THE VIEW: AN EYE-TRACKING STUDY

OF PRINT ADVERTISEMENTS

By

ASHTON LIERLE

Bachelor of Science

in Agricultural Communications

Oklahoma State University

Stillwater, Oklahoma

2015

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
December, 2017

THE VIEW: AN EYE-TRACKING STUDY OF

PRINT ADVERTISEMENTS

Thesis Approved:

Dr. Shelly Peper Sitton
_____
Thesis Adviser
Dr. D. Dwayne Cartmell, II
_____

Dr. Gregory Clare
_____

Name: ASHTON LIERLE

Date of Degree: DECEMBER, 2017

Title of Study: THE VIEW: AN EYE-TRACKING STUDY OF PRINT
                  ADVERTISEMENTS

Major Field: AGRICULTURAL COMMUNICATIONS

Abstract:

This research investigates how agricultural communications students view animal agriculture print advertisements using eye-tracking technology. The advertisements are constructed of a minimum of four areas of interest (AOIs) and are analyzed using eye-tracking metrics (time to first fixation, fixation duration, and fixation count) and scanpath entropy. Eye-tracking technology is a growing phenomenon in the advertising industry, but the data isn't always readily available. The purpose of this study is to determine how agricultural communication view print advertisements and if they view them differently after experiencing an introductory graphic design course.

Students completed a demographic questionnaire and were eye-tracked during the first week of their introductory graphic design course and were then eye-tracked a second time using an identical eye-tracking test at the end of the semester. The eye-tracking test was designed so the participants had five seconds to view each of the eight advertisements.

Based on eye-tracking metrics, participants, on average, viewed all AOIs within the advertisement in less than four seconds and the image produced the highest fixation count. The logo AOI produced the greatest scanpath entropy, meaning it had the most information loss during viewing.

Evidence from this study led to recommendations for graphic designers to include a dominant, attention-attracting element in their designs along with attention-holding elements to keep a viewer engaged in the design. For education, graphic design instructors should consider curriculum revision based on the results of eye-tracking studies.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Studies have found an average adult is exposed to 600 advertisements in any form every day (Media Matters, 2007). But, the question is "Do those consumers ever really think, 'Wow, that designer took a lot of time considering the placement of the elements in that design'?" So, what attracts average consumers to designs: Words? Spacing? Fonts? Bigger, more dominant elements? Bright color schemes? Today, graphic designers are trained to have these questions in mind while they design advertising material (Martin & Hannington, 2012). In fact, designers should continuously review and critique their work to distinguish themselves from others in the industry (Graham, 2005).

According to Graham (2005), graphic designers are creative artists who always strive to meet the needs of the customer. Those needs include identifying a target audience and keeping the characteristics of that audience in mind during the entire design process (Graham, 2005). Every graphic designer should focus on understanding how design elements incorporate the principles of design, and one of the most important aspects of producing a visual creation is to base the design around the interests of the

viewers, not the designer (Graham, 2005).

Every time a designer begins a project, the target audience should be established first (Graham, 2005). Marketing to different age groups, like children and centenarians, can change the whole concept of the design (Graham, 2005). Children most likely prefer designs with brighter colors and "fun" graphics, while people older than 60 probably prefer something a little less busy and more straightforward with larger fonts and graphics (Graham, 2005). College-level design textbooks, such as Martin & Hannington (2012) and Graham (2005), provide curriculum stating designers and artists should be trained to look for key design elements such as lines, shapes, color, and texture. Average viewers of design products tend to look for the same elements most of the time, but skim certain elements or do not recognize relationships among the elements used in the design process as they scan for the overall message (Wedel et al., 2008).

Throughout the last decade, eye-tracking work has evolved in this new technology-driven society (Duchowski, 2007). Researchers now are beginning to understand the unique contributions eye-tracking can lend to their studies (Duchowski, 2007). However, eye-tracking data collected by advertisers is commonly difficult to find (Duchowski, 2007).

Statement of the Problem

Eye-tracking technology has grown in popularity throughout the last decade, but little evidential research of eye-tracking is being used for advertisement analysis (Rayner et al., 2001). Companies implement eye-tracking technology into their advertisement development plan but keep the information mostly proprietary (Rayner et al., 2001).

Additionally, research in curriculum development strategies in higher education are needed (Clarence-Fincham & Naidoo, 2013). Stark (2000) found college professors

and faculty seek little to no help from curriculum research literature when it comes to curriculum development.

Purpose and Objectives

The purpose of this study was to determine how a specific college-age audience views print advertisements and if they view advertisements differently after experiencing graphic-design training. The results of this study will provide graphic design instructors with insights on how their curricula affects the way designers view advertisements.

The following research objectives were established for this study:

1.   Determine the time it takes agricultural communications students to view specific areas of interest (AOIs) in advertisements.

2.   Determine the scanpaths followed by agricultural communications students when viewing advertisements.

3.   Determine the amount of time agricultural communications students spend viewing AOIs in advertisements.

4.   Determine the number of times agricultural communications students view AOIs within advertisements.

5.   Determine information transfer (scanpath entropy) of AOIs when students view advertisements prior to an introductory graphic design course.

6.   Determine information transfer (scanpath entropy) of AOIs when students view advertisements after experiencing an introductory graphic design course.

7.   Compare the information transfer (scanpath entropy) of AOIs when students view advertisements before and after exposure to an introductory graphic design course.

Review of Literature

The literature associated with the use of eye-tracking technology and eye-tracking studies in the discipline of graphic design uses terminology that could require some clarification. To incorporate methods common to eye-tracking research in the current study, we employed the basic concepts of eye-tracking, visual attention, and fixations and saccades.

Eye-tracking

Eye-tracking is a method for incorporating the voice of consumers into design practice and increasing in popularity (Duchowski, 2017). Eye-tracking is based on Just and Carpenter's (1976) "eye-mind" hypothesis, which stated the location of a person's gaze directly corresponds to the most immediate thought in a person's mind.

Eye-tracking technology collects data on the unconscious action of the eye (Duchowski, 2017) and has been used by researchers for several decades to reveal covert perceptual and cognitive processes that inspire the perception and aesthetic evaluation of art (Lochner, 2006).

In 2001, Miall and Tchalenko performed the first thorough examination of a painter's work process. Miall and Tchalenko (2001) observed the rhythm between fixations on the model and fixations on the drawing. They also looked into the pattern of hand movements in relation to the eye positions when drawing quick sketches. Tchalenko and Miall have continued their studies with other researchers, specifically focusing on fixations and saccades.

In hopes of expanding on the role of eye movements, Yarbus (1967) determined the human eye voluntarily and involuntarily fixates on elements that contain essential

4

information to the viewer. The greater the amount of information in the element, the greater amount of time the viewers' eyes stay fixated on that element (Yarbus, 1967). When looking at order and duration of the fixations on elements, Yarbus concluded those measures are influenced by the thought process associated with the analysis of the information received. Yarbus (1967) explained the concept of saccades as:

> 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 saccade usually permits the eye to remain in a state of fixation for 95% of total time. (p. 129)

Several eye-tracking studies have concluded measuring saccades is actually not necessary in eye-tracking studies (Just and Carpenter, 1976; Neilson & Pernice, 2010; Yarbus, 1967). Saccades are among an ongoing debate about their relevance to the literature in certain cases and methodologically more complex to quantify, so for this study, we will primarily focus on measuring fixations.

Large corporations, educational institutions, and others are growing accustomed to using eye-tracking technology. These eye-tracking systems combined with the available software packages can generate detailed statistical results (Duchowski, 2007). Eye-tracking technology measures an individual's eye movements and tells the researcher where the person is looking at any certain time as well as the pattern his or her eyes follow from one element to another (Duchowski, 2007). When it comes to remote, non-intrusive eye-tracking, the most common technique used is pupil center corneal reflection

(PCCR) (Poole & Ball, 2005). This approach measures how light is used to illuminate the eye, which creates highly visible reflections, while a camera is used to capture an image of the eye to show the reflections (Poole & Ball, 2005). This image then is used to detect the reflection of the light source on the cornea and in the pupil. A vector can be developed by the angle between the cornea and pupil reflections. Gaze direction is calculated by combining the direction of the vector with other geometrical features of the reflections (Matos, 2016). Today's most advanced eye-trackers use near-infrared illumination to create the reflection patterns on the cornea and the pupil of the eye. A physiological three-dimensional (3D) model of the eye and advanced image processing algorithms are used to estimate the position of the eye in space and the point of gaze with high accuracy (Matos, 2016).

One common component used to describe eye-tracking is the mind-eye hypothesis. This fundamental approach is found to be the backbone of a majority of eye-tracking studies. In general, the mind-eye hypothesis assumes a person looks at what he or she is thinking about. Anderson et al. (1976) describe the mind-eye hypothesis in more specific terms:

> Eye movements do not necessarily reflect mental processes, but they do reflect ongoing processes to the extent that the processes depend on the encoding of information. Although some cognitive tasks have to wait for information to be encoded, in many cases, the mind has a path to travel after the encoding of the information, and eye movements do not indicate what is happening on that path. (p. 230)

Visual Attention

In eye-tracking research, we first look at the motivation for recording human eye movements to help us understand attentional processes because we need to know more about visual attention (Duchowski, 2007). William James (1981) defined visual attention in his book *Principles of Psychology*:

Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration, of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others and is a condition which has a real opposite in the confused, dazed, scatterbrained state. (p. 404)

For the human mind to process the stimulus of interest, attention is used to focus psychological capacities on selections of the sensory input (Duchowski, 2007). The human brain processes sensory input by concentrating on specific components of the whole sensory range so intriguing sights, sounds, and smells may be inspected with greater attention to detail than peripheral stimuli (Duchowski, 2007).

Three psychologists, Von Helmholtz (1925), James (1981) and Gibson (1941), explored the "where," "what," and "how" of visual attention. Von Helmholtz (1925) suggested visual attention is a vital tool of visual perception. He focused on studying eye movements to spatial location – the "where" of visual attention. James (1981) defined attention as it pertains to the "what," or the identity, meaning, or expectation related to the focus of attention. Gibson (1941) centered his interpretation of visual attention on intention. His proposal described the viewer's preparation as to whether to react to

something, and if so, how and with what class of responses.

Framework

A conceptual framework, with emphasis on the scanpath theory and information theory, will be used to guide the study.

Noton and Stark (1971) studied eye movements and defined the observed patterns as "scanpaths." They determined even without questions for the viewers to consider before viewing, participants tend to fixate on identifiable areas of interests. Scanpaths showed the order of eye movements across areas of interest (AOIs) is significantly variable in Noton and Starks (1971) research. Scanpath theory also depicts how scanpath facilitates subsequent recognition of advertisements (Viviani, 1990).

To better understand the concept of scanpath entropy we reviewed the work of Hooge and Camps (2013) as a guide to this measure of eye-tracking. Hooge and Camps (2013) summarized the use of entropy to quantify gaze guidance along with other existing measures. To explore scanpath entropy, it is first important to understand the concepts of the Information Theory. Information theory is a mathematical theory of communication with two main goals: (a) develop fundamental theoretical limits on the achievable performance when communicating a given information source through a given communications channel using coding schemes from a prescribed class and (b) develop coding schemes providing reasonably good performance compared to optimal performance given by the theory (Gray, 2011). Shannon's Information Theory is seen by some as an extension of the applied probability theory and the ergodic theory (Gray, 2011). Shannon's development of the idea of entropy of random variables to the formation of the information theory. Entropy was later defined by Gray (2011) as the

relevance to a single random variable or random vector.

In 2001, Rayner et al. studied eye movements on print advertisements with different tasks assigned to participants. They found viewers commonly looked at the text longer than they looked at the picture in the advertisement and more fixations occurred on the text than the picture. After doing an initial scan of the advertisements, it is common for viewers to read larger text and then the smaller text, followed by fixating on the image (Rayner, 2001).

In a similar study, Pieters & Wedel (2004) studied brand pictorial and text-size. They determined the size of AOIs within advertisements does directly affect viewers' attention (Pieters & Wedel, 2004). Another aspect to review in regard to attention is visual complexity, which was studied by Pieters, Wedel & Batra (2010). By studying feature and design complexity, Pieters et al. (2010) found attention to more complex advertisements strictly depends on if the advertisement possesses feature or design complexity. Feature complexity describes how complex visual details are in an advertisement, while design complexity relates more to the detail in creative design shapes, objects, and organization (Pieters et al., 2010). In advertisement design Pieters et al. (2010) determined design complexity aids in advertisement performance while feature complexity harms it.

CHAPTER II

METHODOLOGY

In this chapter, you will find the methods and procedures followed by the researcher to conduct this study including the Oklahoma State University Institutional Review Board (IRB) approval, research design, instrumentation, participants, and data analysis.

Institutional Review Board

Federal regulations, along with institutional standards set by Oklahoma State University, require all research conducted using human subjects to be approved prior to beginning a study. The Oklahoma State University Office of University Research Services and Institutional Review Board regulate the biomedical and behavioral research to maintain the welfare of the human subjects. This study was reviewed by the OSU IRB and was approved January 18, 2017 (see Appendix A). This study is identified by IRB application number AG-17-1.

Research Design

A research design is defined as the science and art of planning procedures for conducting studies so as to get the most valid findings (Vogt, 2005). An exploratory one-

group design with a nonprobability convenient population was used for both research studies. A census design was used because of the small population size. Because of these characteristics, the results in both studies cannot be generalized beyond the given population. The researchers designed Manuscript I as a general exploratory study with one group and no control while Manuscript II was a pretest-posttest design. A mixed-methods analysis was used to analyze the data.

Instrumentation

Questionnaire

A researcher-developed questionnaire (see Appendix B) was used in this study prior to collection of the eye-tracking data to gain insight about the participants. The questionnaire asked the participants demographic questions, such as age and sex. The participants also were asked to identify their college major and relation to agriculture. This was done to help the researchers better understand the participants' background. The last five questions on the survey pertained to physical traits of the participants pertaining to vision. The participants were asked if they were colorblind or had been diagnosed with any other disorder or medical condition that could influence their vision. If a participant had reported a non-corrected vision issue, the participant would have been removed from the data set.

The following questions were included in the research questionnaire:

1. What is your sex?

2. What is your primary major?

3. Prior to attending Oklahoma State University, where did you live?

4. Are you right-hand or left-hand dominant?

5. Do you have any vision issues?

6. If answered yes on #5, do you where corrective lenses to obtain normal vision?

7. Are you colorblind?

8. Do you have epilepsy?

9. Have you ever been diagnosed with a disorder or medical condition that could influence your vision?

Eye-Tracking Technology

Eye movements were recorded using a Tobii™ T60 version 3.4.7 screen-based eye-tracker. A desktop iMac computer was used to power the Tobii™ T60 device. The advertisement images were imported into the Tobii™ software as JPEG files and displayed on the screen at a full resolution of 1920 x 1080 pixels. The advertisements were centered on a color monitor when viewed by the participants.

The eye-tracking device software provided corresponding heat maps, gaze plots, and statistical data. The statistical data was exported into Microsoft Excel files by the Tobii™ software program. This data can provide a visual analysis to help readers comprehend the scan patterns and distributed attention (Martin & Hannington, 2012).

Advertisements

Participants viewed eight different unpublished advertisements (see Figure 1) viewed at approximately 8.5" x 11" (612 x 792 pixels) on the screen. Six of the advertisements were full-color, while the other two advertisements were primarily black and white with a smaller color image. The four advertisements used to analyze scanpath entropy were full-color and contained four areas of interest: an image, a headline, a logo, and contact information. Four agricultural species were included in the advertisement set: cattle,

goats, chickens, and horses. Two versions of each of the advertisements were designed to determine different eye patterns and fixations on the same content as suggested by Hooge & Camps (2013). Each advertisement was viewed in RGB color mode at 72 dots per inch (dpi). The advertisements designed for the study were reviewed for face and content validity by two professionals with working knowledge of graphic design principles and one person who had no graphic design experience. The reviewers indicated no changes needed to be made. This was done to assure the advertisements realistically depicted an advertisement that would possibly be seen in a magazine as recommended by Duchowski (2017).
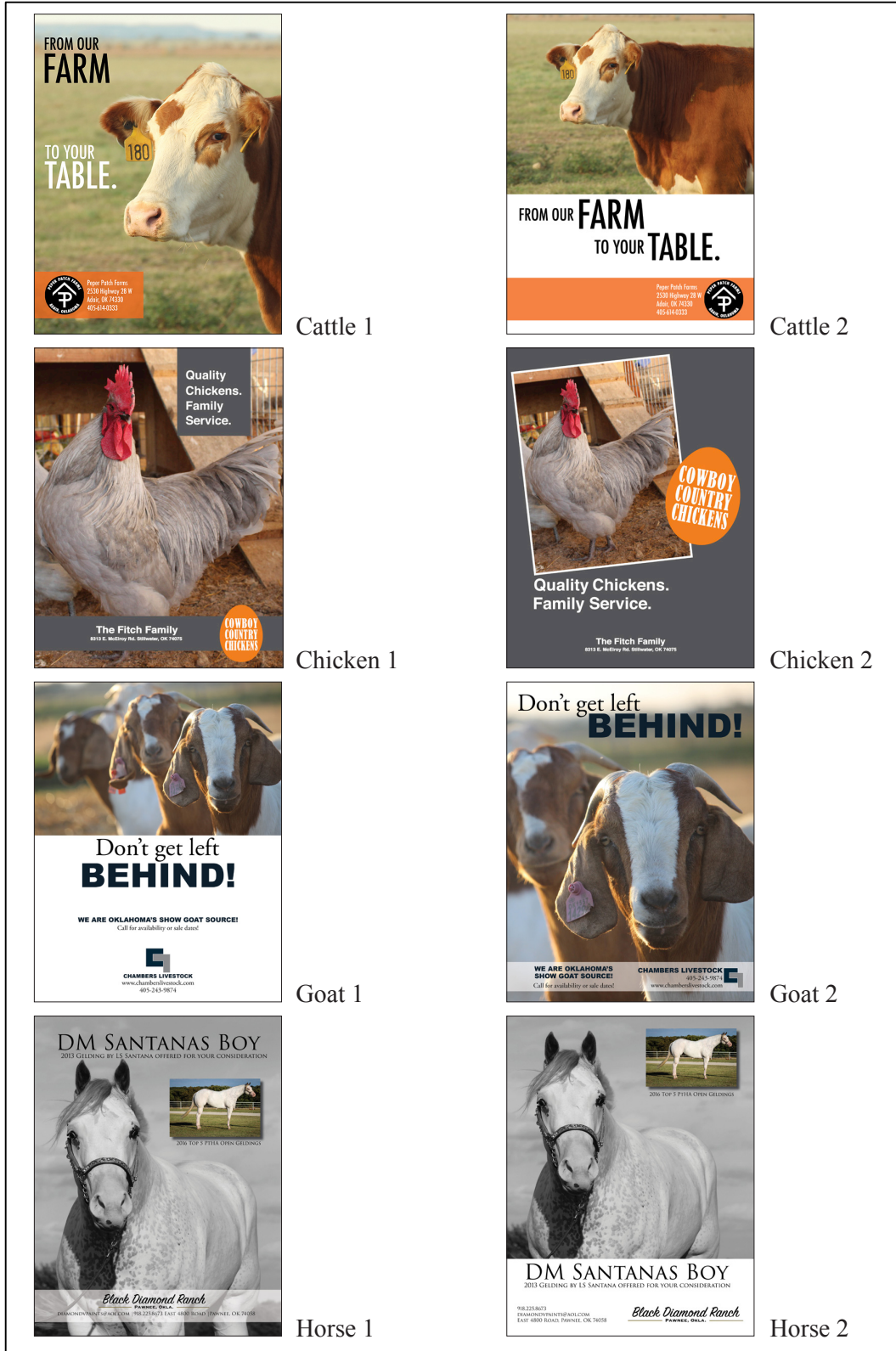
Cattle 1

Cattle 2

Chicken 1

Chicken 2

Goat 1

Goat 2

Horse 1

Horse 2

Figure 1. Advertisement designs used for eye-tracking.

Data Collection

Part 1: Questionnaire Administration

To begin the study, participants were asked to complete a brief questionnaire to help the researchers gain insight on the population. On the first day of the Spring 2017 AGCM 3213 Layout and Design course, the researcher was introduced to the class by the professor of the course. The researcher then read the first section of the script (see Appendix C) regarding the purpose and objectives of the study. After answering some follow-up questions, the researcher explained the relation this study had to an assignment for the course, instructions for the questionnaire, the consent process, and the students' rights as research participants (see Appendix D).

After reading the script and answering all of the questions the participants had, the researcher explained how to register for a time to complete the eye-tracking experience and how to access the eye-tracking laboratory. The professor of the course, who is also the committee chair for this research project, and the researcher left the room while the participants completed the questionnaire and consent form. The questionnaire and consent forms then were placed in a sealed envelope and placed in a locked cabinet by a staff member with no relation to the study. The sealed envelope remained secure until after final grades were recorded.

Part 2: Eye-tracking Experience

For the eye-tracking segment of the study, participants were placed in the eye-tracking laboratory one at a time. The participants were seated so the distance between the computer monitor and their eyes was approximately 50-80 cm, which is the

recommended best practice (Duchowski, 2007). All participants were advised to keep their head and body as still as possible during the eye-tracking session.

The participants were asked to enter their first and last name in the space provided in the Tobii™ software program. They then were instructed to have their eyes follow the red dot on the white screen while the machine calibrated to their eyes. All participants completed the calibration process on the first try without any significant drift, which is when the point of gaze differs from the point of regards (Duchowski, 2017). After the calibration process was complete, the participants were asked to enter their first and last name again before the eye tracking began. An instruction sheet appeared on the screen, and the participants were advised to read the instructions while I also explained them. The instructions read as: Look at the following advertisements as if you were looking at them in a magazine. When you are ready to start the eye-tracking experience please say "begin."

After the instructions were complete, each advertisement appeared individually on the screen and remained on the computer screen for five seconds before the next advertisement appeared. The study was completely "hands-free" after the eye-tracking began, meaning the participants did not have to click or push any buttons to move to the next image. All data was collected through the same eye-tracking software, Tobii™ Studio 3.4.5, on one computer by the same researcher to minimize variance. The eye-tracking laboratory remained controlled in lighting and temperature. The computer used to conduct the eye tracking also was surrounded by a barrier to prevent any distraction for the participants. The advertisements were presented to each participant in the same order.

Threats to Validity

This study runs the risk of having some threats to ecological validity because it was in conducted in a laboratory setting; however, the advertisements were designed to replicate the same size of a magazine and controls – such as the lighting in the room, the same researcher administered all of the tests, and only one participant was allowed in the room at one time – stayed constant.

Participants

Twenty-nine participants with minimal or no graphic design experience took part in the census study. A census design was chosen because the population was small and all participants could be tested conveniently using the eye-tracking instrument. All students in the population were enrolled in or had completed a prerequisite introductory agricultural communications writing course prior to enrolling in the course used in this study.

Participant Confidentiality

The questionnaire was administered by an outside source not connected to the research to avoid the researchers knowing who did or did not consent for their data to be used. The consent forms were placed in a locked cabinet to ensure the identity of the participants was protected. After the completion of the semester, the data collected from the questionnaire was recorded into a secure document and stored on a password-protected computer. All records containing sensitive content were stored on a password-protected computer and in a locked file cabinet only accessible by myself and my committee chair.

Data Analysis

Statistical Analysis

Statistical analysis of the eye-tracking data was used to produce information regarding the following metrics: time to first fixation, total fixation duration, fixation count, total visit duration, visit count, and percentage fixated. Tobii™ (2016) defines these metrics as:

Time to First Fixation: The time from the start of the stimulus display until the test participant fixates on the area of interest (AOI) or AOI group for the first time.

Total Fixation Duration: Duration of all fixations within an AOI.

Fixation Count: Number of times the participant fixates on an AOI.

Visit Count: Number of visits within an AOI or AOI group.

These values, all produced by the Tobii™ software, were analyzed by calculating the means of each AOI on its respective advertisement. The data was also analyzed using SPSS 21 for Macintosh. Four of the advertisements contained four AOIs and the remaining four advertisements contained five AOIs, all of which were determined by the researcher.

Scanpath Entropy

Scanpath, or transition, entropy-based analysis methods have developed as an additional method used to analyze eye-tracking data. Krejtz et al (2015), Stark and Ellis (1981), and others have created a similar method for analyzing scanpath, or transition, entropy. This particular study uses the Shannon entropy measure, which is defined by Information Theory as the relevance to a single random variable or random vector (Gray, 2011). The main goal of scanpath entropy in this study is to quantify gaze guidance.

Since most advertisements are designed for more than just the goal of brand recognition (Hooge & Camps, 2013), we did not specify one particular AOI to calculate entropy for but instead wanted to better understand visual scanning behaviors of the AOIs within the context of the advertisement as a whole.

The first step in creating measurable scanpaths in eye-tracking data is to create AOIs within each image (Hooge & Camps, 2013). Four AOIs were defined in each advertisement used for this study: image, headline, contact, and logo. These AOIs were drawn by hand in the Tobii™ software by the researcher. Hooge and Camps (2013) suggests smaller, more detailed AOIs produce longer and higher numbers of scanpaths. The researcher kept this information in mind while developing each individual AOI.

The measure of information theory, Shannon's entropy, is defined as:

$$H(X) = -\sum_{i=1}^{n} p(x_i) \, {}^2\!\log p(x_i)$$

where H(X) is the entropy in bits and p(X_i) is the proportion of measurement (X_i) (Hooge & Camps, 2013). The concept driving the idea of entropy is the probability of throwing a 6-sided die. By throwing this die once, we have six possible outcomes (x = 1, x = 2, x = 3, x = 4, x = 5, and x = 6), giving us a 1/6 chance to land on each individual value. The entropy formula, which adds the values and weighs them with their probability of occurrence (Hooge & Camps, 2013) can be applied to this study. The value of this entropy number can then determine characteristics of each AOI's visual stimulus within the scanpaths (Hooge & Camps, 2013).

The following steps were used to compute the scanpath entropy of the four AOIs created in the four advertisements.

1. Produced AOIs of each individual advertisement.

2. Analyzed each scanpath playback to create a character string. The AOI character string was determined using a coding system where *I* represented image, *H* represented headline, *C* represented contact, and *L* represented logo.

3. Removed all repeated AOIs in the character string. This leaves no more than four AOIs in each character string. For example: A character string of *IIHCLCH* becomes *IHCL* after removing repetitions. This process is converting the character string from a fixation-based sequence to a dwell-based sequence (Holmqvist et al., 2011).

4. Calculated the number of unique scanpaths.

5. Applied the entropy formula to compute entropy. Shannon's entropy formula was used for this study.

CHAPTER III

MANUSCRIPT I

Abstract

When you look at an advertisement in your favorite magazine, where does your eye go? The picture? The text? What is the last thing you see before turning the page? The objective of this study was to identify key elements college-aged consumers viewed in a livestock print advertisement. Twenty-nine participants with minimal or no graphic design experience viewed eight print advertisements, designed by previous students, for five seconds each. Eye-tracking technology was used to determine time to and location of first fixation, final point of fixation, and fixation count. Participants took an average of 0.81 seconds to view the first fixated element and used an additional 3.34 seconds to reach the last fixated element. The AOI with the largest surface size in the advertisements, the image, produced the highest fixation counts with an average fixation count of 5.25. Therefore, future graphic designers should be mindful when including a dominant element in their designs. Also, current designers should have an understanding of consumer eye behavior to best market their product or service to college-aged students.

Introduction

Advertisements are all around us and play a crucial role in our visual world (Radach et. al, 2003). Since the 1990s, advertisers have increased the amount of money they spend to produce advertisements (Wedel & Pieters, 2000). In a study conducted by Media Matters (2007), an average adult is exposed to 600 advertisements daily, including print and electronic media. This situation can make it difficult for advertisers to "stand out from the others" when it comes to attracting consumers attention (Wedel & Pieters, 2000). By understanding the way potential customers view advertisements, designers can implement guidelines to channel their creative work to meet the needs of their audience (Radach et. al, 2003).

Therefore, the research objectives for this study are (a) to determine the time it takes agricultural communications students to view specific areas of interest (AOIs) in advertisements, (b) to determine the scanpaths followed by agricultural communications students when viewing advertisements, (c) to determine the amount of time agricultural communications students spend viewing AOIs in advertisements, and (d) to determine the number of times agricultural communications students view AOIs within advertisements.

The study of eye movements is gaining attention from researchers because of the possibilities to understand the visual search process (Rayner & Castelhano, 2008). Patterns of visual attention are a useful measure generated by eye-tracking technology when it comes to viewing advertisements (Higgins, Leinenger & Rayner, 2014). Attention can be measured in terms of selection and gaze duration (Pieters et al., 2007). Print advertisements decline in effectiveness when the designer fails to capture consumer' attention, which can lead to the inability to reach marketing goals (Pieters &

22

Wedel, 2004).

Rayner and Castelhano (2008) characterized basic eye movements and determined we move our eyes every 250 to 350 milliseconds. During this time of eye movement, known as saccades, we acquire information during the fixation period (Rayner & Castelhano, 2008). Fixations, or the pauses between saccades, are a key element in gathering visual information and should be considered for the improvement of visual materials, such as advertisements (Hooge & Camps, 2013). Fixations occur when the retina is stabilized over a stationary object and take place during approximately 90% of the viewing time (Duchowski, 2017). Fixations can help determine an advertisement's potential to gain attention (Viviani, 1990).

Yarbus (1967) found fixations occurred on the elements that contain important information to the viewer. The more information within the element, the longer the viewers' eyes remains fixated on the element (Yarbus, 1967). To help us understand the concept of saccades, Yarbus (1967) explained them as the way a viewer changes the point of fixation.

Placement and size of key elements in print advertisements, such as logos, graphics, and text, play an important role in capturing attention (Pieters & Wedel, 2004). It is also still widely practiced among graphic designers to design with the Z-pattern in mind (Hooge & Camps, 2013). The Z-pattern suggests people scan from left to right and from top to bottom, just as people most commonly read in the western culture (Hooge & Camps, 2013). Consumer research conducted by Gorn et al. (1997) showed advertisements containing color were perceived as higher value and more likeable than black and white or greyscale designs. Emphasizing an image or graphic makes it easier

for the viewer to determine what message is being portrayed by the advertisement quickly (Graham, 2005).

To determine scanpaths of the human eye, Noton and Stark (1971) studied the scanpaths to later help them formulate the Scanpath Theory. They found viewers commonly fixate on identifiable areas of interest within a composition without being instructed to consider certain questions. Noton and Stark (1971) also determined the pattern of eye movements across areas of interest is significantly variable. The Scanpath Theory suggests perception and eye-movements are determined by the top-down spatial cognitive model (Privitera, 2006). The concepts of the Scanpath Theory were used in this study to guide us in achieving the overall purpose of the study, which is to determine how an audience views print advertisements.

Methods

Participants

The researchers recruited participants through a junior-level, beginning print design class in the agricultural communications program at Oklahoma State University. Of the 31 students ($N = 31$) enrolled when the course began, 29 ($n = 29$) completed research protocol for a 93.55% response rate. A census design was used because of the small population size (Privitera, 2006).

Materials

Participants' eye movements were recorded using version 3.3.1 of the Tobii™ T60 screen-based eye tracker. Eight unpublished advertisements were presented to the participants at approximately 8.5" x 11" to most closely resemble the size of an advertisement printed in a magazine. Having slightly different sets of advertisement

designs can lead to a thorough comparison of gaze behavior (Hooge & Camps, 2013).

Four animal species were included in the set of advertisements: cattle, goats, chickens,

and horses. The elements within the advertisements were classified into an AOI created

by the researcher through the Tobii™ software (see Figure 2). As recommended by

Duchowski (2017), the advertisements used for this study were all reviewed for face and

content validity by outside sources to determine they realistically depicted advertisements

used in print publications today.

Cattle 1

Cattle 2

Chicken 1

Chicken 2

Goat 1

Goat 2

Horse 1

Horse 2

Figure 2. Researcher-developed areas of interest in the advertisement designs.

26

Procedure

Participants were asked to complete a brief researcher-developed questionnaire to provide insight on the population for the researchers. The completed questionnaires were locked in a cabinet until the completion of the course because of the nature of relationship bias between the researchers knowing who did and did not consent the use of their data. The participants then scheduled a time to complete the eye-tracking exercise.

To maintain consistency throughout the eye-tracking process, all procedures were conducted by one researcher, and each participant was individually eye-tracked on one computer. The instructions given to the participants before the eye-tracking remained consistent throughout and were general to not reveal the purpose of the study to the participants. The laboratory where the eye-tracking exercise took place was controlled for lighting and temperature throughout the study.

Each advertisement appeared on the screen for five seconds, followed by a three second blank black screen before the next advertisement appeared. The eye-tracking software was set up to make the study entirely hands-free so the participants did not have to click or push any buttons to complete the study.

Time to first fixation, total fixation duration, fixation count, total visit duration, and visit count were produced by the Tobii™ Studio v. 3.4.7 eye-tracking software and then analyzed using SPSS for Macintosh version 21 to determine means and standard deviations. Time to first fixation is a useful measure to estimate the attention captured by individual elements within the design (Hooge & Camps, 2013). Effective design techniques can be identified by determining how quickly a viewer fixates on an element for the first time (Hooge & Camps, 2013). The goal of advertisements is message

transfer, which can be obtained by telling a story within the design (Hooge & Camps 2013). This research also discussed the importance of this message transfer by suggesting the analysis of fixation order. Fixation order was determined in this study by reviewing time to first fixation measurements.

As suggested by Hooge and Camps (2013) scanpath illustrations were created using time to first fixation measurements. To avoid the cluttered default arrow plots produced by Tobii™ Studio, researcher developed scanpath illustrations to include only the specified areas of interest once.

Findings

Participants were agricultural communications majors, ranging in age from 19 to 22 years old. Twenty-three (79.31%) of the participants were female and six (20.69%) were male. Fifteen (51.72%) participants indicated they had no vision issues while 12 (41.38%) said they were nearsighted, one (0.03%) farsighted, and one (0.03%) both nearsighted and farsighted. Fourteen (100%) participants who stated they did not have normal vision indicated they wore corrective eyewear to obtain normal vision. Of the 29 participants, 15 (51.72%) of them indicated they lived on a farm or ranch prior to attending Oklahoma State University (see Figure 3). None (0.00%) of the participants indicated they were colorblind or had been diagnosed with any other disorder or medical condition that could possibly affect their vision.
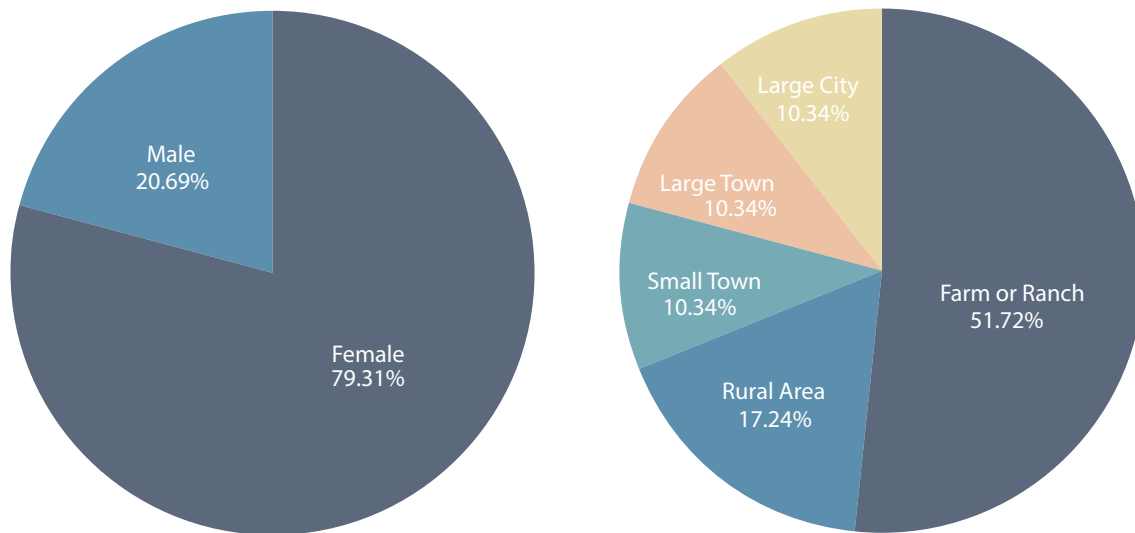
Figure 3. Self-reported sex and permanent geographic residence type.

Tobii™ Studio produced RAW data from the eye-tracking data collection, which was analyzed in SPSS for Macintosh version 21. To analyze the time participants spent looking at each AOI within the design, or average fixation duration, means were calculated for each AOI within the advertisement.

Fixation duration is defined by Tobii™ (2016) as the duration of all fixations within an AOI. On average, the longest amount of time spent looking at an AOI was 1.35 seconds, while the shortest amount of time was 0.23 seconds. The image was most commonly fixated for the longest amount of time (f = 5). In the two advertisements (f = 2) containing body copy, the AOI was fixated on for the shortest amount of time (see Table 1).

Fixation count is defined by Tobii™ (2016) as the number of times a participant fixates on an AOI. Means of fixation counts were calculated for each AOI in all advertisements (see Table 1). The image in the advertisements produced the greatest

fixation count in seven of the eight (87.5%) advertisements. The average fixation count on the image among all advertisements was 5.25 fixations. The advertisements containing more AOIs resulted in a higher number of fixations. The designs containing four AOIs received an average of 94.5 fixations and the designs containing more than four AOIs received an average of 109.75 fixations.

Time to first fixation is defined by Tobii™ (2016) as the time from the start of the stimulus display until the test participant fixates on the AOI or AOI group for the first time. Using this metric, the data showed the average amount of time the participants took to view the first fixated AOI in the advertisements was 0.81 seconds. In the five seconds the participants were given to the view each advertisement, they fixated on all AOIs in an average time of 3.34 seconds. The advertisements with four AOIs produced an average viewing duration of all AOIs in 3.33 seconds while the advertisements with more than four AOIs produced a viewing time of 3.35 seconds (see Table 2).

Among the advertisements, the headline was fixated on first most frequently ($f = 5$), followed by the image ($f = 2$), and logo ($f = 1$). The contact information, which was present in every advertisement studied, was never the first fixated element in the advertisement. The contact information was most frequently viewed last in the advertisements ($f = 5$), with the logo being most frequently viewed last in three ($f = 3$) of the advertisements.

Table 1

Fixation Duration and Count (n = 29)

Advertisement	f	Total Fixation Duration in Seconds				Fixation Count in Views
		Min	*Max*	*M*	*SD*	M
Cattle 1						
Headline	28	0.16	2.79	1.18	0.66	4.14
Image	29	0.40	3.38	1.18	0.71	4.55
Contact Info	20	0.12	1.97	0.76	0.54	1.65
Logo	3	0.13	0.38	0.24	0.13	1
Cattle 2						
Headline	28	0.19	2.04	0.79	0.44	4.21
Image	29	0.20	2.56	1.37	0.66	4.79
Contact Info	24	0.09	2.85	0.90	0.64	2.29
Logo	19	0.02	1.37	0.44	0.33	1.32
Chicken 1						
Headline	28	0.13	2.36	1.13	0.58	2.61
Image	29	0.20	2.96	1.19	0.72	4.07
Contact Info	24	0.06	3.13	0.69	0.64	2.25
Logo	16	0.13	0.98	0.57	0.29	1.38
Chicken 2						
Headline	28	0.12	1.46	0.77	0.39	3.46
Image	24	0.07	1.65	0.68	0.46	2.58
Contact Info	20	0.17	1.28	0.66	0.34	2.15
Logo	29	0.15	2.35	0.96	0.47	3.00
Goat 1						
Headline	29	0.10	1.74	0.73	0.35	3.76
Image	29	0.18	2.14	1.03	0.48	4.59
Body Copy	25	0.15	1.79	0.93	0.49	3.96
Contact Info	17	0.06	1.66	0.61	0.41	1.71
Logo	11	0.12	0.24	1.52	0.04	1.18
Goat 2						
Headline	25	0.14	1.26	0.63	0.32	3.32
Image	29	0.53	3.24	1.71	0.68	8.10
Body Copy	23	0.07	1.77	0.75	0.42	3.17
Contact Info	19	0.10	1.49	0.50	0.32	2.16
Logo	2	0.26	0.38	0.32	0.09	1.00
Horse 1						
Headline	25	0.06	2.52	0.83	0.70	4.20
Image 1	29	0.36	3.43	1.80	0.70	7.83
Image 2	26	0.10	1.35	0.55	0.35	2.62
Body Copy	6	0.06	0.42	0.19	0.14	1.17
Contact Info	7	0.02	0.65	0.36	0.24	1.29
Logo	21	0.08	1.58	0.68	0.43	2.81
Horse 2						
Headline	29	0.01	2.65	0.89	0.66	4.21
Image 1	28	0.21	2.40	1.05	0.58	4.61
Image 2	22	0.07	1.48	0.50	0.40	2.14
Body Copy	10	0.10	0.82	0.32	0.25	1.30
Contact Info	16	0.04	0.93	0.44	0.32	1.50
Logo	14	0.07	1.06	0.58	0.29	2.29

The average time to first fixation measurements for each advertisement also were used to determine common scanpaths followed by the viewers. The average times to first fixation were ordered from shortest amount of time to longest amount of time. The researcher then created illustrations to depict the most frequent scanpath on each advertisement (see Figure 4). Analyzed qualitatively by the researcher, the scanpath illustrations depict a primary viewing pattern of top to bottom. The placement of the AOIs on each individual advertisement, show trends in viewing. When the contact information was placed on the bottom-left region of the page and the logo on the bottom-right region, the logo was viewed first and then the viewer looked to the left at the contact information. In the advertisements with one AOI or AOI group along the bottom of the advertisement, it was most commonly viewed last. In the advertisement where the logo was placed on the left side of the page, the logo was seen only by three ($f = 3;10.35\%$) participants.

Table 2

Time to First Fixation (n = 29)

| Advertisement	*f*	*Min*	*Max*	*M*	*SD*
			Time to First Fixation in Seconds		
Cattle 1					
Headline	26	0.07	4.57	1.21	1.12
Image	25	0.02	4.62	1.28	1.30
Contact Info	20	0.72	4.85	2.96	1.25
Logo	3	4.11	4.52	4.29	0.21
Cattle 2					
Headline	26	0.25	3.58	1.09	0.76
Image	17	0.04	0.91	0.34	0.24
Contact Info	24	0.55	4.90	2.31	1.35
Logo	19	0.78	5.02	3.10	1.23
Chicken 1					
Headline	27	0.27	4.51	1.08	1.10
Image	18	0.10	4.81	1.41	1.68
Contact Info	24	0.67	4.98	2.62	1.15
Logo	16	0.82	4.88	2.88	1.15
Chicken 2					
Headline	28	0.42	4.75	1.72	0.93
Image	19	0.06	4.61	1.47	1.75
Contact Info	20	1.22	4.47	3.04	0.83
Logo	29	0.28	3.68	1.23	1.07
Goat 1					
Headline	28	0.08	4.40	0.78	0.84
Image	22	0.05	3.99	1.00	1.10
Body Copy	25	0.81	4.46	2.12	0.95
Contact Info	17	2.45	4.77	3.59	0.72
Logo	11	1.20	4.29	3.03	0.92
Goat 2					
Headline	24	0.14	2.86	0.74	0.76
Image	13	0.05	3.56	0.83	0.95
Body Copy	23	0.44	4.94	2.58	1.11
Contact Info	19	0.50	4.80	3.01	1.27
Logo	2	1.90	3.44	2.67	1.09
Horse 1					
Headline	22	0.07	4.65	0.87	1.03
Image 1	21	0.03	4.58	1.31	1.38
Image 2	25	0.29	4.45	1.81	1.05
Body Copy	6	1.42	3.66	2.58	0.90
Contact Info	7	2.23	5.02	3.75	1.21
Logo	21	1.19	4.95	3.18	1.06
Horse 2					
Headline	29	0.40	4.98	1.31	1.06
Image 1	16	0.02	0.47	0.20	0.11
Image 2	21	0.35	3.75	1.68	1.20
Body Copy	10	0.46	3.90	1.86	1.40
Contact Info	15	0.29	4.95	3.05	1.42
Logo	14	0.53	4.14	2.57	1.11
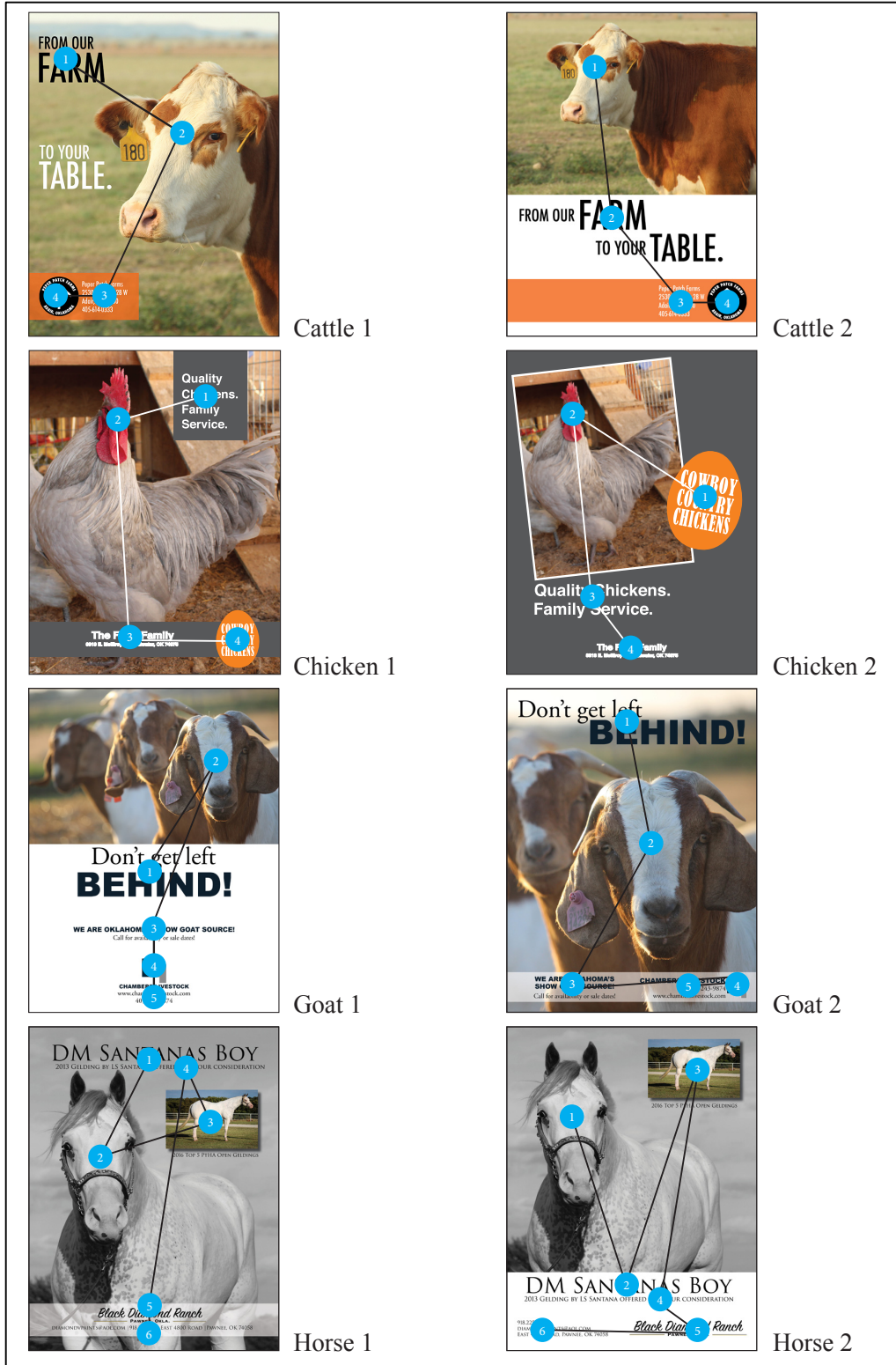
Figure 4. Scanpath illustrations using average time to first fixation measure.

Conclusions and Recommendations

The typical viewer in this study was a 20-year-old female studying agricultural communications who grew up on a farm or ranch. She had normal vision or wore corrective eyewear to obtain normal vision and did not have any medical conditions that affected her vision.

The average amount of time it took participants to view all AOIs in the advertisement was less than four seconds. Therefore, this finding suggests that five seconds is more than adequate time for viewers to look at an advertisement with similar technical design specifications to the sample stimuli. This fixation time of all AOIs on the advertisements was slightly higher than previous studies (Pieters & Wedel 2004; Pieters et al. 2010), which found the time to be around two seconds. Nonetheless, this finding can still provide insight to designers with the evidence that they have a short amount of the time to attract attention and deliver a message to a viewer through a print advertisement.

Contradicting the findings of Radach (2003), participants did not take more time to view the more complex advertisements in this study. However, Radach (2003) concluded controlling the amount of time the viewers can see the advertisement may affect fixation duration and influence scanpaths.

The viewing patterns most commonly followed by participants were from the top of the advertisement to the bottom of the advertisement, which correlates with the typical scanpath among the western culture (Hooge & Camps, 2013). The data from this study also shows when the logo was placed on the left side of the page, it was only viewed by

three participants. However, research has shown the nature of a task given to viewers can influence the duration of each fixation and scanpath (Rayner & Castelhano, 2008).

The headline was most commonly fixated first in all of the advertisements, followed by the image, then the logo, and, lastly, the contact information. Rayner et al. (2001) observed this same scanpath behavior, with the headline being the most common first fixation, in their study of advertisements. Rayner et al. (2001) also concluded the larger text was viewed first regardless of where it was positioned on the page.

The image in the advertisements most frequently had the longest fixation duration. The AOIs with the most importance to the viewer are fixated on longer than the AOIs less important to the viewer (Christianson et al, 1991). To determine the importance of each AOI to the viewer, a specific task would have to be implemented. The two advertisements with six AOIs produced the shortest fixation duration on the body copy AOI. Knowing the body text was smaller than other text on the advertisements, the data contradicts with Rayner & Castelhanno (2008), stating fixation duration increases as text becomes more difficult to read. This short fixation duration could also be credited to its size on the page or relevance to the viewer (Christianson et al, 1991).

The image in the advertisements produced the highest fixation count in seven of the eight advertisements tested. It is assumed the fixation count correlates with the amount of information a viewer obtains from an advertisement (Wedel & Pieters, 2000), concluding the viewers will most likely remember the most about the image. To generalize more about the fixation counts, fixations would need to be analyzed in relevance to the surface area each AOI takes up in the overall design. The advertisements

containing more AOIs resulted in a higher number of fixations, suggesting more complex advertisements may receive a greater number of overall fixations.

Recommendations for Future Research

Limitations of this study can lead to opportunities for future research. First, the participants all had the commonality of college major and fit within a small age range – 19 to 22 years old. This limitation could be avoided in future studies by recruiting a larger, more diverse population. It would also be interesting to see what differences in scanpaths and fixations occur among a diverse population of men and women and participants within a wider age range. Does advertisement viewing differ between men vs. women and children vs. adults? Even without knowing the answer to this specific question, we can recommend designers should always formulate an advertisement for the audience it is meant to reach.

Another limitation was the use of computer monitors to display advertisements intended for printed media. Future studies on this topic could use a head-mounted eye-tracking device and advertisements physically printed in a publication to compare advertisement observation behaviors. By creating advertisement pairs with the same elements and presenting them in order by pair, this study is also limited by an order effect, which in future eye-tracking scripts could be counterbalanced. Counterbalancing can be achieved by the use of Latin squares (Zeelenber & Pecher, 2015) and is a common technique used to avoid order effect. Zeelenberg and Pecher (2015) recommend counterbalancing to increase the control over sequential effects.

To better understand the relation of headline, image, copy and logo to visual attention, future research could include comparison with the surface size of the elements.

To aid in determining visual recall, a post eye-tracking survey could be conducted to identify what elements or message the participants remembered from the advertisements.

A goal-oriented study could be beneficial to research by assigning different tasks to the viewers for each advertisement or group of advertisements, the level of information transfer can better be understood (Pieters & Wedel, 2007).

Recommendations for Practice

Since this study concluded on average all AOIs were fixated before the five second time limit was exceeded, how can graphic designers grab viewers' attention and deliver a message in less than five seconds? By including "attention-getting" and also "attention-holding" elements in designs to maintain consumer's attention for at least two seconds, the chances of memorability increase (Percy & Rossiter, 1983).

Humans are creatures of habit, which leads us to expect they typically view advertisements similarly to how they read – top to bottom and left to right (Hooge & Camps, 2013). Rayner et al. (2001) found the reading behavior to be left to right as expected, however, it was determined that the viewers didn't always read all of the text. Rayner et al. concluded this could be due to the fact the viewers believed they had already had the information they needed to understand the message of the advertisement. By adding an AOI of body text to designs, more research can be done on the reading of text in advertisements. Also, aware of this finding, graphic designers should be mindful of the size of the headline compared to body text to differentiate the two.

The evidence from this study shows the logo loses attraction when placed on the bottom left of the page which, is something designers should take into consideration. Contradicting recommendations for having the logo placed relatively small at the bottom

of the page, Pieters & Wedel (2004) found increasing the size of the logo does not create a negative effect on attention to the advertisement as a whole.

A headline is commonly fixated first by viewers, which creates a need for effective headlines. Ogilvy (1963, p. 104) even went as far to say the headline is crucial to print advertisements and "the wickedest of all sins is to run an advertisement without a headline."

Summary

The data obtained from eye-tracking technology can lead to innovative discoveries for the advertising industry (Duchowski, 2017). This research can lend knowledge to designers for future reference of where certain elements should be placed on the page and what elements should be emphasized to best suit the audience. This information also can provide insight to designers about the amount of time they have to capture a viewer's attention through an advertisement design. This finding also coincides with research conducted by Pieters et al. (2010).

With this study being the first one of its kind pertaining to print advertisements in the animal agriculture industry, several ways exist for this topic to be further explored. Because of the abundance of metrics provided by eye-tracking software, this study could be replicated with several different modifications and produce unique results.

CHAPTER IV

MANUSCRIPT II

Abstract

The key elements of print advertisements play an important role in capturing

consumers attention. By providing evidence of human eye-movements when looking at

print advertisements, graphic designers can better understand what layouts and content

can most effectively communicate the message to the audience. But, do graphic designers

view advertisements differently than viewers with little to no graphic design knowledge?

The findings from this study reveal no significant difference exists in how viewers look at

advertisements before and after being exposed to a graphic design course. However, an

observed difference occurs in advertisements with gaze-guiding properties.

Introduction

In today's society, people are exposed to hundreds of advertisements every day –

around 600 to be exact, according to a study conducted by Media Matters (2007). So,

what exactly do those consumers see when they look at these advertisements, and do they

look at them differently than the designer who created them?

Throughout the last decade, eye-tracking research has flourished (Duchowski, 2017). With the society becoming technology driven, eye-tracking can be a useful tool for researchers to look into different phenomena, including print advertisements (Duchowski, 2017). Corporations are known to use eye-tracking to determine the most effective way to present advertisements to consumers, but this information is not commonly shared with the public (Duchowski, 2017).

Graphic design textbooks used today, like Martin & Hannington (2012) and Graham (2005), depict the key elements designers should be trained to use effectively, such as lines, shapes, color, and texture. Graham (2005) suggests graphic designers should pay close attention to the principles of design and incorporate them into their work and overall should base their design around the interests of the audience, not themselves.

Wedel et al. (2008) determined average viewers tend to look at design products by skimming certain areas while looking for the information they want to get from the advertisement. Viewers typically do not recognize the relationship among the elements used in the design process (Wedel et al., 2008).

Therefore, the objectives guiding this study are as follows:

1. Determine information transfer (scanpath entropy) of AOIs when students view advertisements prior to an introductory graphic design course.

2. Determine information transfer (scanpath entropy) of AOIs when students view advertisements after experiencing an introductory graphic design course.

3. Compare the information transfer (scanpath entropy) of AOIs when students view advertisements before and after exposure to an introductory graphic design course.

According to Morgan and Rucker (2013), layout and design skills are expected of graduates wishing to pursue a career in the agricultural communications field. To aid in preparing students for this demand, collegiate agricultural communications programs across the United States are providing courses in introductory graphic design (Cannon, Specht, & Buck, 2014). The main projects assigned to students in this course are to design a logo, an infographic, an identity package containing a business card and one other branding type item, two advertisements, a brochure, a newsletter, and a magazine layout (Sitton, 2017a).

For this particular study, the researchers focused on the implementation of principles of graphic design, advertisement design, and curriculum. The principles of design emphasized to students in the course were (a) appropriateness, (b) balance, (c) consistency, and (d) focus and flow (Sitton, 2017b). These principles were communicated to the class through PowerPoint Presentations and general lecture. According to Graham (2005), principles of graphic design should always be taken into consideration. Furthermore, designers can improve their work by understanding the principles of design and applying them to their compositions (Graham, 2005). As stated in the text required for the course, the terminology for the principles of design can vary but the outcome is the same – success in design (Gonnella, Navetta, & Friedman, 2015).

In advertisement design curriculum specifically, Sitton (2017b) determined there are four key elements of print advertisements – headline, copy, illustration, and signature. In this study, we refer to the four key elements as headline, body, image, and logo. A headline is a phrase or sentence attracting viewers' attention to the product or service being advertised (Sitton, 2017b). Best practice is for a headline to draw the viewer in to

look at the illustration and then read the copy (Sitton, 2017b). An illustration in an advertisement, such as an image or graphic, should attract and maintain the viewers' attention (Sitton, 2017b).

Another key concept to expose novice graphic designers to is the Gestalt theory (Graham, 2005). The idea of Gestalt explains how the human brain organizes a whole that is different from the sum of the parts (Wageman et al., 2012). In graphic design, Gestalt principles can be implemented to create emphasis, closure, proximity, etc. (Sitton, 2017c). The human brain is trained to "fill in the gaps" when something is not complete and ultimately organizes elements as a coherent whole (Gonnella et al., 2015). For designers, principles of Gestalt theory can be used to unify their designs (Graham, 2005). More recently Yarbus' (1967) and Noton and Starks' (1971) research has contradicted the Gestalt view, but nonetheless should still be discussed as an important asset to design (Duchowski, 2017).

Based on the principles of design and best practice recommendations for graphic design, we could hypothesize the viewers will first look at the dominant element, most commonly the image or graphic, followed by the headline, contact information, and lastly the logo or brand.

A conceptual framework based on the Information Theory was used to guide this study. Information Theory is based on two main goals: (a) develop fundamental theoretical limits on the achievable performance when communicating a given information source over a given communications channel using coding schemes from with a prescribed class and (b) develop coding schemes providing reasonably good performance compared to optimal performance given by the theory (Gray, 2011). This

mathematical theory was devised by Shannon's concept of entropy of random variables. Gray (2011) defines entropy as the relevance to a single random variable or random vector.

Shannon's entropy depicts the information in a variable in terms of ordering. The entropy formula consists of adding up the information values and weighing them with their chance of occurrence (Hooge & Camps, 2013). This measure is defined in formulation as

$$H(X) = -\sum_{i=1}^{n} p(x_i)^2 \log p(x_i)$$

H(X) is the entropy in bits and p(Xi) is the proportion of measurement Xi (Hooge & Camps, 2013). This process is described by Hooge & Camps (2013) as the idea behind throwing a 6-sided die. When throwing the die, six possible outcomes exist (x = 1, x = 2, x = 3, x = 4, x = 5, and x = 6), giving us a 1/6 chance to land on each individual value (Hooge & Camps, 2013). This example can be interpreted as a metaphor for the scanning behavior of a visual element. A lower scanpath entropy value is the result of biased scan behavior (Hooge & Camps, 2013). Entropy can be described as the "expected surprise" of a given scanpath (Duchowski, 2017). Gaze transition is always expected to the same AOI when the entropy value is 0, which is the minimum value entropy can be, while maximum entropy suggests maximum surprise (Duchowski, 2017). Minimal entropy would be obtained if all participants followed the same scanpath, but if this does not happen all entropy calculations would be a value greater than one (Hooge & Camps, 2013).

Scanpath entropy, which is the measure for the spatial aspects of scanning, is fairly new (Hooge & Camps, 2013). For this particular study, scanpath entropy is used to

quantify gaze guidance of the participants. Gaze guidance can be created in an advertisement by subtle visual cues (McNamara, Bailey, & Grimm, 2009). Traditionally, advertisements are designed with the branding element in the bottom right corner of the composition, which figuratively is meant to act as a signature for the design (Hooge & Camps, 2013). This traditional composition arrangement has been hypothesized to attract more attention to the logo (Hooge & Camps, 2013). McNamara et al. (2009) found subtle visual cues can effectively lead to fixations through gaze guidance. For example, Mackworth and Morandi (1967) determined humans are naturally attracted to faces in images. Images containing visually significant elements, such as faces, produce longer fixation times and aid in determining the viewers gaze (Bailey et al., 2009). With this knowledge of the research conducted on gaze guidance, we can hypothesize that scanpaths among different viewers can be determined by visual elements containing gaze-guiding properties. Also, if gaze guidance is effective, scanpaths of individual viewers should be somewhat similar. Hooge and Camps (2013) found advertisements without gaze guiding properties resulted in several different scanpaths and produced maximal entropy. The advertisements designed with gaze guidance properties produced less scanpaths and a lower entropy.

In eye-tracking, fixations take place when eye movements are stable over a stationary object of interest (Duchowski, 2017), which in this study are the researcher-developed AOIs. Hooge and Camps (2013) suggest creating measurable scanpaths and investigating gaze behavior by determining AOIs within each advertisement. It is common for AOIs to be created using drawing tools in software programs, such as Tobii Studio (Hooge & Camps, 2013). The AOIs created in each advertisement (see Figure 5)

45

for this study were image, headline, contact information, and logo since most print

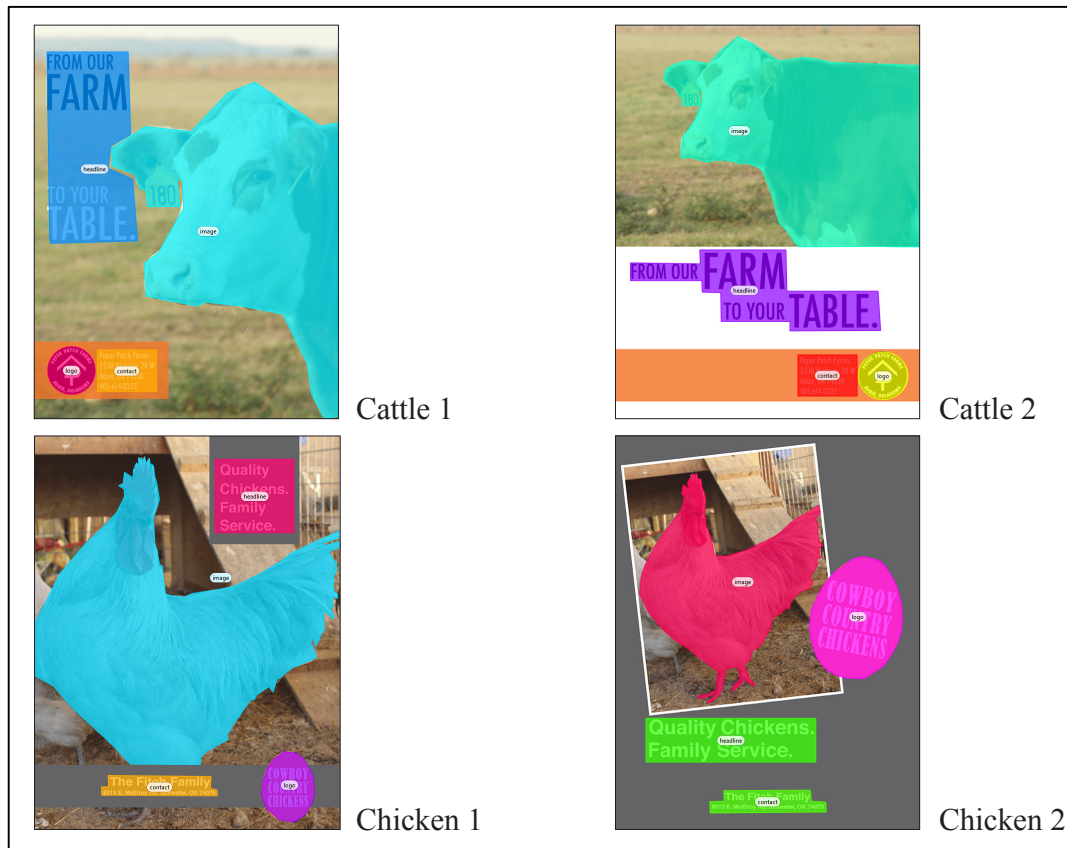advertisements contain a brand, pictorial, and text element (Pieters & Wedel, 2004).

Figure 5. Researcher-developed areas of interest in the advertisement designs.

Methods

The researchers recruited participants through a junior-level, beginning print

design class in the agricultural communications program at Oklahoma State University.

Of the 31 students ($N = 31$) enrolled when the course began, 29 ($n = 29$) completed

research protocol for a 93.55% response rate. A census design was used because of the

small population size (Privitera, 2006).

A Tobii™ T60 screen-based eye tracker, version 3.4.7, was used to record

participants eye movements for this study. The eye-tracking software was installed on a

Macintosh computer located in an on-campus laboratory controlled for light and temperature. The eye-tracking device operated binocularly at 60 Hz at an accuracy of about 0.5° (Tobii™, 2016). As with most eye-tracking devices, the table-mounted machine used for this study produced instantaneous (x, y) coordinates of the viewer's gaze.

Participants viewed four unpublished advertisements based on animal agriculture for this study. Two of the advertisements contained an image of a cow, and the other two contained an image of a chicken. Variations of slightly different advertisements were created for each animal species to help lead to a thorough comparison of gaze behavior as suggested by Hooge and Camps (2013). All four of the advertisements were presented in full color. The four advertisements used in this study met the following criteria:

1. The ad contained an image depicting animal agriculture.

2. The ad contained a headline.

3. The ad contained contact information.

4. The ad contained a logo to represent the company.

To most closely depict an advertisement viewers would routinely see in a print publication, the advertisements were presented on the screen at approximately 8.5" x 11". As a recommendation from eye-tracking methodology literature (Duchowski, 2017), sources not connected to this study reviewed the four advertisements for face and content validity where they verified the designs portrayed advertisements being published in print. Participants were recruited, offered the chance to consent, and were then asked to complete a questionnaire on the first day of their introductory graphic design course. This researcher-developed questionnaire was used to collect information about the population.

47

These completed questionnaires were stored in a locked cabinet not accessible by the researchers until the completion of the course.

For the second part of the study, each participant was individually eye-tracked by one researcher. Each participant entered his or her name into the eye-tracking software, and the researcher instructed each participant on how to calibrate their eyes to the machine. Upon completion of the calibration, instructions were given to the participants to "look at the ads as if they were looking at them in a magazine," which was similar to the instructions given in Pieters & Wedel (2004).

The four advertisements appeared separately on the screen for five seconds and were followed by a blank black screen that appeared for three seconds. Participants did not have to click or push any buttons throughout the eye-tracking experience.

Participants then were exposed to a semester-long introductory graphic design course. Objectives for this course as highlighted in the course syllabus were to expose students to the understanding of publication design, including layout, content, and typography (Sitton, 2017a). Upon completion of the course, students were expected to be able to demonstrate knowledge of desktop publishing, photo and graphic editing, and prepress preparation (Sitton, 2017a).

During the final week of the course, participants completed the eye-tracking exercise again. The post-test for this study was a replica of the pre-test and was conducted by the same researcher in the same light and temperature-controlled on-campus computer laboratory.

The following steps were used to compute the scanpath entropy of the four AOIs created in the advertisements.

(1) Produced AOIs of each individual advertisement. (2) Analyzed each scanpath playback to create a character string. The AOI character string was determined using a coding system where *I* represented image, *H* represented headline, *C* represented contact, and *L* represented logo. (3) Removed all repeated AOIs in the character string leaving no more than four AOIs in each character string. For example: A character string of *IIHCLCH* becomes *IHCL* after removing repetitions. This process involves converting the character string from a fixation-based sequence to a dwell-based sequence (Holmqvist et al., 2011). (4) Calculated the number of unique scan paths. (5) Applied the entropy formula to compute entropy using Shannon's entropy formula.

It is common for scanpath entropy to measure only the gaze guidance to one AOI (Hooge & Camps, 2013), such as the logo, but for this particular study the scanpath entropy was computed for all four of the AOIs. To determine if the scanpath entropy was high or low, Hooge & Camps (2013) suggest comparing the scanpath entropy calculations to the minimum (0.000) and maximum (0.374) entropy possible.

The use of a convenience sample created a limitation for this study. The participants all possessed similar characteristics including age and college major. A larger, more diverse population could be recruited to avoid this limitation in future research. A testing effect also has to be discussed as a limitation since the participants were exposed to the same advertisements for both the pre- and post-test. A threat to internal validity also exists in this study because the study does not include a non-treatment control group for comparison.

One limitation of the eye-tracking apparatus is it was not validated with a second calibration method. As recommended by Duchowski (2017), it is best practice to

incorporate a calibration grid to validate the default machine calibration. By having an additional image acting as a calibration grid and instructing the participants to view the point in a specific pattern, precision and accuracy can be increased (Duchowski, 2017).

Results

The 23 (79.31%) female participants and six (20.69%) male participants ranged in age from 19 to 22 years old. Fifteen (51.72%) participants indicated they had no vision issues while 12 (41.38%) said they were nearsighted, one (0.03%) farsighted, and one (0.03%) both nearsighted and farsighted. When asked if they wore corrective eyewear to obtain normal vision, all participants answered yes. All participants indicated they were an agricultural communications major and more than half (51.72%) said they lived on a farm or ranch prior to attending the university. None of the participants indicated they were colorblind or had been diagnosed with any other disorder or medical condition that could affect their vision.

In the pre-test portion of this study, the greatest entropy appeared in the logo AOI of the four advertisements tested. The average entropy calculation of the logo on the pre-test was 0.144. The highest entropy calculation (0.374) appeared on the logo in the Chicken 2 advertisement where the logo size was 23% of the design. In the Cattle 1 advertisement entropy greater than 0.000 was produced in all of the AOIs, which was not the case for the other three advertisements. In the Cattle 1 advertisement pre-test the headline produced an entropy of 0.022, the image produced an entropy of 0.059, the contact information produced an entropy of 0.027, and the logo produced an entropy of 0.061 (see Table 3).

Table 3

Weighted Scanpath Entropy (n = 29)

		Entropy		
Advertisement	*%*	*Pre*	*Post*	*Difference*
Cattle 1				
Headline	25.0	0.022	0.013	-0.009
Image	68.0	0.059	0.035	-0.02
Contact Info	4.0	0.027	0.000	-0.027
Logo	3.0	0.061	0.048	-0.014
Cattle 2				
Headline	20%	0.010	0.010	0.000
Image	71%	0.037	0.037	0.000
Contact Info	5%	0.000	0.000	0.000
Logo	4%	0.064	0.064	0.000
Chicken 1				
Headline	10%	0.005	0.002	-0.003
Image	82%	0.042	0.042	0.000
Contact Info	4%	0.000	0.000	0.000
Logo	5%	0.077	0.077	0.000
Chicken 2				
Headline	20%	0.010	0.010	0.000
Image	51%	0.026	0.026	0.000
Contact Info	6%	0.000	0.000	0.000
Logo	23%	0.374	0.374	0.000

Note. Scanpath entropy numbers were weighted using the number of pixels of each AOI compared to the size of the whole advertisement.

The lowest entropy numbers were produced by the contact information AOI in three of the four advertisements, where it was 0.000. In the three advertisements where the contact information resulted in 0.000 entropy, the AOI size was less than 6% of the design.

In the post-test portion of the study, the greatest entropy appeared in the logo AOI, as it did in the pre-test. The average entropy calculation on the logo in the post-test was 0.141. As in the pre-test, the logo on the Chicken 2 advertisement produced the

greatest entropy again in the post-test. The contact information AOI produced the lowest

entropy numbers of 0.000 in 100% of the advertisements on the post-test.

Based on observation, the entropy did not change from pre-test to post-test. An

observed difference was present on the four AOIs in the Cattle 1 advertisement and on

the headline AOI in the Chicken 1 advertisement. The observed differences between pre-

test and post-test showed a decrease in entropy in all cases of change.

Conclusions and Discussion

Aside from in the first advertisement viewed, Cattle 1, the contact information

produced minimal entropy for all other advertisements. When minimal entropy is 0, the

highest amount of predictability is obtained (Krejtz et al., 2015). This suggests gaze

transition can be expected to contact information with the same size, placement and

relation to other AOIs in the design. The average entropy was highest in the first

advertisement presented to the participants, which can be attributed to its lack of gaze-

guiding properties compared to the other advertisements. Advertisements with less gaze-

guiding properties can result in different scanpaths without a trend for any of the paths

followed (Hooge & Camps, 2013).

After the participants were exposed to an introductory graphic design course, they

conceptually viewed the advertisements the same way. Barth et al. (2016) determined

trained experts scan their environment differently than inexperienced viewers would.

However, one cannot classify the participants as "experts" in graphic design by only

exposing them to an introductory course.

The advertisement that created the greatest amount of difference in entropy was

the first advertisement viewed, Cattle 1. In the post-test, Cattle 1 did not produce the

highest average entropy as it did in the pre-test. This could be a result of the students

being more familiar with gaze-guiding cues. Guidance should be accomplished without

the viewer noticing (Barth et al., 2006), but since the viewers were aware of design

principles in the post-test, it could have contributed to this more defined pattern. Also, it

is still unknown if the order of fixations relates to message transfer (Hooge & Camps,

2013).

The size of elements and how it affects their ability to attract attention can be

explored in this study by comparing the Chicken 1 advertisement to the Chicken 2

advertisement. The logo AOI in Chicken 1 took up 4% of the design while in Chicken 2

the logo took up 23% of the design. The entropy calculations do not show a significant

change from the logo in Chicken 1 to the logo in Chicken 2 but the scanpath illustrations

show us the logo was viewed last in Chicken 1 and first in Chicken 2. As determined by

Pieters & Wedel (2004) increasing the size of the logo does not affect attention to the

entire advertisement. However, by increasing attention to the brand, you also can increase

attention to the image or graphic (Pieters & Wedel, 2004).

Recommendations for Future Research

Regarding future research on this topic, a focus group design could be

implemented into this study to help researchers understand why people think they look at

certain elements within advertisements. A recall survey also could be added to this study,

asking participants what elements they remembered or what message they took away

from each design. Research has shown memory, attitudes, and buying trends can be

attributed to attentional elements of advertisements (Wedel & Pieters, 2000).

Pieters and Wedel (2004) found increasing the size of the brand does not have a negative effect on overall attention to the advertisement, so further research could be done on the entropy produced by the logo as it increases in size. Entropy can also be investigated for one designated AOI (Hooge & Camps, 2013), instead of all AOIs within an advertisement, as done in this study.

Recommendations for Education and Practice

For graphic designers, without being aware of trends in human eye movements, the message of their advertisements could easily be overlooked (Pieters & Wedel, 2004). From the results of this study, we know novice graphic designers view their work relatively the same as they did before they were familiar with design principles, but this should not deter them from always designing with their audience in mind (Graham, 2005).

Revising curriculum is a crucial aspect of academia (O'Neill, 2010), and the results from this study combined with other studies of its kind can lend information to revisit and possibly revise some current graphic design curriculum.

CHAPTER V

DISCUSSION AND IMPLICATIONS

In Chapter V, you will find overarching discussion and implications related to both parts of this two-fold research study.

Since participants in this study shared common demographics, such as college major and age, these results cannot be generalized to advertising consumers. However, this study could be replicated with a larger more representative population.

It could be beneficial to eye-track a group of professionals in the graphic design industry to explore their viewing trends. Comparing the advertisement design observations of expert designers also could reveal if the graphic designers view the advertisements like they intend for them to be viewed by their target audiences. However, without being able to control the exposure to graphic design curriculum and level of expertise, as done in this study, it could lead to flaws in the research design. Also, using a post-test only design would only allow for comparison among advertisement designs.

Although the advertisements used for the first manuscript were not all studied in the second manuscript due to varied designs and the number of specified AOIs, the four advertisements can be compared through eye-tracking metrics and entropy. The logo in the four advertisements produced the greatest entropy as well as the least fixations on

average. By comparing entropy and fixations, some evidence suggests the logo in an advertisement may be an important consideration for designers. If the overall goal of the design is for the logo to not draw any extra attention, the visual stimuli used for this study could be effective. On the other hand, if the designer is wanting to attract attention to the logo, further research would need to be conducted to determine its most effective size and placement in advertisements.

Comparing pre-test and post-test results, difference were observed in all AOIs in the Cattle 1 advertisement and the headline AOI in the Chicken 1 advertisement. Entropy decreased from pre-test to post-test, which may indicate a slight increase in predictability of scanpaths after the students were exposed to graphic design curriculum. This phenomenon could be further explored with a larger population or with a different group of participants with and without graphic design experience. Without knowing the amount of information the students retained from the course, it can become difficult to describe them as "trained" graphic designers after they completed the course. However, it is safe to assume participating students were primed with more knowledge of graphic design than typical consumers.

This particular study could be improved by including a control group in the pre-post design. By including a control group not exposed to graphic design curriculum, we could explore more variations in viewing trends. It also could be beneficial to use designs seen in livestock publications today. Most of the time the modern livestock publication advertisement designs are complex and, in some people's opinion, can be classified as "busy" designs. By using actual designs being used as advertisements to the livestock industry, we could better understand consumer viewing trends.

The designs for this study also were similar in composition and could be altered more to compare advertisement observation changes through varying the graphic design stimuli, such as controlling the image size and placement in the advertisement. For example, the logo was never at the top of the page in any of the designs used in this study, and the image was always the dominant AOI. By moving the AOIs around more throughout the design and varying them in size, we could better understand viewing trends.

Few academic departments offer instruction on the role eye-tracking research can play (Duchowski, 2017). As observed by the researcher conducting the eye-tracking portion of the study, students were intrigued by the eye-tracking technology and most stated they did not know it existed on the university campus. An abundant amount of research should be done in regard to eye-tracking print advertisements but without the awareness of the technology, this research could be left untouched.

Eye-tracking research can be beneficial to future and current professionals in the graphic design industry. Without the understanding of trends of human eye movements, designers could be costing the company for which they design money in the long run. Visual attention is a complex topic, but with effective implementation of design the overall goal of communicating a message can be achieved.

As a graphic designer and future design instructor, I plan to implement my findings from this study as well as future eye-tracking research in my designs and design curriculum. This research has opened my eyes to the endless possibilities eye-tracking research can provide to the design industry and education. Without understanding the

concepts of visual attention, designers and design instructors could quickly fall behind their peers in the industry who are executing these findings in their work.

REFERENCES

Anderson, J.R., Bothell, D., & Douglass, S. (2004). Eye movements do not reflect
retrieval process: Limits of the eye-mind hypothesis. *Psychological Science,
15(4), 225-231*.

Bailey, R*.,* McNamara, A., Sudarsanam, N., & Grimm, C. (2009). Subtle gaze direction.
ACM Transactions on Graphics, 28(4).

Barth, E., Dorr, M., Bohme, M., Gegenfurtner, K., & Martinetz, T. (2006). Guiding eye
movement for better communication and augmented vision. *Perception and
Interactive Technologies. Lecture notes in computer science, 4021*.

Blascheck, T., Kurzhals, K., Raschke, M., Burch, M., Weiskopf, D., & Ertl, T. (2014).
State of the art visualization for eye tracking data. *Eurographics Conference of
Visualization, State of the Art Report*.

Cannon, K.J., Specht, A.R., & Buck E.B. (2014). Agricultural communications: A
national portrait of undergraduate courses. *Journal of Applied Communications,
100(1), 6-16*.

Christianson, S.A., Loftus, E.F., Hoffman, H., & Loftus, G.R. (1991). Eye fixations and
memory for emotional events. Journal of Experimental Psychology: *Learning,
Memory, and Cognition, 17, 693-701*.

Clarence-Fincham, J., & Naidoo, K. (2013). Taking a longer view: Processes of

    curriculum development in the department of graphic design at the University of

    Johannesburg. *Critical Studies In Teaching and Learning (CriSTal), 1 (1).*

Duchowski, A.T. (2007). *Eye Tracking Methodology: Theory and Practice*. New York:

    Springer-Verlag Londan Limited.

Duchowski, A.T. (2017). *Eye Tracking Methodology: Theory and Practice*. New York:

    Springer-Verlag Londan Limited.

Gibson, J. J. (1941). A Critical Review of the Concept of Set in Contemporary

    Experimental Psychology. *Psychological Bulletin, 38 (9), 781–817.*

Gonnella, R.*,* Navetta, C.J., & Friedman, M. (2015). Design fundamentals: notes on

    visual elements & principles of composition. *San Francisco: Peachpit Press.*

Gorn, G.J., Chattapadhyay, A., Yi, T., & Dahl, D.W. (1997). Effects of color as an

    executional cue in advertising: They're in the shade. *Management Science,*

    43(10). 1387-1400.

Graham, L. (2005). Basics of design. *Clifton Park, NY: Thomson/Delmar Learning.*

Gray, R.M. (2011). Entropy and information theory. *New York, NY: Springer.*

Higgins, E., Leinenger, M., & Rayner, K. (2014). Eye movements when viewing

    advertisements. *Frontiers in Psychology, 5, 1-15.*

Holmqvist, K., Nyström, M., Andersson, R., Dewhurst, R., Jarodzka, H., & Van

    deWeijer, J. (2011). *Eye tracking: A comprehensive guide to methods and*

    measures. Oxford, UK: Oxford University Press.

Hooge, I., & Camps, G. (2013). Scan path entropy and arrow plots: Capturing scanning

    behavior of multiple observers. *Frontiers in Psychology, 4 (996).*

James, W. (1981). The Principles of Psychology (Vol. I). Cambridge, MA: Harvard

University Press.

Just M.A., & Carpenter, P.A. (1976). Eye fixations and cognitive processes. *Cognitive

Psychology, 8, 441-480.*

Krejtz, K., Duchowski, A.T., Sxmidt, T., Krejtz, I., González Perilli, F., Pires, A., Vilaro,

A., & Villalobos, N. (2015) Gaze transition entropy. *ACM Transactions on

Applied Perception, 13 (1), 4:1-4:20.*

Lochner, P.J. (2006). The usefulness of eye movement recording to subject an aesthetic

episode with visual art to empirical scrutiny. *Psychology Science, 2, 106-114.*

Mackworth, N.H., Morandi, A.J. (1967). The gaze selects informative details with

pictures. *Perception and Psychophysics, 2(11).*

Martin, B. & Hannington, B.M. (2012). Universal methods of design: 100 ways to

research complex problems, develop innovative ideas, and design effective

solutions. *Beverly, MA: Rockport.*

Matos, R. (2016). Eye tracking essentials. Retrieved March 8, 2017, from

http://www.tobiipro.com/learn-and-support/learn/eye-tracking-essentials/

McNamara, A., Bailey R., & Grimm, C. (2009). Search task performance using subtle

gaze direction with the presence of distractions. *ACM Transactions on Applied

Perception, 6(3).*

Media Matters (February 2007). "Our Rising Ad Dosage: It's Not as Oppressive as Some

Think".

Miall, R.C., & Tchalenko, J. (2001). A painter's eye movements: A study of eye and

hand movement during portrait drawing. *Leonardo, 34(1), 35-40.*

Morgan A.C., & Rucker, K.J. (2013). Competencies needed by agricultural communication undergraduates: An academic perspective. *Journal of Applied Communications, 97(1), 50-65.*

Nielsen, J., & Pernice, K. (2010). *Eye-tracking web usability.* New Riders.

Noton, D., & Stark, L. (1971a). Eye Movements and Visual Perception. *Scientific American, 224, 34–43.*

Noton, D., & Stark, L. (1971b). Scanpaths in saccadic eye movements while viewing and recognizing patterns. *Vision Research, 11, 929–942.*

Ogilvy, D. (1983). *Ogilvy on advertising.* New York: Crown Publishers, Inc.

Oklahoma State University. (2017). 2017-2018 University Catalog. Retrieved from https://registrar.okstate.edu/University-Catalog

Percy, L., & Rossiter, J.R. (1983). Effects of picture size and color on brand attitude responses in print advertising. *Advances in Consumer Research, 10, 17-20.*

Pieters, R., Wedel, M. (2004). Attention capture and transfer in advertising: Brand, pictorial, and text-size effects. *Journal of Marketing, 68, 36-50.*

Pieters, R., Wedel, M., & Zhang, J. (2007). Optimal feature advertising design under competitive clutter. *Management Science, 53(11), 1815-1828.*

Poole, A. & Ball, A.J. (2005). Eye tracking in human computer interaction and usability research. *Encyclopedia of Human Computer Interaction, 2005.*

Privitera, C.M. (2006). The scanpath theory: Its definition and later developments. *Human Vision and Electronic Imaging, 6057.*

Radach, R., Lemmer, S., Vorstius, C., Heller, D., & Radach, K. (2003). Eye movements

in the process of print advertisements. *The Mind's Eye: Cognitive and Applied*

Aspects of Eye Movement Research.

Rayner, K., & Castelhano, M.S. (2008). Eye movements during reading scene

perception, visual search, and while looking at print advertisements. *Visual*

Marketing From Attention to Action.

Rayner, K., Rotello, C.M., Stewart, A.J., Keir, J., Duffy, S.A. (2001). Integrating text and

pictorial information: Eye movements when looking at print advertisements.

Journal of Experimental Psychology, 7(3), 219-226.

Sitton, S. (2017a). *AGCM 3213: Layout and Design for Print Publication* [Syllabus].

Stillwater, OK: Department of Agricultural Education, Communications, and

Leadership, Oklahoma State University.

Sitton, S. (2017b). *Advertisements: AGCM 3213* [PowerPoint Slides]. Stillwater, OK:

Department of Agricultural Education, Communications, and Leadership,

Oklahoma State University.

Stark, J.S. (2000). Planning introductory college courses: Content, context and form.

Instructional Science, 28, 414-438.

Stark, L.W., & Ellis, H.C. (1981). Scanpaths revisited: Cognitive models direct active

looking. *Eye Movements: Cognition and Visual Perception. Lawrence Erlbaum*

Associates.

Tobii Studio. (2016). User's Manual: Version 3.4.5

Viviani, P. (1990). Eye movements in visual search: Cognitive, perceptual, and motor

    control aspects in eye movements and their role in visual and cognitive processes.

    Elsevier Science Publishers BV.

Vogt, W. P. (2005). Dictionary of statistics and methodology: A nontechnical guide for

    the social sciences. *London: Sage.*

Von Helmholtz, H. (1925). Handbuch der Physiologischen Optik (Treatise on

    Physiological Optics) (Vol. III, Translated from the Third German ed.).

    Rochester, NY: The Optical Society of America.

Wagemans, J., Feldman, J., Gepshtein, S., Kimchi, R., Pomerantz, J.R., & van der

    Helm, P. (2012). A century of gestalt psychology in visual perception: II.

    Conceptual and theoretical foundations. *Psychological Bulletin, 138(6), 1218-*

    1252.

Wedel, M., & Pieters, R. (2000). Eye fixations on advertisements and memory for

    brands: A model and findings. *Journal of Marketing Science, 19 (4), 297-312.*

Wedel, M., Pieters, R., & Liechty, J. (2008). Attention switching during scene

    perception: How goals influence the time course of eye movements across

    advertisements. *Journal of Experimental Psychology: Applied, 14 (2), 129-138.*

Yarbus, A. L. (1967). Eye Movements and Vision. New York: Plenum Press.

Zeelenberg, R., Pecher, D. (2015). A method for simultaneously counterbalancing

    condition order and assignment of stimulus materials to conditions. Behavior

    Research Methods 47 (1), 127-133,

APPENDICES

APPENDIX A

INSTITUTIONAL REVIEW BOARD (IRB)
APPROVAL FORM

Oklahoma State University Institutional Review Board

Date: Wednesday, January 18, 2017

IRB Application No AG171

Proposal Title: Effectiveness of Layout and Design Curriculum on Students' Eye Patterns: A Print Advertisement Eye-tracking Study

Reviewed and Processed as: Exempt

Status Recommended by Reviewer(s): Approved   Protocol Expires: 1/17/2020

Principal Investigator(s):

Ashton Lierle

Stillwater, OK 74078

Shelly Sitton
435 Ag Hall
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☐ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

   1.Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2.Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3.Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4.Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Scott Hall (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Hugh Crethar, Chair
Institutional Review Board

APPENDIX B

QUESTIONNAIRE

AGCM Eye-tracking Study

Printed Name _____

What is your age? _____

What is your sex? Choose one.
- ○ Male
- ○ Female
- ○ Prefer Not to Respond

What is your primary major? Choose one.
- ○ Agricultural Communications
- ○ Agricultural Communications/Agribusiness
- ○ Agricultural Communications/Animal Science
- ○ Agricultural Education/Agricultural Communications
- ○ Animal Science/Agricultural Communications
- ○ Agribusiness/Agricultural Communications
- ○ Other _____

Prior to attending Oklahoma State University, where did you live? Pick the one that most closely matches.
- ○ On a farm or ranch
- ○ In a rural area
- ○ In a small town (10,000 or less)
- ○ In a large town (10,000-50,000)
- ○ In a large city (50,000 or more)

Which describes you best? Choose one.
- ○ Right-hand dominant
- ○ Left-hand dominant
- ○ Ambidextrous (neither right- or left-hand dominant; both function equally)

Which of following describes you best? Choose one.
- ○ No vision issues
- ○ Nearsighted (need corrective lenses to see at a distance)
- ○ Farsighted (need corrective lenses to see close to me)

If you wear corrective lenses, which type of corrective lenses do you use most frequently? Choose one.
- ❑ Glasses
- ❑ Contacts
- ❑ Neither

AGCM Eye-tracking Study

Are you colorblind? Choose one.
- ❍ Yes
- ❍ No
- ❍ Prefer Not to Respond

Do you have epilepsy? Choose one.
- ❍ Yes
- ❍ No
- ❍ Prefer Not to Respond

If you been diagnosed with a disorder or medical condition that could influence your vision or ability to focus on images, please list in the space below. For example, autism, attention-deficit disorder, traumatic brain injury, etc. **This question is optional.**

APPENDIX C

RECRUITMENT SCRIPT

Script

Read by chief researcher, Ashton Lierle:

My name is Ashton Lierle, and I am a graduate student in the OSU Department of Agricultural Education, Communications and Leadership as well as the Graduate Teaching Assistant for this class, AGCM 3213. I am studying the effectiveness of layout and design curriculum on students' eye patterns.

Your participation in this study is completely voluntary and truly appreciated. If you choose to participate, your responses and tracking results will be confidential and not available to the researchers until after final grades are recorded with the OSU Registrar. Results of the research will be reported in the aggregate only. Completing the eye-tracking exercise is a requirement for AGCM 3213, but you are not required to consent for your data to be used for this research project.

This study will take around 30 minutes to complete. There are no known risks for participating in this study, and there is no direct compensation or benefits. This research is to help the OSU AGCM program to improve its graphic design education curriculum.

Are there any questions at this time? If not, we will begin the survey portion of the study. Dr. Sitton and I will exit the room while you complete the questionnaire. After you have completed the questionnaire please place it in the envelope provided. If you choose to not answer the questions presented on the questionnaire, just place it into the envelope provided along with all of the others. The envelope containing the completed questionnaires will be stored in a secure area and not accessed by us until after final grades have been posted at the end of the Spring 2017 semester.

Before you exit the room, place your name next to a time slot on the eye tracking exercise sign up sheet provided on the table. If your scheduled AGCM 3213 lab time is on Thursday please sign up for a time slot on Thursday and if your scheduled AGCM 3213 lab time is on Friday please sign up for a Friday time slot.

APPENDIX D

CONSENT FORM

AGCM Eye-tracking Study

Eye-tracking is an evolving tool used to help determine the effectiveness of advertising in media forms such as print, images, video and graphics. Eye-tracking is used in the marketing and communications field to provide insight on consumer actions. Advertisers strive to present the most effective information in advertisements as possible. Today's eye-tracking machines have the capabilities of tracking eye patterns as well as determining gaze points.

Please read this consent information carefully before deciding to participate in this study. Once you have read the following, sign and return with your completed survey.

My name is Ashton Lierle, and I am a graduate student in the OSU Department of Agricultural Education, Communications and Leadership as well as the Graduate Teaching Assistant for this class, AGCM 3213. I am studying the effectiveness of layout and design curriculum on students' eye patterns.

Your participation in this study is completely voluntary and truly appreciated. If you choose to participate, your responses and tracking results will be confidential and not available to the researchers until after final grades are recorded with the OSU Registrar. Results of the research will be reported in the aggregate only. Completing the eye-tracking exercise is a requirement for AGCM 3213, but you are not required to consent for your data to be used for this research project.

This study will take around 30 minutes to complete. There are no known risks for participating in this study, and there is no direct compensation or benefits. This research is to help the OSU AGCM program to improve its graphic design education curriculum.

If you have any questions or concern, please contact myself or my research adviser, Shelly Sitton, at 405-744-3690. Mailing address is 436 Agricultural Hall, Stillwater, OK 74078. Any questions or concerns about your rights as a research participant can be answered by **Dawnett Watkins, IRB Manager, 223 Scott Hall, 405-744-5700.**

I understand I must complete the eye-tracking assignment to meet AGCM 3213 requirements.

_____

Participant Signature   **Date**

I give my permission to use my eye-tracking results and my questionnaire responses in research. I will not be identified to researchers until after final grades are submitted. Choosing to allow my results in the research will not affect my final grade.

_____

Participant Signature   **Date**

VITA

Ashton Elizabeth Lierle

Candidate for the Degree of

Master of Science

Thesis: THE VIEW: A PRINT ADVERTISEMENT EYE-TRACKING STUDY

Major Field: Agricultural Communications

Biographical:

Education:

Completed the requirements for the Master of Science in Agricultural Communications at Oklahoma State University, Stillwater, Oklahoma in December, 2017.

Completed the requirements for the Bachelor of Science in Agricultural Communications at Oklahoma State University, Stillwater, Oklahoma in December, 2017.

Experience:

Employed as a graduate teaching assistant in the Agricultural Education, Communications and Leadership Department at Oklahoma State University, Stillwater, Oklahoma from January 2016 – December 2017.

Professional Memberships:

Agricultural Communicators of Tomorrow, August 2013 – December 2017.

Graduate Student Association in Agricultural Education, Communications, and Leadership, January 2016 – December 2017.

North American Colleges and Teachers of Agriculture, March 2017 – December 2017.