THE EFFECT OF FULL BODY VERSUS PARTIAL BODY GRAPHIC LABELING ON BEVERAGE PACKAGING

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THE EFFECT OF FULL BODY VERSUS PARTIAL BODY GRAPHIC LABELING ON BEVERAGE PACKAGING

A Thesis
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
Packaging Science

by
Toni Gomes
May 2012

Accepted by:
Dr. Rupert Andrew Hurley, Committee Chair
Dr. Andrew Duchowski
Dr. Duncan Darby
ABSTRACT

Through the collection of quantitative and qualitative data, the shelf presence of full body graphic labels versus partial body graphic labels on plastic beverage bottles was examined and evaluated. Eye tracking was used to collect phenomenological data atop the stimuli, while a shopping checklist was used to collect purchase preference. A post-experiment survey was also conducted in order to gather qualitative data regarding possible purchase influences.

The experiment was a 2 (label size) x 6 (beverage flavor) x 2 (age group) study, conducted with 28 participants in a consumer retail environment using mobile eye tracking technology. The goal of this study was to determine if one label attracted more attention than another.

Data revealed that both label sizes drew an equivalent amount of attention; however, partial body labels elicited more visits and more fixations than full body labels. Consumers also selected partial body labels more often than full body labels, regardless of the flavor of the beverage or their age group. Survey results suggested that consumers prefer to be able to see the product when shopping for beverages.

Despite the current trend toward full body graphic labels, the study showed that these labels do not attract more attention on the shelf next to partial labels that show the product. While there may be other reasons for using full body labels, with respect to shelf appeal, full body labels do not appear to carry any advantage over partial labels.
DEDICATION

This work is dedicated to my family, whose endless support and patience has carried me throughout.
ACKNOWLEDGMENTS

I would like to thank my advisor Dr. Rupert Andrew Hurley, and my committee members Dr. Duncan Darby and Dr. Andrew Duchowski for all of their assistance and direction.

I would also like to thank the many people that worked with me and helped me on a daily basis throughout the program, including fellow graduate students Joanna Fischer, Rachel Randall, Dan Hutcherson, Josh Galvarino, Katie Thackston and Andy Pham, along with Andrew Ouzts and Erin Snyder.

None of this would be possible without the support of Harris A. Smith and the staff at the Sonoco Institute of Packaging Design and Graphics.
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CHAPTER ONE
INTRODUCTION

Approximately half of all the products packaged in the U.S. are food products, and Americans spend well over $500 billion on food every year (Osborn & Jenkins, 1992). Without food packaging, the modern food industry would be dramatically different, as consumer marketing would be virtually impossible (Nancarrow, Wright, & Brace, 1998).

Some of the main functions of packaging include: containment, protection and communication. In terms of containment, a package surrounds a product and keeps the product inside, preventing spillage or dispersion (Robertson, 2006). It also allows for portion control and convenience when using the product.

Prevention of product damage falls under protection. Outside sources should be prevented from entering and contaminating the product (Brody, Bugusu, Han, Sand, & McHugh, 2008).

Communication is a broad function that includes displaying information, showing tamper evidence, and advertisement of the product (Brody, at al., 2008).

While protection and containment cannot be overlooked in package design, this paper focuses on the communicative aspects of packaging.

In order to communicate and ultimately sell itself, the product must attract the consumer’s attention. Attention is a valuable resource in consumer goods, as it can be traced back to a person’s focused concentration. A label can be the vehicle to attracting consumer attention and communicating information on packaging. Robertson, (2006)
refers to a label as a “silent salesman”. This can be important in a consumer retail environment since 70% of purchase decisions are made at the shelf (Clement, 2007).

Labels can come in a variety of styles dependent on materials, processes, and the end use of the label. Paper and plastic films are the two most common types of label materials, and can come in a variety of options, including wet glue, self-adhesive, roll fed, stretch sleeves and shrink sleeves. There are different ways designers can make their labels stand out against other product labels. Utilizing various label sizing gives designers different sized canvases to work with in order to attract consumer attention and communicate product information. Full body shrink sleeve labels have become increasingly popular for beverage labeling as they offer an increased surface area and also serve as an effective method of showing tamper evidence. Due to the increase in material and additional processing that goes into full body shrink sleeve labels, there are additional costs associated with this type versus a partial body film label.

While previous studies have shown the importance of food appearance and packaging appearance on consumers’ food perceptions, (such as Cardello, 1994; Moir, 1936; Wheatley, 1973; Meiselman & McFie, 1996; Garber, 2000; Kalick & Cardello, 1991; Kramer, 1989; Hanlon, Kelsey & Forcinio, 1998) prior to this research, no study has tested the difference in consumer attention to full body labels versus partial body labels on food packaging. This study gathered qualitative and quantitative data through surveys, and eye tracking in a simulated shopping environment to examine the shelf presence of full body graphic labels versus partial body graphic labels. For the purposes of this study, shelf presence is defined as the amount of attention a product attracts when
located on a shelf beside other products. This information will assist producers and designers to determine the value-benefit of additional material and increased manufacturing cost to use full body shrink labels.
Role of Appearance on Food/beverage Acceptance

Packaging and labeling influence a consumer’s acceptance of food products, a schematic model of food related behavior created by Cardello (1994) in his paper “Consumer expectations and their role in food acceptance,” suggests that a food product’s first impression can be dictated by the appearance of both the food and the packaging.

Of the many visual attributes of food, food appearance can be the most influential of all, as it is the most universal, and well studied (Cardello, 1994). Moir (1936) was one of the first to show a strong association between food color and consumer acceptance. In his study, participants were presented with many discolored (but otherwise “normal”) foods, to which participants complained that the food tasted “off”, or that they did not feel well after eating it. Other studies have continued to confirm this association. In 1973, Wheatley performed a study in which participants were given a meal consisting of steak, French fries, and peas, under masked lighting conditions. After consumers ate the meal for a certain amount of time, the lights were unmasked to reveal that the steak was blue, the French fries were green, and the peas were red (Meiselman & MacFie, 1996). Results were similar to those in Moir’s study where participants involved were “turned off” and nauseated by the food’s appearance. Such behaviors can be explained by a discontinuity
between expectations or assumptions and what is actually presented, leading consumers to believe something is “wrong” with the product, e.g. spoiled.

A study conducted by Garber at al. (2000) tested participants’ association with food and packaging color to flavor profiles. Participants were exposed to various beverages in color form and neutral (clear) form and asked to identify the beverages flavor after viewing and tasting. A significantly larger number of participants were able to identify flavors when colored than when clear. Findings also showed that participants related certain flavor profiles to different colors, such as purple being “tart,” and orange being “flavorful, sweet and refreshing.”

In a study conducted by Kalick and Cardello (1991), the importance of package appearance on food quality perception was demonstrated. Four products were packaged, three of which were packaged with bright, attractive designs, while the fourth was packaged with a standard, military ready to eat (MRE) plain brown packaging. After looking at the packages and rating them on a series of attributes, participants perceived the products inside the bright, attractive packaging to be of a higher quality than that of the standard MRE packaging (Kalick & Cardello, 1991).

In a similar study, conducted by Kramer, Edinberg, Luther and Engel (1989), participants not only rated, but also consumed the same pudding product in four different packages: one plain white package, two different military packages, and one commercial package. The product in the commercial package was rated significantly higher on an acceptability scale and was also consumed significantly more, showing that in this
particular study the commercial brand and packaging increased acceptability (Kramer et al., 1989).

The studies described above show how both food and package appearance can influence a consumer’s experience with a product. Both allow the consumer to judge the product and decide what their experience with that product will be like before consumption. Consumers can identify through packaging, both physically and aesthetically, the perceived quality of the product.

**Tamper evidence in Beverage Packaging**

Caps and seals for bottles can often be a critical part of the overall packaging as they can maintain the integrity of the contents inside. They must be durable throughout all processing steps (assembly, storage, shipping, etc.) but also allow access to the product by the consumer (Hanlon, Kelsey, & Forcinio, 1998). In 1982 bottle sealing changed forever after the Chicago Tylenol® Murders, in which seven people died after cyanide was put into bottles of Tylenol® at a pharmaceutical store (Hanlon, et al., 1998). The Food and Drug Administration (FDA) then required all over the counter drugs to have tamper evident seals, as well as a statement that would draw attention to the seal in order to promote safety (Hanlon, et al., 1998).

Food product manufacturers also use tamper evident and “freshness seals” with their products (Hanlon, et al., 1998). Tamper evident devices can be expensive for low profit foods. Making simple, innovative devices/designs desirable, such as shrink sleeves. Beverage packages can apply various sealing methods to assure that the product is fresh,
and is tamper-resistant. Although not required by the FDA, beverage tamper evident devices are still important when considering the prominence of beverage packaging.

**Consumer Attitudes about Beverage Packaging and Labels**

The majority (60%) of US juice and drink sales in 2011 was through supermarkets (Mintel, 2011). Driving forces behind beverage purchases can be different depending on the size of the package. For single serving beverages, impulse is the determinant, while for multi-serving beverages cost per serving is the determinant (Mintel, 2011). Private label beverage sales are almost exclusive to supermarkets at 94.2% of sales, while representing 21.4% of overall beverages sales (Mintel, 2011). Their success can be attributed to innovation that takes advantage of a growth in demand for “better for you” (bfy) beverages at a low cost (Mintel, 2011). Through the use of innovation and design, private labels can be successful by appearing to be a premium product with a low price attached (Mintel, 2011).

As consumer confidence in 2011 remained low due to the economic recession, low price was the most considered attribute by consumers when buying beverage products in 2011. Consumer confidence is a measure of consumer optimism about the economy. Consumers’ personal financial situations determine their purchasing power. The low measure led to a 25% increase in the amount of new beverage launches from 2006-2010, as beverage companies pursued new methods to attract consumers to purchase their products. Product innovation (such as claims, package design, ingredients, etc.) is critical to a new product’s success (Mintel, 2011).
The most important beverage packaging characteristics were those that allowed convenience and usefulness (Mintel, 2011). Such characteristics include ease of opening, retainability, resealability, portability, and recyclability. The least important characteristics were packaging material, serving size, weight, minimalism, and style (Mintel, 2011). Consumer age was shown to play a factor in determining these characteristics, however, as those younger than 25 years of age favored stylish design over functional features.

As of 2011, with labeling, the order of importance of packaging characteristics according to Mintel is as follows:

1. Simple, easy to read, without clutter
2. Can identify if the product is “All Natural”
3. Nutritional content
4. Can identify if the product contains high fructose corn syrup
5. Can identify the products ingredients in regards to allergy information
6. Seal of approval from a legitimate association
7. Environmentally friendly materials
8. Interesting graphics/design

Age played a factor in determining these characteristics, especially in regards to “interesting graphics/design.” Table 1 shows how younger age groups are more influenced by packaging graphics/design (Mintel, 2011).
Table 1. Percent influence of packaging graphics/design on beverage purchases

(Mintel, 2011)

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<tr>
<th>Age</th>
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<th>35-44</th>
<th>45-54</th>
<th>55-64</th>
<th>65+</th>
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<tr>
<td>% Influence</td>
<td>50%</td>
<td>42%</td>
<td>35%</td>
<td>34%</td>
<td>29%</td>
<td>22%</td>
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The information above shows the importance of beverage packaging to consumers. The high demand for such products leads to a high demand for the materials used to develop the packaging. Plastics are the most frequently purchased type of beverage packaging (Mintel, 2011).

**Plastic Packaging and Films**

The use of plastics began mostly after WWII as polyethylene (PE) became more abundant and available commercially (Hernandez, Selke, & Culter, 2000). Its early use was for bread bags, but continued to evolve into resalable packages and molded shapes. Once plastic films became mainstream, their usage increased due to their versatility and low density (Hernandez, et al., 2000). By 2000, plastics accounted for 29% of packaging, most of which was food packaging (Hernandez, et al., 2000). In a Mintel Beverage Packaging Trends (2011), plastic beverage containers were ranked first in overall beverage purchase frequency.

Plastics are polymers composed of macromolecules, which are very large molecules. Monomers are the constitutional units whose repetition describes the main chain of the macromolecule, and are connected chemically with primarily covalent bonds. A covalent bond is one in which electrons are shared by atoms, in contrast to an
ionic bond in which electrons are transferred. These are primary bonds that determine molecular structure. Secondary bonds are intermolecular forces that determine physical structure.

Polymers are long molecules composed of monomers. Some occur in nature, but most are synthetically created using polymerization, a process in which monomers are joined to form a chain (Osborn & Jenkins, 1992). The usefulness of a polymer is dependent on the length of its chain, as length can determine characteristics such as strength, viscosity, elasticity, stress relaxation, creep and melting temperature. The backbones of polymers are usually made of carbon (Hernandez, et al., 2000). PE is the most basic polymer, consisting of only carbon and hydrogen, as shown in Figure 1. Branching occurs when side chains attach to the ends of the polymers.

Also important is the chemical nature of the polymer, which determines characteristics such as toughness, stiffness, and transparency.

![Figure 1. Polyethylene](image)

When some polymers are cooled, the compositional molecules align themselves with their neighbors, creating crystalline domains and forming a solid. This process is known as crystallization. Crystalline properties include light diffraction, resistance to force, stiffness, tensile strength, and barrier to diffusion (Hernandez, et al., 2000).
However, parts of the chains often get entangled during crystallization and create amorphous, or non-crystalline, regions. Linear molecules, such as linear low density polyethylene, are more crystalline than branched polymers, such as low density polyethylene, as it doesn’t have any free radical polymerization (Hernandez, et al., 2000). The crystalline melting point ($T_m$) is the temperature in which the crystal’s forces are overcome and it “melts”. Amorphous polymers do not have crystals and therefore do not have a melting point. Instead, amorphous polymers have a glass transition temperature ($T_g$), which is the temperature that instigates segmental motion between molecules to that they can move around better arrange themselves.

Plastics are polymers that can be molded and made to flow through the use of controlled heat or pressure (Hernandez, et al., 2000). They are characterized by their ability to continually deform until reaching a certain point, becoming hard and retaining shape when cooled.

Thermal conductivity of a material is an important characteristic in packaging, especially when dealing with plastic heat shrink films. It is the measure of a materials ability to conduct heat, which determines the heat transfer process in processing applications.

\textit{Plastic Film Processing}

Plastic extrusion is a process that converts raw plastic materials (resin) into useful materials for products. An extruder is shown in Figure 2. Resin is fed to the machine and pushed into a barrel containing a large, rotating screw that melts the resin though heat,
friction and pressure. The material is then mixed and filtered at the final end of the extruder.

Figure 2. Extruder

Film can then be created by this plastic material through one of two methods: blown/tubular process or cast process. Shrink films are created by the blown/tubular process, in which the plastic is blown through a circular die to form a tube.

Blown film is oriented through adjustments of the inflation ratio and take-away speed of the film in relation to the forming rate of the film tube. The film can be either monoaxially (one direction) or biaxally oriented (two directions), although biaxial orientation is used for most shrink wrapping applications. The orientation of the film can play a large role in its end characterizes, such as stiffness, strength and shrink direction (Osborn & Jenkins, 1992). Orientation is the directionality of a molecule’s arrangement. It can be changed based on how a polymer is cooled, or if there are external forces acting upon it.
Molecular realignment also orients film, and is used to produce shrink film. This occurs when a polymer is between its $T_g$ and $T_m$, as polymer chains are able to move and disentangle. When the polymer is then brought to temperatures below $T_g$, the molecular structure will be frozen in place. When the polymer is reheated to the correct conditions, however, the molecules will go back to their original position.

The listed processes show how plastics are formed in order to be used for packaging purposes. These processes include making the package themselves, as well as making plastic film for labels.

*Labels*

Labeling can be considered the principal decoration method for containers (Garber, et al., 2000). Their usage dates back to the early 19th century when they were used to identify drugs (Hanlon, et al., 1998). Usage of labels increased once literacy increased and packaged products become more abundant. As usage increased, so did the promotional value, especially with beer, wine, matchbooks, food, and medicine labels (Hanlon, et al., 1998). The later introduction of bar codes and nutrition panels helped to reinforce the necessity of labels on a product.

Today labels are available in a wide variety, dependent on materials and end use. The most common materials are paper, and plastic film; however, laminates, paperboard, fabric, and metal are among other substrates that can be used. Material opacity and colors will vary depending upon the material used, and can be adjusted by printing. Labels can be coated or uncoated, adhesive or non-adhesive, and pressure sensitive or heat sensitive.
Paper is the most common type of label, and can be low cost or high quality. This material is more likely to scuff, wrinkle, and lift than plastic, and making it look like an integral part of the package can be difficult (Hanlon, et al., 1998). Films are not only used as labels, but also as carriers and laminates. Commodity plastics such as polyethylene (PE), polypropylene (PP), polystyrene (PS), and polyvinylchloride (PVC) are often used for plastic film labels due to their high volumes, modest prices and reasonable performance (Hernandez, et al., 2000). Shrink film is a type of film that can shrink at least 25% at relatively low temperatures (<100˚C), and is classified in the flat and tubular film oriented category (Osborn & Jenkins, 1992). Polymer blends with reduced crystallinity are desired in order to control shrinkage properties.

Typical roll stock labels are made from paper or film, and are often either self-adhesive or wet glued. These labels are on a large roll, cut to size, that unwinds onto a rotating bottle. An eyespot located on the label communicates to the cutting machine when to cut the label, which can be done before or after wrapping around the bottle, depending on the machinery. For wet glued labels, glue is applied to the bottle before the label is wrapped around it. For self-adhesive labels, the adhesive layer is exposed and the label is applied to the bottle. Virtually all printing processes are available for roll stock labels, depending on the specific material used, including gravure, offset lithography, flexography, letterpress, and screen-printing.

Shrink sleeves are a fast growing segment of the label market, and are believed to greatly improve shelf appeal and brand image when used as a full body label on a container (Hanlon, et al., 1998). Similar to roll stock labels, virtually all printing
processes are possible for shrink films depending on specific material choice. The single reels then go through a process called “seaming”, where it is formed into a continuous tube and then formed and sealed, making a sleeve (Hanlon, et al., 1998). Usually a solvent or a heat application is used to seal the sleeve. Hot wire sealing is the most common since it is unobtrusive and the most visually pleasing. Once the sleeve is placed over the container, the package is conveyed into a heat tunnel that uniformly shrinks the film onto the contours of the container. Distortion factors must be taken into account when designing graphics for shrink film, including film shrinkage and bottle contours. Also, a variety of heat shrinking problems can arise in this process due to imbalanced heat, temperature variation, line speed, air circulation, and container temperature (Garber, et al., 2000).

Labels provide a method of communication between the product and consumer that can aid the consumer in making purchase decisions. With a large variety of label materials and methods to use, ultimately deciding which label to use depends on manufacturing and supply limits, as well as the end use of the product. For consumer products, such as beverages, attracting attention may be a principle driver for label choice.

Attention

Visual attention is best described by psychologist William James (1890) in his book *The 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.”

Humans use their eyes to examine things about which they want to know more information, and to focus their concentration onto those things (Duchowski, 2007). This can be done intentionally, or it can happen involuntarily. Tracking eye movements can show the path of attention and potentially provide insight to the interaction between the viewer and the object/scene.

Today, many consumers can feel overwhelmed by the amount of products and advertising presented in a retail environment, making attention an important resource of particular significance in packaging (Pieters, et al. 2004). According to Krugman’s (1994) “information-attitude-behavior communication theory”, attention is the first step to comprehension, which is then followed by attitude changes in behavior. In order to change a consumer’s behavior, product packaging has to first attract attention.

There are two types of visual information search methods: goal-directed and exploratory search (Janiszewski, 1998). Goal-directed search is driven by top down cognitive processing. It occurs when the viewer is familiar with the visual information and uses memorized search routines in order to derive specific information. This is generally the more efficient of the two search methods, as it is often associated with
searching with a specific search task. Bottom up cognitive processing, on the other hand, drives exploratory search. This method can be associated with “browsing” as it does not involve a specific search task (Janiszewski, 1998). This is generally referred to as a slower search method even when few non-focal items are present due to the lack of incentive to shift attention.

As attention is a valuable resource in consumer environments, it can be sought after using different advertising methods. Packaging and labeling design is a method that can be utilized to attract attention.

Label Design

The role of marketing communication in packaging is to provide information regarding contents and usage, and to encourage sale (Nancarrow, et al., 1998). Label design must take into consideration technical aspects of product information, such as nutrition information, legal considerations, and rules and regulations. The Nutrition Labeling Education Act (NLEA) of 1990 is a significant food labeling legislation that allows the FDA to regulate nutrition and disclosure information on almost all packaged foods, with the intention of causing labels to be accurate and non-misleading about the information being conveyed (Derby & Levy, 2001). This act includes mandatory nutrition labeling, per serving information, and nutrient reference values. The act also calls for uniform definitions of nutrient claims such as “low,” “reduced,” and “lean.”

Many consumer goods are found in “self-servicing” stores, meaning consumers locate and decide on a product on their own. In self-servicing stores, packaging acts as
advertising for that product, especially since many similar products can be located next to each other. Product “decoration” is both the visual communication of the product and the designed artwork that is placed on the product or package (Osborn & Jenkins, 1992).

In “Buyer Behavior: Theoretical and Empirical Foundations,” Howard and Ostlund discuss the mixture of consumer motives with search behavior (Howard & Ostlund, 1973). The “Howard-Ostlund Model”, recommends three main factors marketers and designers can address when packaging a product: a consumer’s past needs and wants; a design’s ability to be noticed; and a design’s ability to communicate effectively (Howard & Ostlund, 1973). According to the model, a consumer can have past experiences with products and stimuli that can bias or distort how they perceive other products and stimuli (Howard & Ostlund, 1973). These perceptions may have favorable or adverse effects on products. A designer’s awareness and ability to understand these motives can assist in addressing the consumer’s needs and wants.

Products exist within a competitive array and designers must take into account the context in which products are presented (Garber, et al., 2000). Design execution can be a challenge (Garber, et al., 2000). An example of this is the 2009 Tropicana re-design failure. Tropicana launched a brand re-design of their orange juice packaging in order to gain new attention and refresh the branding (Zmuda, 2009). After releasing the re-design, sales plummeted $33 million in 53 days and Tropicana pulled the new packaging. An eye tracking study was completed in order to see what may have caused the market leader in orange juice to fail. It was found that consumers were unable to locate the re-design on the shelf because it looked so different from previous Tropicana brand design. When
consumers were unable to find the typical Tropicana packaging with brand, color, and other characteristics that had become familiar for so long, they gave up and chose a competitive product (Stevens, 2012).

A label’s design can determine the effectiveness of its communication. Determining the level of a label’s effectiveness can be difficult since it is dependent on a consumer’s attention retention. There are, however, various methods to evaluate this effectiveness as it pertains to attention retention through both qualitative and quantitative data collection.

**Qualitative and Quantitative Data Acquisition**

The traditional method of gathering personal preference data for packaging is through focus groups. A focus group is a body of participants that are collectively asked about a particular product. This method mainly derives *qualitative* data, which according to Sam Young (1999), author of “A designer’s guide to consumer research”, can be highly subjective due to the lack of numerical presentation. Using focus group information can potentially be unreliable since participants can behave differently in groups than they would when present in a real-life one-on-one scenario with the product, and in the current contextual environment. A focus group can be beneficial when discussions, or further insights are desired. Surveys can provide similar qualitative data, however, they can also provide quantitative information and participant demographics.

Eye tracking is a technological method that provides quantitative data in measuring and evaluating a person’s visual search information (Wedel & Pieters, 2007).
Visual research has become increasingly dominant in marketing and advertising, as people are highly visually oriented (Wedel & Pieters, 2008). Packaging companies such as Kraft and Unilever privately use eye tracking as research and testing methods (Wedel & Pieters, 2007). Eye tracking is a method that provides a way to acquire and analyze visual attention in advertising and packaging through quantitative data collection (Krugman, et al. 1994). While eye tracking may provide eye movement information, it cannot provide the reason why a participant may be looking at something. In order to draw conclusions a study must be designed around a specific metric, and/or be supported by a survey that can provide information as to why a participant was looking at one product versus another. Also, as with other equipment, there can be technological shortcomings in data collection, such as participants being out of the equipment’s data collection range, or participants moving the equipment in a way that affects calibration.

**Eye Tracking Methods**

There are essentially two different types of eye trackers: table mounted and head mounted. Eye trackers can use various eye movement recording methods, such as electro-oculography (EOG), scleral contact lens/search coil, photo-oculography (POG) or video ocularography (VOG), and video based combined pupil/corneal reflection. Only the latter two methods provide point of regard measurement, a separation of head movement from eye movement (Duchowski, 2007). The pupil/corneal reflection method uses light, often infrared (IR), to measure corneal light reflection in relation to the pupil. The video based
portion of this method calculates point of regard in real time using a camera and image processing. This method can be used for head mounted or table mounted eye trackers.

Traditionally, eye trackers are static, in the sense that the user cannot move around an environment when wearing them, and are often required to sit/stand still and view a screen. Newer mobile eye trackers are head mounted eye trackers that allows a person to freely move about an environment. This allows test subjects to interact with objects/scenes in a more realistic fashion than they would sitting in front of a computer screen. Mobile eye tracking is a relatively new but rapidly growing technology that can be especially useful when examining consumer products and.

Eye tracking data can provide multiple metrics through the use of fixations and saccades. A fixation occurs when there is a stabilization of the retina over an object (Duchowski, 2007). Fixations are actually made up of small, rapid eye movements known as microsaccades. Saccades are fast movements of the eye, and can be both voluntary and involuntary.

Setting up an eye tracking study is dependent on end result requirements. Certain factors must be accounted for to balance the effect of order of presentation effects. According to the Gutenberg diagram (Figure 3), a person whose reading language reads from left to right will generally move their eyes from the top left to the bottom right when observing an item (Lidwell, Holden, Butler, 2010). Other visual patterns include the “Z pattern” and the “F pattern,” shown in Figure 4. The Z pattern contains views that appear in to make a “Z”, as shown in Figure 4. The F pattern is slightly different and it often associated with web design with heavy text. Its pattern suggests that viewers start with
the top of the design; reading horizontally from left to right, then dwindle off to only reading the information on the left. These patterns suggest that there are naturally weak and strong visual areas on a visual plane, therefore these areas must be taken into account when setting up an experiment.

Figure 3. Gutenberg Diagram (Lidwell, et al., 2010)

Figure 4. The Z pattern (left) and F Pattern (right). (Lidwell, et al., 2010)

One method to control for biased areas on the visual plane is to use Latin square sequencing. A Latin square, depicted in Figure 5, is an arrangement of letters in rows and columns in which each letter appears only once in each row and column (Grant, 1948).
The letters can be representative of variables or items in an experiment so that they are rotated in such a way that allows for every possible condition. An experiment with different conditions can apply this rotation method to ensure that every condition is present, and to account for any claim that a certain area on the visual plane was favored over another in terms of results. For example, if Product B is chosen the most but is always placed in the middle of Products A and C, it cannot be determined that Product B is preferred because of its location or because of the product itself. A Latin square rotation would determine this.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>B</td>
<td>C</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>A</td>
<td>B</td>
<td></td>
</tr>
</tbody>
</table>

Figure 5. A Latin square

Eye tracking, surveys, and focus groups can provide necessary data in order to provide a statistical analysis and determine significance.

*Methods to Determine Statistical Differences*

In order to determine significance of data, statistical analysis is necessary. One method of statistical analysis is an analysis of variance (ANOVA), which determines whether or not the means of two or more groups differ significantly. The ANOVA model relies on fixed effects, random effects, and mixed effects. A fixed effect model is one
where conditions are presented to subjects in order to see if there are variable responses. When conditions are not fixed, the model is a random effect model. A mixed effects model has both fixed and random effect factors.

The purpose of an ANOVA is to determine whether to accept or reject a hypothesis. This is known as the null hypothesis (H₀), and is often one in which the groups are equal. When the null hypothesis is accepted it means that variance between groups (mean square due to treatments, or MSTR) is equal to that within groups (mean square error, or MSE), meaning a difference between variables cannot be proven. The test statistic is known as an “F statistic,” which can be defined as the ratio of MSTR to MSE.

A statistical analysis of collected eye tracking data can be used to evaluate a packaging shelf presence study because it will determine the significance of various metrics related to attention. Previous research shows the importance of both food and packaging appearance on consumer judgment; however no studies have used eye tracking in their evaluation.

One of the major roles of packaging is to communicate to the consumer, and labels can provide the canvas necessary for this communication and hopefully influence a consumer. Plastic beverage packaging utilizes various labeling methods in order to aid in product success, including full body heat shrink sleeve labels made from plastic film. While label companies claim that full body graphic labels can lead to more sales, no previously published studies have compared such labels to partial body graphic labels. Through the data collection and analysis techniques described above, it is hoped that this evaluation can be made.
CHAPTER THREE
MATERIALS AND METHODS

Objectives

The purpose of this research was to obtain quantitative and qualitative data on consumers’ attention to labels on beverages. The following metrics were recorded: time to first fixation, total fixation count, total fixation duration, and visit count.

Eye tracking methods were employed to examine the shelf presence of two different styles of beverage labels. With mobile eye tracking technology and a consumer experience laboratory, this study characterized how consumers observe products when making a purchase decision. This combination of resources allowed for quantitative data concerning consumer response to products. A survey provided qualitative consumer preference data of test products to expand on the eye tracking data.

Eye Tracking

The eye tracker used for this study was Tobii® Glasses, a mobile eye tracker worn on the head like a regular pair of glasses. This device is shown in Figure 6. The Tobii® Glasses are made of plastic, rubber and glass, containing an integrated microphone, a scene camera, and the eye tracking camera. The glasses are monocular, meaning they sample from the one eye only. The Tobii® Glasses sample from the right eye at 30 Hz using the pupil centered corneal reflection method. This method measures the corneal reflection of an infrared light source in relation to the center of the pupil in order to
calculate where the participant is looking (Duchowski, 2007). Point of regard data that separates head movement from eye rotation is also provided with this method.

![Figure 6. Tobii® Glasses attached to the Recording Assistant (Tobii, 2009)](image)

The Tobii® Glasses were used in conjunction with two other pieces of hardware: the Recording Assistant (RA) and infrared (IR) markers. The RA, also displayed in Figure 7, is a 12 x 8 x 3 cm device that calibrates the Tobii® Glasses and collects and stores eye tracking information from the Tobii® Glasses. Data is stored on a 4GB SD HC memory card within the RA. The RA also shows information regarding calibration quality and battery life (Tobii, 2009).

The IR markers, shown in Figure 7, are used to define virtual planes called Areas of Analysis (AOAs) and any specific Areas of Interest (AOIs). These are depicted in Figure 8. An AOA is a hardware implementation of a 2D plane, in which data can be aggregated. An AOI is a smaller, marked area contained inside of an AOA in which software can implement a data region. The AOA is defined in the Tobii® Studio software
as a photo or “snapshot” taken by the Glasses in order to aggregate the data from multiple participants. The Tobii® Glasses recognize IR markers in order to correspond real-time data on an aggregated 2D plane. IR marker holders are required to position the IR markers in place when set up. The holders are marked with ID numbers, as well as IR marker connection pins that communicate with Tobii® Glasses using infrared light.

![IR markers](image)

Figure 7. Tobii® IR markers (Tobii, 2009)

![AOA and AOI](image)

Figure 8. An example AOA shown in green, while an example AOI shown in red
Tobii® Studio, an eye tracking and visualization software, was used to gather data in this study.

*Calibration*

There is a nine-point calibration process required for the Tobii® Glasses to properly capture data. The participant places the Tobii® Glasses on their head and looks straight at a flat, unmarked wall, one meter away. The RA will display a 3 x 3 point grid where the experimenter moves an IR marker corresponding to points on the grid. When the participant fixates on all nine points the participant is calibrated, and the RA will report the respective quality.

*CUShop™: Consumer Experience Laboratory*

The experiment was conducted in CUShop™, Clemson University’s Consumer Experience Lab, which serves as an immersive, realistic shopping environment that allows participants to be actively engaged when participating in a study. CUShop™ contains three, twelve foot, grocery shelves, all filled with actual products (Figure 9). The shelves were 78 inches tall and 16 inches deep.
Materials

The stimuli used for this study were twelve beverage bottles, comprised of six different flavors and two different labels for each flavor. Figure 10 shows the stimuli. The bottles were sixteen ounce, polyethylene terephthalate (PET) clear plastic procured from Freund Container and Supply. They had a square/bevel shape, with dimensions 2.4 inches in diameter and 8.5 inches tall. These bottles came with white polypropylene (PP) caps, size 38/400. Figure 11 illustrates the bottle design.
Labeling film was uni-lateral PVC heat shrink film, forty micron caliper, supplied by Klockner Pentaplast. Label designs were created in Adobe Illustrator and digitally printed using a Roland VersaUV Print and Cut LEC-330 (Figure 12), with Roland ECO-UV inks.
Printed labels were cut to size, then wrapped around the bottle, as shown in Figure 13. Both full and partial labels were manually seamed using Flexcraft Seaming Solution, Adhesive for PVC and PETG Film, (Figure 14).
Figure 13. Bottle wrapped with full body label before heat shrinking.

Figure 14. Seaming the labels with Flexcraft adhesive.
A Wagner Spray Tech Model 775 heat gun was used to shrink the full labels to the bottles, seen in Figure 15. The partial labels did not have to be heat shrunk, as they were already form fitted to the bottle. Examples of finished prototypes are shown in Figure 16.

Figure 15. Heat shrinking the full body label with the heat gun.

Figure 16. Examples of finished products
Retail Audit

In order to determine the partial body label size used for the study, a retail audit of various beverage labels was necessary. Nine different single serving beverages from a local supermarket were retrieved and then measured to determine the partial label coverage. The surface area of each label was measured and then compared to the total surface area of the bottle, (not including the cap) as shown in table 2. The cap was not included in the measurement for any of the bottles since partial labels typically do not cover the cap. The surface area of each label was divided by the total surface area of the bottle and multiplied by 100 in order to get percent label coverage. The average percent label coverage of the bottles was 51.95%. This percentage determined the amount of coverage that would be used for the partial body label stimulus bottle.
Table 2. Determining Partial Body Label Coverage

<table>
<thead>
<tr>
<th>Beverage</th>
<th>Dimensions (in) (Circumference x height)</th>
<th>Surface Area (in²)</th>
<th>% Label Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gatorade Label</td>
<td>9.00 x 3.25</td>
<td>29.25</td>
<td>46.43%</td>
</tr>
<tr>
<td>Bottle</td>
<td>9.00 x 8.00</td>
<td>63.00</td>
<td></td>
</tr>
<tr>
<td>Sobe Juice Label</td>
<td>9.00 x 3.25</td>
<td>31.50</td>
<td>47.55%</td>
</tr>
<tr>
<td>Bottle</td>
<td>(9.00 x 6.25) + (5.00 x 2.00)</td>
<td>66.25</td>
<td></td>
</tr>
<tr>
<td>Vitamin Water Label</td>
<td>9.00 x 3.75</td>
<td>33.75</td>
<td>53.57%</td>
</tr>
<tr>
<td>Bottle</td>
<td>9.00 x 7.00</td>
<td>63.00</td>
<td></td>
</tr>
<tr>
<td>Arizona Label</td>
<td>8.25 x 5.50</td>
<td>43.38</td>
<td>68.75%</td>
</tr>
<tr>
<td>Bottle</td>
<td>8.25 x 8.00</td>
<td>66.00</td>
<td></td>
</tr>
<tr>
<td>Sweet Leaf Label</td>
<td>8.50 x 4.00</td>
<td>34.00</td>
<td>57.14%</td>
</tr>
<tr>
<td>Bottle</td>
<td>8.50 x 7.00</td>
<td>59.50</td>
<td></td>
</tr>
<tr>
<td>Honest Tea Label</td>
<td>9.00 x 3.00</td>
<td>27.00</td>
<td>46.16%</td>
</tr>
<tr>
<td>Bottle</td>
<td>9.00 x 6.50</td>
<td>58.50</td>
<td></td>
</tr>
<tr>
<td>Inko’s Tea Label</td>
<td>9.00 x 3.00</td>
<td>28.13</td>
<td>48.08%</td>
</tr>
<tr>
<td>Bottle</td>
<td>9.00 x 6.50</td>
<td>58.50</td>
<td></td>
</tr>
<tr>
<td>T42 Tea Label</td>
<td>9.00 x 3.00</td>
<td>27.00</td>
<td>48.00%</td>
</tr>
<tr>
<td>Bottle</td>
<td>9.00 x 6.75</td>
<td>56.25</td>
<td></td>
</tr>
<tr>
<td>Ocean Spray Label</td>
<td>8.00 x 3.50</td>
<td>28.00</td>
<td>51.85%</td>
</tr>
<tr>
<td>Bottle</td>
<td>8.00 x 6.75</td>
<td>54.00</td>
<td></td>
</tr>
</tbody>
</table>

Average % Label Coverage: 51.95%

**Stimulus Label Dimensions**

The stimulus bottle was 6 inches tall, by 8.5 inches around, creating a total surface area of 51 square inches. Based on the average percent label coverage found above (51.95%), the partial label coverage of the stimulus bottle was determined to be 26.49 square inches (Equation 1). Dimensions of the partial body label were 8.50 in x 3.12 in, calculated using Equation 2.

The partial body label was centered on the bottle, starting 1.35 inches above the bottom of the bottle and ending 1.35 inches below the bottom of the neck of the bottle.
Equation 1: \((8.50 \text{ in} \times 6.00 \text{ in}) \times 0.5195 = 26.49 \text{ in}^2\)

\[
\frac{26.49 \text{in}^2}{8.50 \text{in}} = 3.12 \text{in}
\]

Equation 2:

A label was considered “full body” when it covered the entire bottle, starting at the bottom of the bottle and ending approximately 0.25 inches on the cap.

Both full body and partial body labels were printed, cut, then wrapped around the bottle and sealed. The full body label was heat shrunk onto the bottle using the heat gun. The partial label was not heat shrunk since it was already form fitted to the bottle.

Stimuli Designs

In order to promote generality of the study, six different beverage flavors were used: Water, Mixed Berry, Green Tea, Orange, Coffee, and Lemon-lime (sports/energy drink). In order to eliminate brand recognition or influence, the stimuli were part of a fictitious product line, branded “fixe! Juice Co.” These specific flavors were used based on their popularity in retail, as well as their variety in beverage color (using Water as a clear control). Each bottle was filled with a beverage from a similar colored product: Water with water, Mixed Berry with Berry Juicy Juice®, Green Tea with Arizona® Green Tea, Orange with Minute Maid® Orange Juice, Coffee with Starbucks® Mocha Frappucino, Lemon-lime with Lemon Lime Gatorade®. All test samples were designed and created in the Sonoco Institute of Packaging Design and Graphics in the Harris A. Smith Building at Clemson University using the materials listed above.


*Experimental Design*

The experiment was a 2 (type of label) x 6 (beverage type/flavor) x 2 (age group) study, creating 24 total conditions. The flavor and label type was within-subjects, while age was between subjects. Participants were grouped into two different categories: ages 18-25 and ages 26+ based on previous Mintel (2011) research that suggested people under 25 were more likely to be influenced by graphics than those over the age of 25. For each age group, half of the participants were female, half were male. A full table of participants’ range of ages can be seen in Appendix A. In order to create generality, six different types of beverages were used: Water, Mixed Berry, Orange, Green Tea, Coffee, and Lemon-Lime. In order to control flavor bias, these flavors were rotated in a Latin square, creating six different possible conditions. To avoid the Gutenberg Diagram effect, the stimuli were randomly lined up so that half of the beverages had the full label to the left of the partial label, and the remaining half of the beverage had the partial label to the left of the full label. The flavor and label rotation created six conditions per each age category, shown in Figure 17.
Figure 17. The six conditions used during the study
The stimuli were placed in the beverage and snack aisle, as displayed in Figure 18. Their location on the shelf was eye level for ease of observing, and to get the most accurate information from the eye tracker since the angle of viewing would be as straight as possible given the environment. All of the stimuli bottles (all flavors and all labels) were present to all participants. No other beverages were present in the store. Each individual bottle was an AOI, as shown in Figure 19.

Figure 18. Snack aisle containing stimulus AOA
After participants were calibrated, each were given a shopping list (shown in Figure 20) and told to shop as they normally would for themselves at a grocery store. Shopping lists were randomized, and contained other items in order to obfuscate the purpose of the study. Participants were not given time or price restraints while shopping as to provide their full attention on the products and make a decision based on non-price related factors. Items in the grocery store were all randomly numbered so that participants would write the number of the product they wished to purchase on the space provided on the shopping list. Upon exiting the store, the Tobii® Glasses were removed, and the participant was asked to complete a survey.
Statistical Analysis

Various eye movement metrics were used for the study to determine which labels participants preferred. Time to first fixation is the amount of time (seconds) required for the participant to make the first fixation on the AOI once the stimulus is shown. Total fixation count is the total number of fixations a participant makes in an AOI. Total fixation duration is the total amount of time a participant spent looking at an AOI.

Recorded eye movement data was manually coded in Tobii® Studio and then exported to Microsoft Excel in order to calculate metric information. The handcoding eye movement classification process involved watching every participant’s recording frame by frame, and counting and logging every fixation on each AOI. A fixation was determined to be a minimum of four gaze points in a single area (Figure 21), since four gaze points makes a fixation of about 120ms at a 30Hz. This is a reasonable minimum
value since the average fixation is 200-250 ms (Sereno, 2003). These gaze points had to be touching each other in order to be considered a fixation. At the start of a fixation, a log entry was added to the video labeled “(AOI#)_S”. The video was then moved forward frame by frame until the end of the fixation, recognized as a saccade away from the group of at least four gaze points. At the end of the fixation, a log entry was added to the video labeled “(AOI#)_E”. This process was repeated for every determined fixation. The data from every recording was then exported to Microsoft Excel to produce eye tracking movement metric data.

Figure 21. Examples of gaze points and determining fixations, shown in orange circle
This eye tracking metric data was then statistically analyzed using the statistical computation program “R”. The experiment was a 2 (type of label) x 6 (beverage type/flavor) x 2 (age group) study, creating 24 total conditions. The flavor and label type was within-subjects, while age was between subjects. A 3-way ANOVA test was conducted in R with fixed factors of type of label, beverage type, and age group, to provide a p-value for each of the three metrics. An ANOVA test will give a p-value, which is the probability that random sampling leads to a difference in sample means as large as that observed. A p-value less than or equal to significance level (alpha) of 0.05 (95% confidence interval) was considered statistically significant and lead to a rejection of the null hypothesis for each metric. The null hypotheses for the various metrics and conditions are that the groups being compared are equal.

A power analysis is a statistical method that can be used to test the size of the effect by examining how large the sample size would need to be in order for the effect to be significant. A post-hoc power analysis with confidence interval 95% was conducted with the program “R” in order to estimate the sample size needed for significant differences to be reported by particular metrics.
A total of 28 participants participated in the study and provided calibrated eye tracking data. Statistical significance was shown for two of the metrics and for the preference test, indicating that data from 28 participants was sufficient to elicit statistical significance. A post-hoc power analysis was conducted for those metrics for which no significance differences were observed. For these, it was estimated that over 1,000 participants would be needed to possibly show significance (at a 95% confidence interval), suggesting that the effect measured was not likely to be strong.

Eye Tracking Results and Statistics

The following eye movement metrics were extracted through Tobii Studio and calculated using Microsoft Excel: total fixation count, total fixation duration, time to first fixation, and visit count. This data was then statistically analyzed using the program “R”. The code used for this analysis can be found in Appendix B, while the output with specific p-values is detailed in Appendix C. For all metrics, obtained data was statistically analyzed using within subjects, 3-way repeated measures ANOVA with fixed factors of label, flavor and age. A 95% confidence interval was used.

Total fixation count is a metric that determines the total amount of fixations on a specific AOI. There was a significant difference (p<0.05) in the total amount of fixations between full and partial size graphic labels, favoring partial labels (figure 22).
Figure 22. Total fixation count difference between label types.

The decision was to reject the null hypothesis for this statistic. The difference in total fixation count shows that the partial body labels had more within-AOI fixations than the full body labels. There was no significant difference (p>0.05) between flavor and label size, indicating that flavor did not influence choice, making the decision to not reject the null hypothesis (Figure 23).
Figure 23. Total fixation count difference between label types with regard to flavor.

There was no significant difference between age and label (Figure 24), nor was there a significant difference between age and flavor choice. The decision was to not reject the null hypothesis.
Figure 24. Total fixation count difference between label types with regards to age.

Total fixation duration is the total amount of time, in seconds, of fixations within a given AOI. There was no significant difference in total fixation duration between label sizes (Figure 25).
There was also no significant difference found between flavor choice and label sizes (Figure 26).

Figure 25. Total fixation duration difference between label types.

Figure 26. Total fixation duration difference between label types with regards to flavor.
Age did not affect this metric either, as there was no significant difference between age and label sizes, or age and flavor choice (Figure 27). The decision was to not reject the null hypothesis.

Figure 27. Total fixation duration difference between label types with regards to age.

The lack of difference between total fixation duration within label sizes shows that both types were viewed for the same amount of time before making a purchase decision.

The fact that the partial body labels drew more fixations, but did not draw a longer total fixation duration could be explained by the fact that the bottle with the partial body label was composed of two parts: the label and the visible product. Participants may have devoted more fixations on the partial body label bottle because they were shifting
from fixating on the label to the product, and vice-versa. The full body label did not have any product showing, therefore potentially making less within-AOI transitions.

Time to first fixation tells the amount of time, in seconds, it took for the first fixation to occur in a given AOI, starting when the stimulus is shown. No significant difference was found for time to first fixation between label sizes, or flavor choice and label size, as shown in Figure 28.

![Figure 28. Time to first fixation difference between label types.](image-url)
There was also no significant difference found for time to first fixation between age and label choice (Figure 29), or age and flavor choice (Figure 30). The lack of difference between time to first fixation shows that neither product was an initial attention grabber.
Visit Count, also known as *saccadic crossovers*, is a metric that indicates how many times an AOI was visited. A visit occurs when a participant transitions between AOIs, e.g., a participant looking at an AOI, then looking off the AOI and then looking at the AOI again would have a visit count of two. There was a significant difference in this metric between label sizes, favoring partial body labels, shown in Figure 31.
No significant difference was found between label sizes and flavor (Figure 32).

Age did not have an effect on this metric, as there was no significant difference between
age and label sizes (Figure 33), or age and flavor.
Figure 32. Total visit count difference between label types with regards to flavor.

Figure 33. Total visit count difference between label types with regards to age.
The difference in visit count between label sizes shows that participants returned
to looking at partial body labels more often than full body labels.

*Shopping Results and Statistics*

According to selections made on participants’ shopping lists, beverages with a
partial body label were significantly preferred over beverages with a full body label.
Those with partial body labels were chosen a total of 18 times, while those with full body
labels were chosen a total of ten times. The decision was to reject the null hypothesis.
In regards to flavor, there was no significant difference in selection when taking flavor
into account, leading to decision to fail to reject the null hypothesis. The mixed berry
juice was chosen the most at nine times, followed by green tea, lemon-lime, orange,
water, and coffee, which was not chosen by any of the participants. A breakdown of
beverages chosen based on flavor and size of label is shown in table 3.

<table>
<thead>
<tr>
<th></th>
<th>Berry</th>
<th>Green Tea</th>
<th>Lemon-lime</th>
<th>Orange</th>
<th>Water</th>
<th>Coffee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Partial</td>
<td>6</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

*Survey Results*

The survey was given to participants in order to provide qualitative data regarding
their preferences. A total of 25 participants (89.3%) claimed that they were the primary
shoppers in their household, suggesting that these participants are the ones making
purchase decisions in their household. Most (53.6%) participants claimed that they shop for single serving beverages on a weekly basis, suggesting the abundant frequency of this product’s purchase (Figure 34). The consumer environment was effective in that 78.6% of participants claimed that they felt CUShop™ was a realistic shopping experience.

![Frequency of Single Serving Bottled Beverage Purchases](image)

**Figure 34.** Frequency of single serving beverage purchases made by participants

With respect to influences on making a purchase decision, graphics were the dominant factor, regardless of age, with 96.4% of participants claiming that graphics were either somewhat or very influential (Figure 35). Participants often stated that graphics were the most influential when approaching food packaging in which the brand or product is unfamiliar, or if the product itself is not visible (Figures 36 and 37). These results imply that graphics have a strong influence on purchase decisions for the participants used in the study. It is advisable to point out that participants may have been
influenced to show a preference for graphics based on their interests (if they were a graphics or marketing major, or worked in the graphics industry), or the fact that the study was conducted in a packaging design and graphics building. But for purposes of this study, this information was only used to further understand eye tracking and preference results, not to draw statistics from. This would not have had an effect on searching during the experiment because of the immersive environment and the given search task.

![Influence of Graphics on Beverage Purchase Choice](image_url)

Figure 35. Influence of graphics on beverage purchase choice by participants
Figure 36. Aspects that participants base their purchase decisions off of when the product itself is not showing.

Figure 37. Aspects that participants base their purchase decisions off of when approaching products or brands that they are unfamiliar with.
This information alone would suggest that full body graphics would be preferred. In this study, both beverages had the same graphics; the difference being the partial body label had less actual material containing graphics since it was approximately half the size of the full body label. This eliminates the potential of graphic design solely influencing a purchase decision, since both had the same graphic design. When presented with the same graphics on two different sized labels, the partial label was preferred. Participants claimed that the beverage with the partial body label seemed to be a higher quality, and also appeared to be less cluttered (Figures 38 and 39).

![Beverage Perceived as Being Higher Quality](image)

Figure 38. Beverage perceived as being higher quality by participants based on label
Many of the participants that perceived the partial label to be a higher quality claimed they liked being able to see the actual product in order to assess visual aspects of the product (color, thickness, etc) to judge its quality. Participants that perceived the full label to be a higher quality claimed that more label/materials were used to package it, so it was a more expensive product, which correlates to a higher quality product. Participant 12 said that he preferred the full label because he could see some sediment in one of the liquids. Participant 22 said that she believed light exposure was bad for a beverage, thus preferring the full label. Participants that perceived the beverages to be the same quality said so for different reasons, including “None of the beverages seemed attractive,” “just needed orange juice,” “they all looked to be the same brand,” and “the full design caught my eye, but I also liked seeing what was inside the bottle.”
Those participants that preferred to see the product versus only graphics claimed they liked to see what they are buying. They claimed that they could tell the quality of the product better when they could actually see it, and make sure that the product was still safe, i.e. “no mold.” Those that preferred graphics said so because they already know what they were getting and were basing their decision off of how the product is presented, i.e display quality.
CHAPTER FIVE

CONCLUSION

A current trend in beverage packaging marketing is the use of full body heat shrink sleeves as labels. Label companies will advertise these sleeves as a tamper evident device and a marketing tool that can cover an entire bottle. With respect to product marketing, the labels provide 360 degrees of bottle coverage, and are often claimed to provide enhanced shelf appeal, and to cover odd shaped bottle designs. Specific full body label specifications and qualities are limited to those of the material and manufacturer, dependent on end usage. Full body labels can use up to 50% more label material on average, increasing material costs, and incurring higher application cost. But many brand owners are willing to use full body labels because they believe that they can attract more attention than partial body labels, and therefore increase sales.

The overall hypothesis of the study was that the full body graphic labels would attract more attention on the shelf than the partial body graphic labels when accounting for flavor and age. This hypothesis was rejected, as there were significant results showing that both labels drew the same amount of attention in terms of fixation duration and time to first fixation. Partial labels were favored in total fixation count and visit count metrics; however, these metrics may be reflective of participants shifting attention from the label to the visible product within the same area of interest.

It was also hypothesized that full body labels would be chosen more often to “purchase” by participants on their shopping checklist. This hypothesis was also rejected,
as shopping list results significantly favored partial labels over full labels. According to survey results, participants claimed that they liked being able to see the product before buying it, ensuring product quality and confirming what they were getting.

Contrary to previous research that stated age had an effect on the ability of graphics to affect purchase decisions, it was found that age did not have significantly an effect on the results of this study. In addition, the various flavors used to control preference bias did not significantly affect the results of the study either.

Despite the benefit of having more graphics, the data analyzed in this research shows that under the conditions of this study, full body labels do not have an advantage over partial body labels in terms of shelf presence or purchase choice. One limitation of this study is that the information provided on both labels had to be the same in order to remain constant, when in reality full body labels can be used to portray more information than partial labels due to their increase surface area. However, even with the same amount of information, participants claimed that the partial label appeared less cluttered than the full body label.

Although the results of this study are contrary to what is claimed by label companies in terms of shelf appeal, it is possible that full body labels aren’t used to attract greater attention solely to the label, but for other reasons, such as to create a greater brand awareness overall. Oftentimes when brands convert to full body graphics they undergo complete branding re-designs, not just an enlargement of their current design. This could attribute to companies’ claims that full labels caused an increase in sales. The study kept label design constant in order to eliminate the design variable, but
various designs could be employed to emphasize brand information and establish recognition. Naturally, the design itself could have been a factor in the results, but eye tracking data showing that participants fixated equally to both labels shows that this was not the case. Neither design had an advantage over the other outside of label size.

Since point of sale marketing is impulse buying, as most purchase decisions are made at the shelf, the use of full body graphic labels can be reconsidered since they did not attract more attention than partial body graphic labels. Full body labels may provide other benefits such as additional brand information, odd shaped bottle labeling opportunities, and tamper evident seals, all of which could be researched in future studies.
Similar research methods could be used for future research in labeling and product coverage. Different products could be used; along with other different types of label coverage not used here, e.g. full body label coverage with product showing through the label through windows.

Various products and packaging materials could also be studied, as different products could yield different preferences for product coverage or exposure.

One limitation of this study is that this only tested one particular type of graphic design. Other graphic design methods could also be tested on similar labels to those of this study.

The study showed that visually appealing beverages benefitted from being visible, future studies could employ different beverages that are less appealing (‘off’ color, sediment, etc.) to see if that has an effect on label preference. It is also possible that covering up the beverage is desired by the brand owner if the product itself is not visually appealing, i.e. there is sediment or separation within the liquid.

Different demographics could also be used in order to see if they have an influence on results.
APPENDICES
Appendix A

Participant Ages

<table>
<thead>
<tr>
<th>Ages</th>
<th>Median</th>
<th>Mean</th>
<th>Mode</th>
<th>Range</th>
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</thead>
<tbody>
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<td>26.5</td>
<td>30.4</td>
<td>20.0</td>
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<td>29</td>
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</tr>
<tr>
<td>68</td>
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</tr>
</tbody>
</table>

Figure A-1: Specific ages of participants
Appendix B

Input Code for Statistical Analysis in “R”

data = read.table("data.csv",sep="",header=TRUE)
data$Subject <- factor(data$Subject)
data$Flavor <- factor(data$Flavor)
data$AgeGroup <- factor(data$AgeGroup)
data$Full <- factor(data$Full)
attach(data)

# within each group
summary(aov(FC ~ Full*Flavor*AgeGroup + Error(Subject + Subject:Full + Subject:Flavor),data))
print(model.tables(aov(FC ~ Full*Flavor*AgeGroup,data),"means"),digits=3)
pairwise.t.test(FC, Flavor, p.adjust="none")
summary(aov(TTFF ~ Full*Flavor*AgeGroup + Error(Subject + Subject:Full + Subject:Flavor),data))
print(model.tables(aov(TTFF ~ Full*Flavor*AgeGroup,data),"means"),digits=3)
pairwise.t.test(TTFF, Flavor, p.adjust="none")
summary(aov(VC ~ Full*Flavor*AgeGroup + Error(Subject + Subject:Full + Subject:Flavor),data))
print(model.tables(aov(VC ~ Full*Flavor*AgeGroup,data),"means"),digits=3)
pairwise.t.test(VC, Flavor, p.adjust="none")
summary(aov(Dur ~ Full*Flavor*AgeGroup + Error(Subject + Subject:Full + Subject:Flavor),data))
print(model.tables(aov(Dur ~ Full*Flavor*AgeGroup,data),"means"),digits=3)
pairwise.t.test(Dur, Flavor, p.adjust="none")

# power test
mnP <- array(1:length(data$Full))
mnF <- array(1:length(data$Full))
sd <- array(1:length(data$Full))
dd <- array(1:length(data$Full))
for (i in 1:length(data$Full)) {
  arrF = data$Dur[which(Full == 1)]
  mnF[i] = mean(arrF)
  arrP = data$Dur[which(Full == 0)]
  mnP[i] = mean(arrP)
  sd[i] = max(sd(arrP),sd(arrP))
  dd[i] = mnF[i]-mnP[i]
}
power.t.test(power=.95,sig.level=.05,sd=max(sd),delta=min(dd))
# generate an output of means and SEs
out <- file("toni.dat","w")
mn <- array(1:length(levels(data$Full)))  # note [1:n] index
se <- array(1:length(levels(data$Full)))  # note [1:n] index
for (i in 1:length(levels(data$Full))) {
  arr = data$FC[which(Full == levels(data$Full)[i])]
  mn[i] = mean(arr)                      # mean
  se[i] = sd(arr)/sqrt(length(arr))      # SE = SD/sqrt(n)
  cat(i,"",file=out)                    # col 1
  cat(mn[i],se[i],"n",file=out)         # col 2 3
}
close(out)
detach(data)

Figure B-1: Statistics code for eye movement metrics, and power testing.
data = read.table("toni2.csv",sep="",header=TRUE)
#data$Participant <- factor(data$Participant)
#data$Flavor <- factor(data$Flavor)
#data$Selection <- factor(data$Selection)
attach(data)

  # full/partial diffs
  t.test(data$Selection)

  # account for flavor
  pairwise.t.test(data$Selection, data$Flavor, p.adjust="none")

detach(data)

Figure B-2: Statistics code for shopping results.
Appendix C

Output from Statistical Analysis in “R”

R version 2.10.1 (2009-12-14)
Copyright (C) 2009 The R Foundation for Statistical Computing
ISBN 3-900051-07-0

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> data = read.table("data.csv",sep="",header=TRUE)
> data$Subject <- factor(data$Subject)
> data$Flavor <- factor(data$Flavor)
> data$AgeGroup <- factor(data$AgeGroup)
> data$Full <- factor(data$Full)
> attach(data)
>
> # within each group
> summary(aov(FC ~ Full*Flavor*AgeGroup + Error(Subject + Subject:Full + Subject:Flavor),data))

Error: Subject:Full
             Df Sum Sq Mean Sq F value Pr(>F)
Full           1 38.003  38.003  4.5885 0.04172 *
Full:AgeGroup  1  0.077   0.077  0.0093 0.92396
Residuals     26 215.337   8.282
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Error: Subject:Flavor
<table>
<thead>
<tr>
<th>Df</th>
<th>Sum Sq</th>
<th>Mean Sq</th>
<th>F value</th>
<th>Pr(&gt;F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavor</td>
<td>5</td>
<td>364.1</td>
<td>72.817</td>
<td>2.2394</td>
</tr>
<tr>
<td>Flavor:AgeGroup</td>
<td>5</td>
<td>324.2</td>
<td>64.842</td>
<td>1.9941</td>
</tr>
<tr>
<td>Residuals</td>
<td>130</td>
<td>4227.1</td>
<td>32.516</td>
<td></td>
</tr>
</tbody>
</table>

---

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

P value adjustment method: none

> summary(aov(TTFF ~ Full*Flavor*AgeGroup + Error(Subject + Subject:Full + Subject:Flavor),data))

---

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Error: Subject:Full

<table>
<thead>
<tr>
<th>Df</th>
<th>Sum Sq</th>
<th>Mean Sq</th>
<th>F value</th>
<th>Pr(&gt;F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td>1</td>
<td>2.0071e+10</td>
<td>2.0071e+10</td>
<td>4.1077</td>
</tr>
<tr>
<td>Full:AgeGroup</td>
<td>1</td>
<td>1.2576e+06</td>
<td>1.2576e+06</td>
<td>0.0003</td>
</tr>
<tr>
<td>Residuals</td>
<td>26</td>
<td>1.2704e+11</td>
<td>4.8861e+09</td>
<td></td>
</tr>
</tbody>
</table>

---

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Error: Subject:Flavor

<table>
<thead>
<tr>
<th>Df</th>
<th>Sum Sq</th>
<th>Mean Sq</th>
<th>F value</th>
<th>Pr(&gt;F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavor</td>
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<td>2.3371e+10</td>
<td>4674119404</td>
<td>0.7599</td>
</tr>
<tr>
<td>Flavor:AgeGroup</td>
<td>5</td>
<td>3.8592e+10</td>
<td>7718343040</td>
<td>1.2548</td>
</tr>
<tr>
<td>Residuals</td>
<td>130</td>
<td>7.9965e+11</td>
<td>6151132669</td>
<td></td>
</tr>
</tbody>
</table>

P value adjustment method: none

> summary(aov(VC ~ Full*Flavor*AgeGroup + Error(Subject+ Subject:Full + Subject:Flavor),data))

---

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Error: Subject:Full

<table>
<thead>
<tr>
<th>Df</th>
<th>Sum Sq</th>
<th>Mean Sq</th>
<th>F value</th>
<th>Pr(&gt;F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td>1</td>
<td>10.714</td>
<td>10.7143</td>
<td>5.7310</td>
</tr>
<tr>
<td>Full:AgeGroup</td>
<td>1</td>
<td>0.178</td>
<td>0.1780</td>
<td>0.0952</td>
</tr>
<tr>
<td>Residuals</td>
<td>26</td>
<td>48.608</td>
<td>1.8695</td>
<td></td>
</tr>
</tbody>
</table>

---

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Error: Subject:Flavor
  Df   Sum Sq Mean Sq F value  Pr(>F)
Flavor   5   57.10   11.419  1.7507 0.12758
Flavor:AgeGroup  5  74.46  14.8924  2.2832 0.05007 .
Residuals 130  847.94   6.5226
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

P value adjustment method: none
> summary(aov(Dur ~ Full*Flavor*AgeGroup + Error(Subject + Subject:Full + Subject:Flavor),data))

Error: Subject
  Df   Sum Sq Mean Sq F value  Pr(>F)
AgeGroup 1 15353830 15353830  3.1245 0.08886 .
Residuals 26 127763949  4913998
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*.' 0.05 '.' 0.1 ' ' 1

Error: Subject:Full
  Df   Sum Sq Mean Sq F value  Pr(>F)
Full     1 2284096 2284096  2.5891 0.1197
Full:AgeGroup 1   860   860  0.0010 0.9753
Residuals 26 22937403  882208

Error: Subject:Flavor
  Df   Sum Sq Mean Sq F value  Pr(>F)
Flavor   5  19711350 3942270  1.7795 0.12144
Flavor:AgeGroup  5  21188799 4237760  1.9129 0.09644 .
Residuals 130 287993958 2215338
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*.' 0.05 '.' 0.1 ' ' 1

> pairwise.t.test(Dur, Flavor, p.adjust="none")

  pairwise comparisons using t tests with pooled SD

data: Dur and Flavor

     Berry  Coffee GreenTea LemonLime Orange
Coffee 0.0040  -   -   -   -
GreenTea 0.0206 0.5677 -   -   -

73
LemonLime 0.0687 0.2847 0.6177  -    -  
Orange  0.1935 0.1117 0.3071  0.6011  -  
Water     0.0086 0.7995 0.7508 0.4143  0.1809  

P value adjustment method: none

> # power test
> mnP <- array(1:length(data$Full))
> mnF <- array(1:length(data$Full))
> sd <- array(1:length(data$Full))
> dd <- array(1:length(data$Full))
> for (i in 1:length(data$Full)) {
+   arrF = data$Dur[which(Full == 1)]
+   mnF[i] = mean(arrF)
+   arrP = data$Dur[which(Full == 0)]
+   mnP[i] = mean(arrP)
+   sd[i] = max(sd(arrP),sd(arrP))
+   dd[i] = mnF[i]-mnP[i]
+ }  
> power.t.test(power=.95,sig.level=.05,sd=max(sd),delta=min(dd))

Two-sample t test power calculation

n = 1608.229  
delta = 164.8988  
sd = 1296.771  
sig.level = 0.05
power = 0.95
alternative = two.sided

NOTE: n is number in *each* group

>  
>  
>  
> # generate an output of means and SEs
> out <- file("toni.dat","w")
> mn <- array(1:length(levels(data$Full))) # note [1:n] index
> se <- array(1:length(levels(data$Full))) # note [1:n] index
> for (i in 1:length(levels(data$Full))) {
+   arr = data$FC[which(Full == levels(data$Full)[i])]
+   mn[i] = mean(arr) # mean
+   se[i] = sd(arr)/sqrt(length(arr)) # SE = SD/sqrt(n)
+   cat(i,"",file=out) # col 1

74
```r
+   cat(mn[i],se[i],"n",file=out)  # col 2 3
+ }
>
> data = read.table("toni2.csv",sep="","header=TRUE)
> #data$Participant <- factor(data$Participant)
> #data$Flavor <- factor(data$Flavor)
> #data$Selection <- factor(data$Selection)
> attach(data)
>
> # full/partial diffs
> t.test(data$Selection)

One Sample t-test

data:  data$Selection
t = 4.1366, df = 28, p-value = 0.0002911
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 0.1914774 0.5671433
sample estimates:
  mean of x
  0.3793103

>
> # account for flavor
> t.test(data$Flavor~data$Selection)
>
> close(out)
> detach(data)
>
>
Figure C-1: Statistics output and power test output
```
REFERENCES


Cardello, A. V. (1994). 10 Consumer expectations and their role in food acceptance.


Stevens, R. (2010). The truth about Tropicana, or how to save $100,000,000 using observational research.


