.7999 c: 919.696.8262 | www.zestworld.net




New Year's Requests from the House:
1 Vacuum away all of the "Holiday Bustle"!
2 Dust my ceiling fans
3 Scrub down my bathrooms
4 Shine and sanitize the kitchen
5 Steam clean my carpets
6 Remove the dust from my in side surfaces and trim
7 Wash the floor
Don't Let Your New Year's Resolutions Gather Dust.
Established in 1994 Carpe Diem Cleaning is a locally owned residential cleaning company with valuable experience caring for the Triangle's homes. Providing customer care and quality service, Carpe Diem Cleaning creates time and peace of mind leaving you with the freedom to not only "Seize a Clean Day," but to "Seize a Clean Year!"
good through 02/29/12
CARPE DIEM CLEANING
$25 off your first "CLEAN DAY" with Carpe Diem Cleaning after a FREE Consultation for Regular Service.
$25 OFF
919-68-CLEAN 919-682-5326 www.carpediemcleaning.com




New Year's Requests from the House:
1 Vacuum away all of the "Holiday Bustle"!
2 Dust my ceiling fans
3 Scrub down my bathrooms
4 Shine and sanitize the kitchen
5 Steam clean my carpets
6 Remove the dust from my in
side surfaces and trim
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good through 02/29/12
CARPE DIEM CLEANING
$25 off your first "CLEAN DAY" with Carpe Diem Cleaning after a FREE Consultation for Regular Service.
$25 OFF
919-68-CLEAN 919-682-5326 www.carpediemcleaning.com

APPENDIX F: Written Answers Data Table

Participant #	Gender	Exp Level	Age	Yrs Train		total time	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16	a17	a18	a19	a20	look writing
348	F	Expert	21	3		4:05	Y	moped	Color	Y	Color Area	Texture	Logo	Most atte	color of ba	N too sma	Logo size	More - big	Yellow Ba	Not Impor	N too sma	Orange Ba	Less	Worse	Orange Banner	NA
350	F	Expert	21	3		7:28	Y	old couple	compositi	Y	old couple	compositi	Logo	It is the bo	unsure	Y	Logo size	More - pa	List at the	Not Impor	N too sma	Color Cha	More	Better	coupon	NA
354	F	Expert	22	4		6:14	N	old couple	happy exp	Y	Color Area	color + flo	watermar	size + mid	bottom gr	Y	Logo size	More	coupon	Not Impor	Y/N - copy	Orange Ba	Less	Worse - H	coupon	N
356	F	Expert	22	4		10:59	N	old couple	not every	Y	Color Area	Most inte	watermar	clear but p	color of ba	Y	Logo size	Less	coupon	Not Impor	N top is di	Color Cha	More	Better	Glove cleaning	N
359	F	Expert	23	3		8:48	Y	Fridge are	Most strik	Y	Color area	still more	logo	most pron	change th	Y	Logo size	More/Less	Coupon- b	Not Impor	N does no	Color Cha	Less	Worse	Coupon	NA
360	F	Expert	23	7		15:59	Y	old couple	happy exp	N	Bushes ba	Calm area	watermar	if too stro	bottom gr	Y	Logo size	More/Less	What ad is	Not Impor	N too sma	Color Cha	Less	Worse	Orange banner - because it mak	N
349	F	Expert	28	10		11:34	Y	old couple	Most varia	Y	old couple	humans at	Logo	first attrac	adjust z to	Y	Logo size	Less	Note title	Not Impor	Y needs co	Orange Ba	More	Better - At	Orange Banner, high contrast	N
358	F	Expert	30	3		8:12	Y	logo uppe	Clean + Ap	Y	Flowers o	Bright colo	Logo	Visually d	change let	Y	Logo size	More	$25 coupo	Not Impor	N not eno	Orange Ba	Less	Worse	Glove thumbs up	NA
357	F	Expert	46	8		11:08	Y	moped + V	Color + ha	Y	old couple	happy fac	Logo	most pron	font at top	Y	Logo size	Less	Yellow Ba	Not Impor	Y good for	Orange Ba	Equal	Better - cc	Glove hand	N
355	M	Expert	21	3		10:21	Y	Fridge are	color + vib	Y	Color Area	color + vib	watermar	size + mos	nothing	Y	Logo size	Less	List at the	Not Impor	N not nec	Color Cha	Less	Worse	Message at bottom	N
					avg. times	9:28																				
					Median	9:34																				
					Mode	#N/A																				
366	F	Novice	20	0		2:59	Y	moped	Bright colo	Y	Flowers o	first thing	Logo	placed at	nothing	Y	Logo size	More	Yellow Ba	Not Impor	N should b	Color Cha	Less	Worse	Orange banner	NA
361	F	Novice	30	0		9:13	Y	old couple	happy exp	Y	Flowers o	enjoymen	bottom	lack of kn	bottom - r	Y	Logo size	Less	$25 coupo	Not Impor	N didn't e	Color Cha	More	Better	Orange Banner	NA
367	M	Novice	19	0		8:57	Y	Fridge are	Bright colo	Y	Flowers o	visual cue	Logo	without th	nothing	N	Logo size	More	$25 coupo	Not Impor	Y	Color Cha	More	Better	Colors - they give insight into th	NA
353	M	Novice	22	0		5:34	N	moped	Color	Y	shirts	color	watermar	repetition	nothing	Y	Logo size	Less	List at the	Not Impor	Y right size	Color Cha	Less	Worse	Orange Banner	N
363	M	Novice	22	0		7:26	Y	Fridge are	Bright colo	Y	Text area	central wo	watermar	can be see	nothing	N	Logo size	Less	Yellow Ba	Not Impor	N too nea	Color Cha	Less	Worse	$25 off	N
364	M	Novice	22	0		11:19	Y	old couple	She is hav	N	Flowers o	different	Logo	most pron	change wa	N	Logo size	Equal	$25 coupo	Not Impor	N too sma	Color Cha	Equal	Better	$25 off	N
365	M	Novice	22	0		8:37	Y	Woman +	colors are	Y	color area	color	watermar	central an	color of w	N	Logo size	More	$25 coupo	Not Impor	N does no	Color Cha	More	Better	Banner text	N
351	M	Novice	23	0		7:00	Y	old couple	not busy	N	couple/m	blurry	bottom	it is where	nothing	Y	Logo size	Less	Bottom	Not Impor	Y Just righ	Color Cha	Less	Worse	thumbs up	N
362	M	Novice	23	0		7:34	N	Fridge are	Stands ou	Y	Bushes ba	Trees look	bottom	provides c	color of ba	Y	Logo size	More	$25 coupo	Not Impor	Y great pro	Color Cha	Less	Worse	$25 off	NA
352	M	Novice	26	0		6:25	Y	old couple	lady expre	Y	Color Area	Popped V	bottom	it is where	more reac	y	Logo size	More	Yellow Ba	Minimal In	N too aggr	Color Cha	Less	Worse	$25 off	N
					avg. times	7:30																				
					Median	7:30																				
					Mode	#N/A																				