

Eye Tracking of Recycle Codes on Packaging

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Abstract

The purpose of recycle logos is to inform and encourage consumers to recycle the product or package at the end of its use. In return, less material will end up in a landfill. We conducted a study that seeks to verify if recycle logos play a critical role in influencing consumers to recycle. Furthermore, it also seeks to understand if the type of material used in packaging bears any importance, visually, in choosing eco-friendly packaging. We created four comparison images that were viewed on an eye-tracking monitor to see if the participants notice the recycle logo on the principle display panel of the package. Also, we wanted to understand if the type of substrate was more influential than the recycle logo. It was determined there is no significant difference between the recycle logo and packaging substrate. However, by conducting a brief survey, we can were able to determine that recycle logos were not useful in helping the consumer determine if the package is recyclable or eco-friendly.

Keywords: Eye tracking, recycle logos, recycling, eco-friendly packaging.

Introduction

Labels are used to convey a variety of information on packaging and are increasingly being used to communicate environmental information. However, with the multitude of graphics, designs, verbiage, and other labeling displayed on the package can lead to confusion as to what to do with the package after its end use. Ultimately, without participation of consumers recycling will not improve. [5]. According to the Sustainable Packaging Coalition (SPC), poor coordination between the design of packaging

and the growing diversity of different types of packaging material are further challenges to increasing recycling rates in the United States [14]. By observing natural eye movements when looking at packaging while the consumer tries to identify the recycle code, industry can more accurately position the code on the package for effective and comprehensive labeling for recovery systems.

The goal of this study is to evaluate visual recognition of the recycle chasing arrows symbol with respect to the length of time it takes consumers to identify recycle codes on packaging. Furthermore, the experiment will evaluate whether the participants notice recycle logos on packaging.

Background

Effective recovery of packaging materials through closed loop cycles, particularly recycling, is one of many strategies to heighten environmental profiles of packaging companies. With the increased demand for recycling, the directives and responsibilities of conveying to the consumer recycling information has been shifted towards packaging companies alone. A closed loop system is defined as materials not being disposed of in a landfill. Instead the products are used to make new products such as bottles, cans, or paper [8]. There are three parts of a closed loop system: the packaging manufacturer, the package itself, the consumer, and the recycler. Yet, the performance of packaging recycling is dependent on consumer participation. Recycle labeling on packaging exists; however, there is a lack of uniformity and many are not in visible locations on the package. For example, the

chasing arrows logo can change styles and colors. Often times the recycle symbol is located inconspicuously on the package, forcing the consumer to search for it. The recycle logo can appear anywhere the manufacturer decides to place it on the package. There are no regulations or standards for designing recycle codes, which is regulated by the Federal Trade Commission (FTC). The FTC conveyed to the SPC that they are not able to provide approval of labels [13]. However, what goes on the principle display panels of packages, which are regulated by the Food and Drug Administration, are crowded with graphics and information about the product to motivate sales. When consumers are examining packaging, perception is rapid, and recognition is quick in decision-making processes [4]. So, the question arises: does the consumer see or look for the recycle code in such a short amount of time?

Over the past few decades, there have been increasing concerns about the ecosystem and the effects of packaging waste. Packaging materials accounts for approximately 30 percent of solid municipal waste in the United States, which is the single largest component of waste [10]. As a result, leading companies in the United States such as Coca-Cola, Pepsi, Procter & Gamble, and International Paper have implemented green packaging programs to increase recovery of packaging for recycling or reusable packaging [15]. 61 percent of Americans feel packaging should be recycled. However, according to the Environmental Protection Agency (EPA), the recycling rate is approximately 35 percent, below how consumers feel [11,8]. Although there are efforts from suppliers to increase recycling, there must be consumer involvement to make recycling effective.

In a 2010 Gallup survey, Americans are no more environmentally friendly now, than they were at the turn of the century. The changes of the numbers are negligible, with recycling rates staying the same [11]. A contributing factor to this dilemma is consumers can misunderstand what the recycle logo means, especially regarding plastics packaging. Furthermore, resin codes that

are on plastic packaging were never meant for consumer interpretation nor are they meant for recycle claims. However, the chasing arrow's symbol with one number (1-7), located in the center, leads the consumer to believe the product is recyclable [1]. This motivated the SPC to redesign a new recycle logo with instructions to reduce confusion, improve the reliability and transparency of recyclability claims, and decrease the amount of products going into a landfill. However, no data has been released as to whether the redesigned label has been effective [14].

Frequently, symbols and labels can create confusion and cynicism when used in conjunction with "green," "eco-friendly," or "environmentally safe" claims. For example, the Energy Star label found on electrical appliances is often known for energy savings. However, if the star is used on a dishwasher, it doesn't include information about water usage, which is an area of environmental impact [3]. Since there are no regulations or standards for recycle symbols, companies are able to develop their own proprietary labels in order to differentiate themselves. However, this adds further confusion to the consumer and increases their lack of trust [3].

According to Goldstein et al (1999), there is a Five Second Law, which states how long it takes consumers to select one brand over another. 76 percent of purchases are impulsive and made within 3.5 seconds. The average consumer spends an average of 30 minutes in the grocery store between two and three times per week, immersed with an estimated 35,000 stock keeping units (SKU's). In regards to the hierarchy of visual information, a symbol the one of the last things a consumer sees on a package [17].

Eye tracking is a technique or technology, that an individual's eye movements are measured so that the researcher knows where the subject's eyes are pointing [2]. Considering consumers make impulsive and rapid purchasing decisions, eye tracking would be an efficient apparatus to use in

determining what the consumer identifies on packaging.

When people read sentences, their fixations are usually 60 and 500 ms long, with an average of 250ms. Readers tend to fixate on longer words, yet skip function words, which are shorter [9]. Therefore, it is an objective to determine where the eyes are fixating during orienting and detecting phases of the subject looking at the stimuli. In conjunction with the orienting and detecting, overt and covert attention can be associated with eye movements. Overt attention is attention, which occurs when the eyes are moving, and covert attention occurs when the eyes remain fixated [13]. It is believed that peripheral visual targets are what causes covert attention and cannot be achieved unless overt attention occurs [9]. This brings us to the question: does the package with so many graphics and labels in the peripheral view of the consumer cause too many eye movements and overstimulation to the point they do not see or notice recycle codes?

Eye tracking being used as a method to understand consumer behavior in respect to recycling is relatively new. Few studies have been done, if any, with eye tracking, to understand consumer perceptions of recycling logos. However, the most closely related research found was an ergonomic study to improve performance of recycling chimneys using eye tracking, which had positive results [7].

Hypothesis

The following hypotheses were developed prior to running the experiment:

- H1: The unbleached kraft paperboard packaging material influences the consumer to recycle the package regardless of having a recycle code.
- H2: Excessive peripheral visual targets cause many shifts in attention; therefore, the recycle chasing arrows symbol is unnoticed and erroneously used.



Figure 1: Recycle logo used in experiment that was placed on one of the two cereal box panels in each comparison image.

Methodology

This experiment took place at Clemson University in Clemson, S.C. We used the eye-tracking lab in McAdams to run the experiment. The experiments ran for a week to collect adequate data.

The fundamental premises of this study are to see if individuals notice recycle logos on packaging and to see if the type of packaging substrate influences their decisions when choosing an “environmentally friendly” package. We created an experiment to collect data from participants who limited knowledge of recycling packaging. By using the collected data, we can analyze if the subjects notice the recycle code. We can also analyze whether the substrate influences their decision upon deciding which package is more “eco-friendly.” The subjects also completed a survey after viewing the comparison image. The data collected from the survey will further provide collective information about behaviors and opinions regarding recycling.

Participants

Participants were Clemson University faculty and students. They were randomly chosen to participate in the experiment. Both male and

females between the ages of 18-70 participated in the study. No incentives were offered to participate in the study.

Stimulus

A total of four comparison images were used, with each participant only viewing one comparison image. Each comparison image contained two front-panel images of cereal boxes, one being shown on a unbleached kraft paperboard material and the other on a printed white paperboard. In each instance, either the kraft or the white paperboard contained a recycle logo in the bottom right-hand corner. The recycle logo was present on only one package, not both. Due to the need to randomize the order that participants viewed the panel images, four overall comparison images were developed:

- Left: Kraft, Right: Bleached with recycle code
- Left: Kraft with recycle code, Right: Bleached
- Left: Bleached with recycle code, Right: Kraft
- Left: Bleached, Right: Kraft with recycle code

In each comparison image, the left design was labeled as A and the right design as B. All images for the experiment were designs custom created digitally by using a combination of Adobe Photoshop CS6 and Illustrator CS6. These images were then uploaded to Tobii Studio, and the experiments were conducted on a Tobii Eye-Tracking Model ET-1750 located in the eye-tracking lab at McAdams. Ultimately, each participant view only one of the four comparison images. Four separate Tobii Studio files were created and then run on an alternating cycle. Data from each experiment was then combined together for final analysis.

Apparatus

Eye movements were tracked using Tobii Studio, which is screen-based eye tracking technology. The stimuli are presented on a computer monitor, which can allow the subjects to be tested in a

distraction free environment. Also, the monitor allows for a larger degree of head movement, which can offer a higher level of natural behavior in the testing area, therefore more valid results [16]

Experimental Design

This study was designed to examine to see if consumers see recycle logos on the front of packaging. Furthermore, the study will identify if consumers decide which package is more recyclable based on a more natural substrate versus a printed white substrate. The survey results will help strengthen the experiment by providing information regarding recycling behaviors and opinions.

Often times, consumers do not see recycle codes on packaging. To this end, we created a natural kraft paperboard package and a basic white paperboard package to see if the substrate is more influential than the recycle logo. These two packages have four variations, alternating the recycle logo on each package. Only one package has a recycle logo on the front. At the end of each experiment, the participant will choose which package they felt most resembled eco-friendly package.

All four comparison images had the areas of interest (AOI's) marked, which were the recycle logo, the entire printed white paperboard, and the entire kraft paperboard. The order that each participant saw one comparison image was randomized, and each participant had five seconds to view the image.

The eye tracking data was processed and analyzed using Tobii Studio to determine fixation points and duration time spent on the image. These results were visualized by generating heat maps, time to first fixation (TTFF) graphs and total fixation duration (TFD) graphs. The survey was integrated into each individual's experiment using Tobii Studio. The survey was later analyzed and compiled through the same program. Each experiment ran in 15-minute intervals.

Procedures

Those who volunteered to participate took part in a five-minute or less experiment. The experiment consisted of three aspects: (1) participant calibration with the Tobii Eye-tracking Model ET-1750, (2) five-second viewing of a comparison image, and (3) a brief survey.

1. Participant Calibration (<2 minutes)

Prior to each experiment, the researcher calibrated the participant's eyes to the Tobii Eye-tracking T60XL Monitor. Calibration required the participant's eyes to follow a series of moving red dots across the screen.

2. Viewing (5 seconds)

Upon completion of calibration, participants were shown a comparison image consisting of two cereal box front-panel designs, with the left design labeled as A and the right as B. The time to view the comparison image lasted five seconds. Participants had been pre-instructed with opening screen instructions to choose which of the two designs in the comparison image appeared as more sustainable.

3. Survey (2-3 minutes)

After finishing viewing the comparison image, participants completed a brief survey, including which design (A or B) appeared more sustainable, and was their decision based on seeing a recycle logo.

Once all participants had completed their experiments, all data was compiled and organized within Tobii Studio to generate graphs to show trends within the participant population. The entire experiment was run over four days, with testing being conducted during the first two and data collection and analysis on the final two.

Results

We recruited approximately 50 students and faculty members of Clemson University to

participate in the study. Each participant viewed one of the four comparison images for five seconds. A proportional comparison between the time to first fixation of the recycle logo AOI and the participants survey answer of whether they actually saw the recycle logo. While quantitative results may provide information as to what the participant saw, qualitative information obtained from the survey is also important. The goal of the analysis is to obtain information to see if the recycle logo is erroneously used or not.

Total Time to First Fixation. We limited analysis of eye-tracking results to total time of fixations and total fixation durations to track whether the participant identified seeing the recycle logo. According to Dr. Andrew Duchowski (2007), the fixation duration range is between 150ms to 600ms[6].

We conducted a basic F-test at a 95 percent confidence interval to test for equal variances. It was determined that each comparison image showed no significant variances when compared to each other. The results are:

- The package that was printed white paperboard with recycle logo was compared to the printed white paperboard. The results showed, ($F(20,20)=0.81$, $P=0.64$ n.s.). Refer figure 4.
- The package printed white with recycle logo was compared to the unbleached kraft paperboard package. The results showed, ($F(20,20)=0.74$, $P=0.50$ n.s.). Refer figure 5.
- The white paperboard package with recycle logo compared to the unbleached kraft package with logo showed ($F(20,20)=1.55$, $P=0.33$ n.s.). Refer figure 6.
- The white paperboard package without the recycle logo was compared to the kraft paperboard with no logo. The results showed ($F(20,20)=0.91$, $P=0.84$ n.s.) Refer figure 7.

- The white paperboard package without the recycle logo was compared to the kraft paperboard with the recycle logo. The results showed ($F(20,20)=1.92$, $P=.155$ n.s.) Refer figure 8.
- The kraft paperboard package without the recycle logo was compared to the kraft paperboard with the recycle logo. The results showed ($F(20,20)=2.10$, $P=0.11$ n.s.) Refer figure 9.

A proportional test compared what the participants saw compared their answer to the survey question of did they see the recycle logo. It again showed no significance with $P=0.16$.

Total Fixation Duration. In contrast to Time To First Fixation, which revealed the amount of time until participants fixated on an AOI (area of interest), Total Fixation Duration shows the amount of time participants fixated on a particular AOI. This is helpful in identifying what AOI's have the strongest visual attraction.

We conducted a two-sample t-test at a 95 percent confidence interval. The results are as follows:

- The package that was printed white paperboard with recycle logo was compared to the printed white paperboard. The results showed, $T(40, 0.05)=0.49$ n.s. Refer to figure 13.
- The package printed white with recycle logo was compared to the unbleached kraft paperboard package. The results showed, $T(40,0.05)=0.23$ n.s. Refer to figure 14.
- The white paperboard package with recycle logo compared to the unbleached kraft package with logo showed $T(40, 0.05)=0.75$ n.s. Refer figure 15.
- The white paperboard package without the recycle logo was compared to the kraft paperboard with no logo. The results

showed $T(40, 0.05)=0.24$ n.s. Refer figure 16.

- The white paperboard package without the recycle logo was compared to the kraft paperboard with the recycle logo. The results showed $T(40, 0.05)=0.17$ n.s. Refer figure 17.
- The kraft paperboard package without the recycle logo was compared to the kraft paperboard with the recycle logo. The results showed $T(40, 0.05)=0.43$ Refer figure 18.

Survey. Out of 52 participants the results concluded 69 percent did not see the recycle logo. 79 percent felt the participants felt the unbleached kraft paperboard was the most recyclable and eco-friendly.

Heat Maps. The heat maps were resourceful in determining if the participants saw the recycle logo. According to the heat maps, the recycle logo was seldom identified on each comparison image.



Figure 10: Heat maps obtained from participants' gaze path.

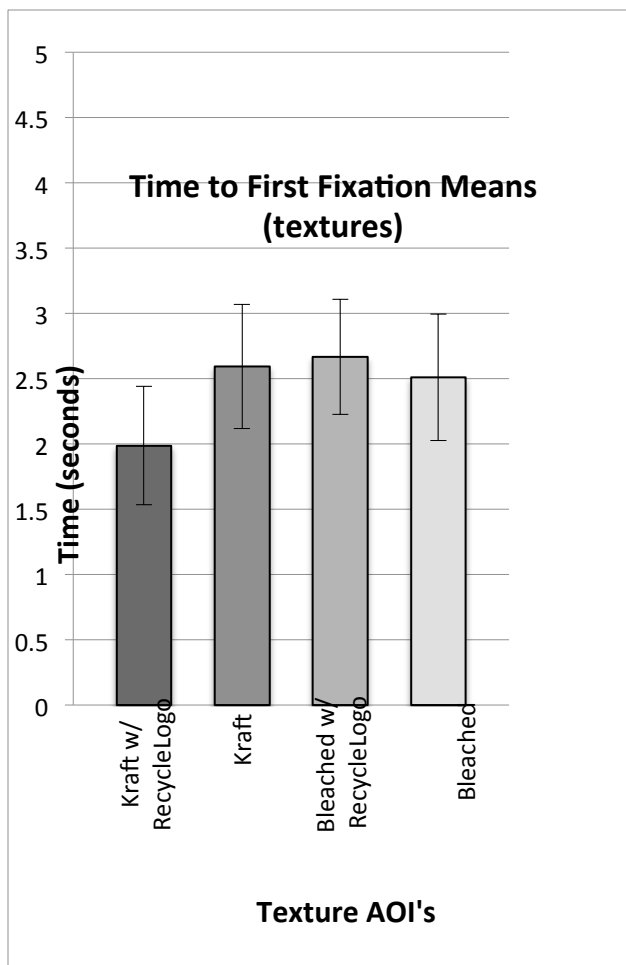


Figure 2: Bar chart showing TTFF mean results for the four texture AOI's including SE.

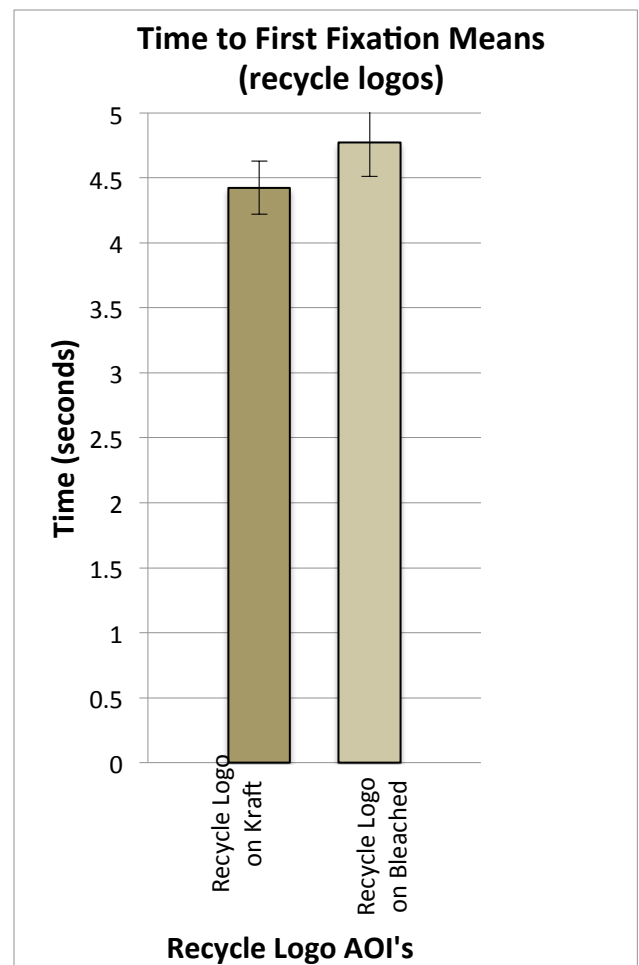


Figure 3: Bar chart showing the TTFF mean results for the two recycle logo AOI's including SE.

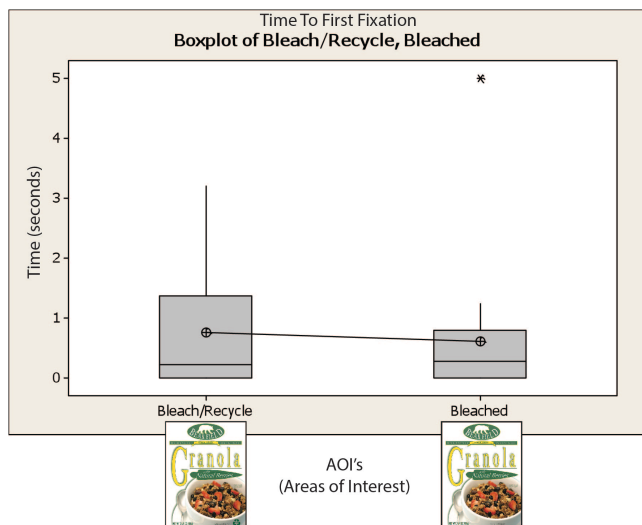


Figure 4: TTFF Boxplot comparing Bleach with recycle logo vs. Bleached without recycle code AOI's.

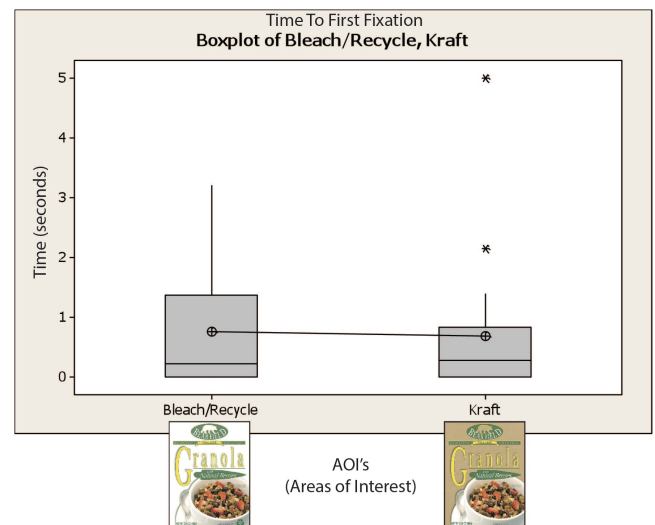


Figure 5: TTFF Boxplot comparing Bleach with recycle logo vs. Kraft without recycle logo AOI's.

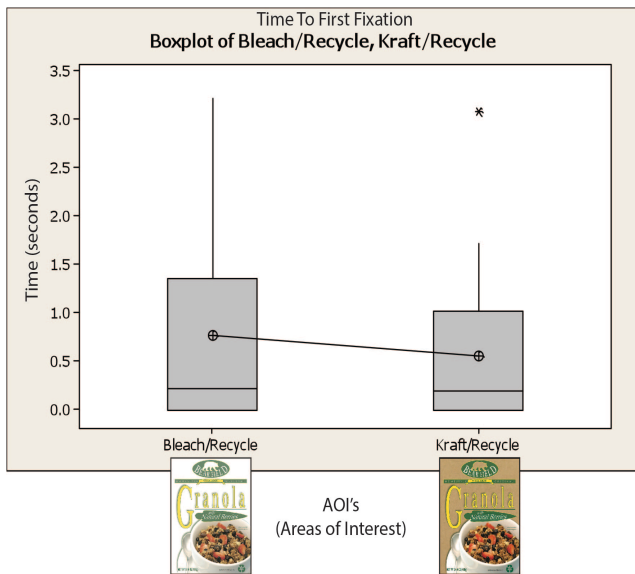


Figure 6: TTFF Boxplot comparing Bleach with recycle logo vs. Kraft with recycle logo AOI's.

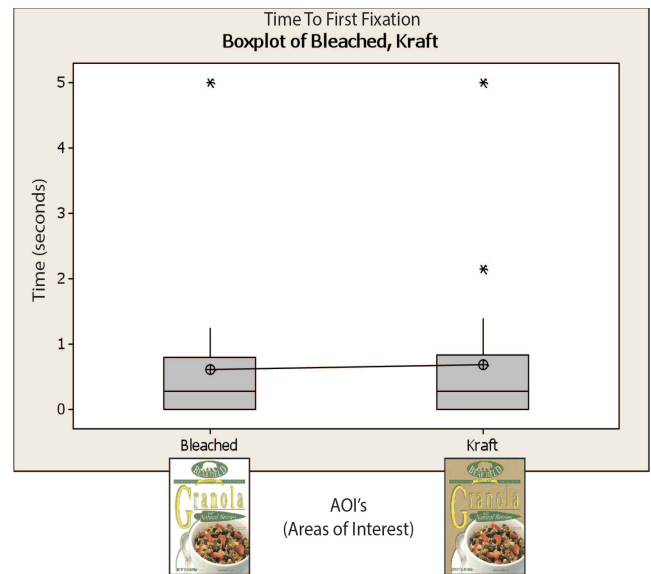


Figure 7: TTFF Boxplot comparing Bleach without recycle logo vs. Kraft without recycle logo AOI's.

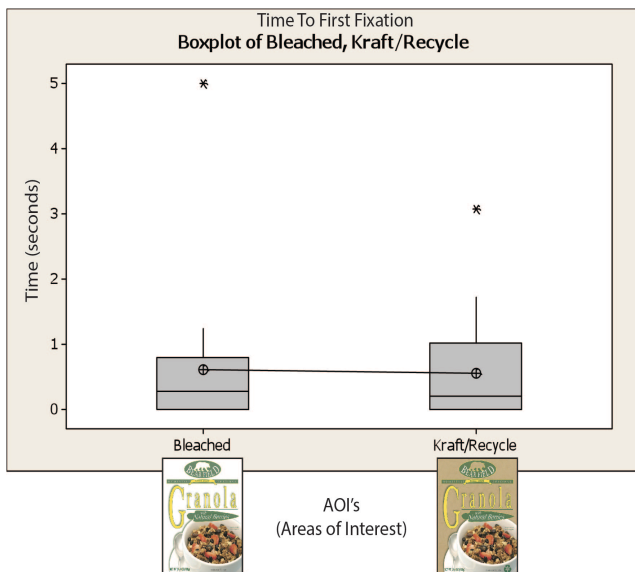


Figure 8: TTFF Boxplot comparing Bleach without recycle logo vs. Kraft with recycle logo AOI's.

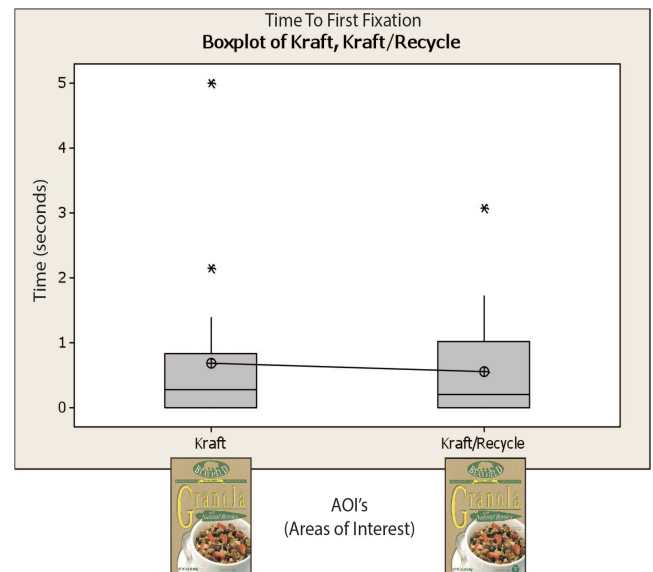


Figure 9: TTFF Boxplot comparing Kraft without recycle logo vs. Kraft with recycle logo AOI's.

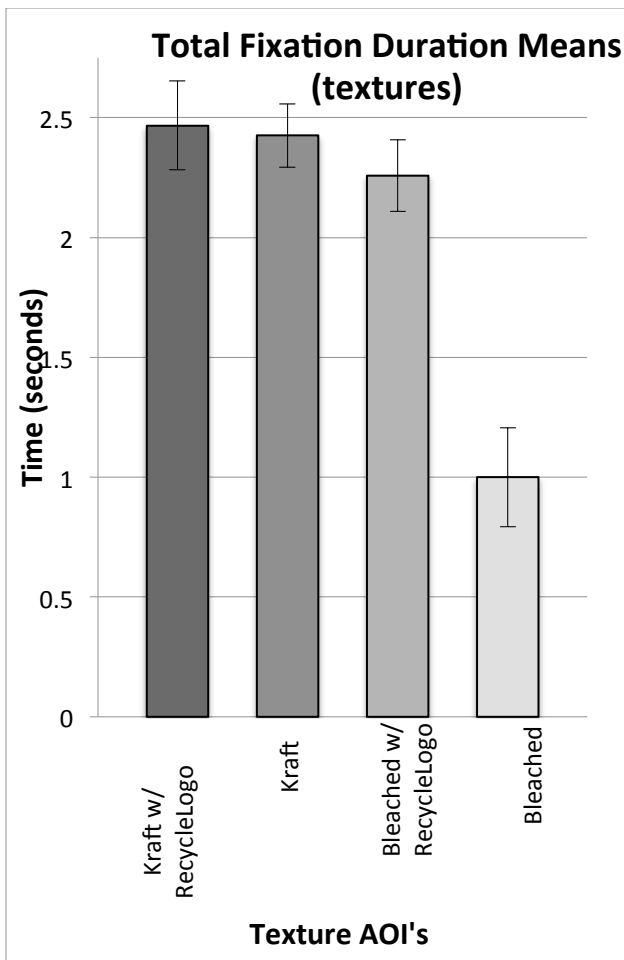


Figure 11: Bar chart showing TFD mean results for the four texture AOI's including SE.

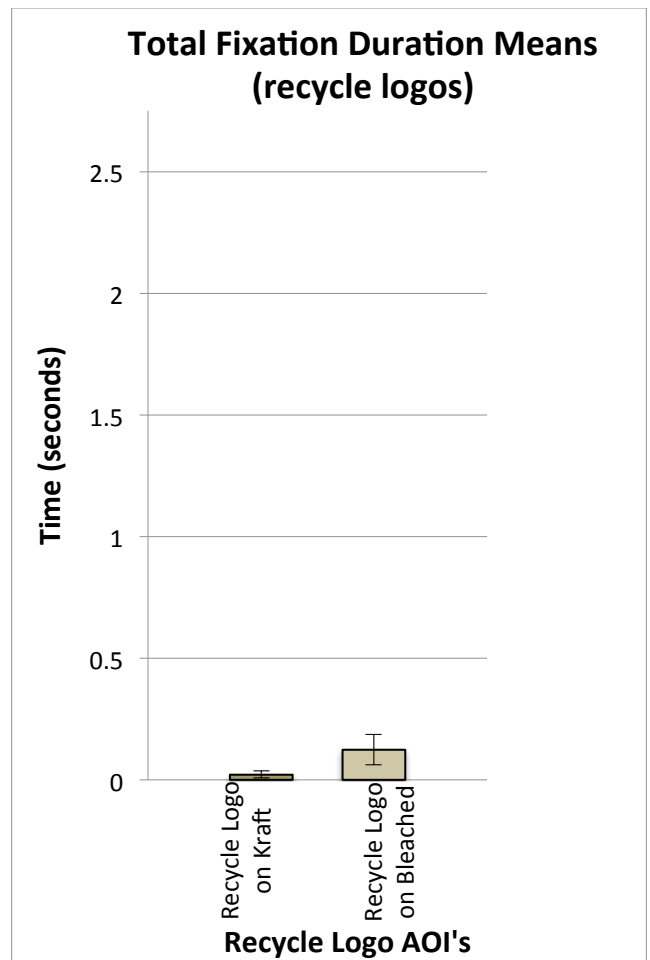


Figure 12: Bar chart showing the TFD mean results for the two recycle logo AOI's including SE.

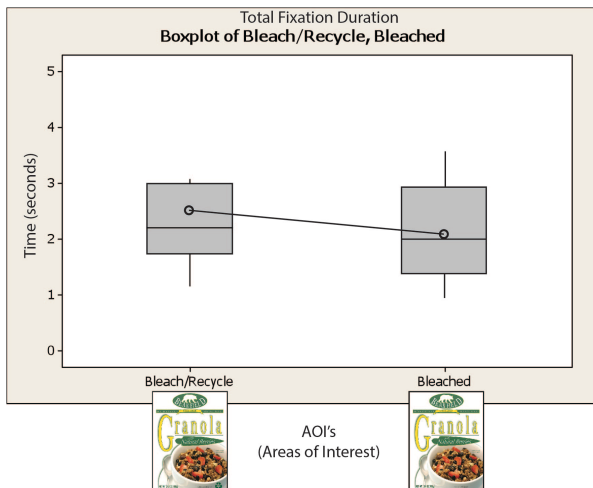


Figure 13: TFD Boxplot comparing Bleach with recycle logo vs. Bleach without recycle logo AOI's

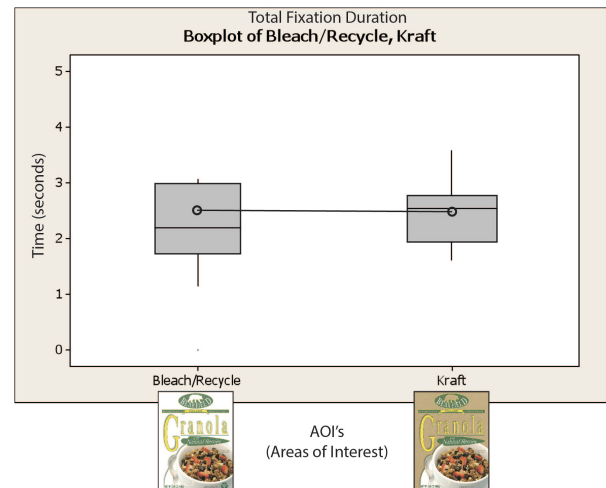


Figure 14: TFD Boxplot comparing Bleach with recycle logo vs. Kraft without recycle logo AOI's.

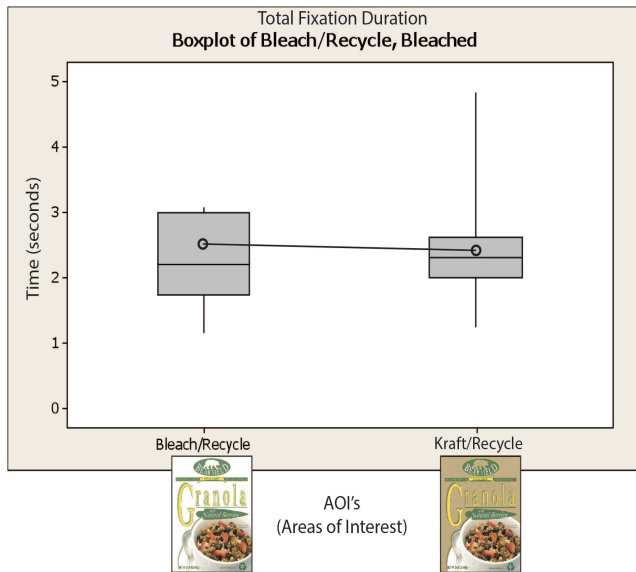


Figure 15: TFD Boxplot comparing Bleach with recycle logo vs. Kraft with recycle logo AOI's.

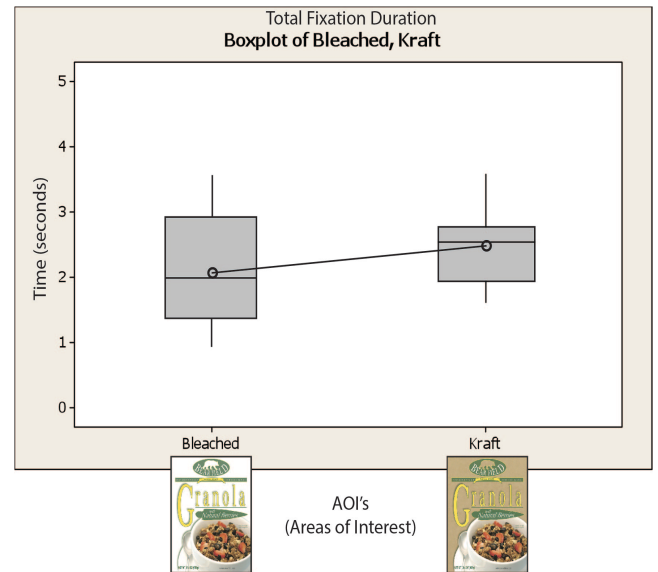


Figure 16: TFD Boxplot comparing Bleach without recycle code vs. Kraft without recycle logo AOI's.

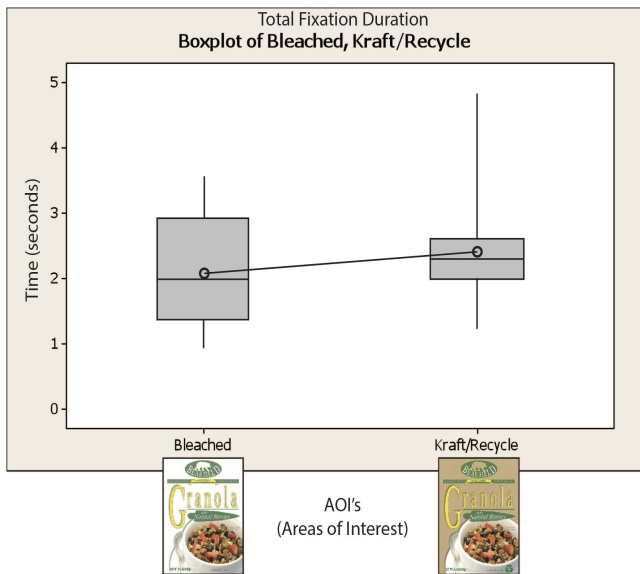


Figure 17: TFD Boxplot comparing Bleach without recycle logo vs. Kraft with recycle logo AOI's.

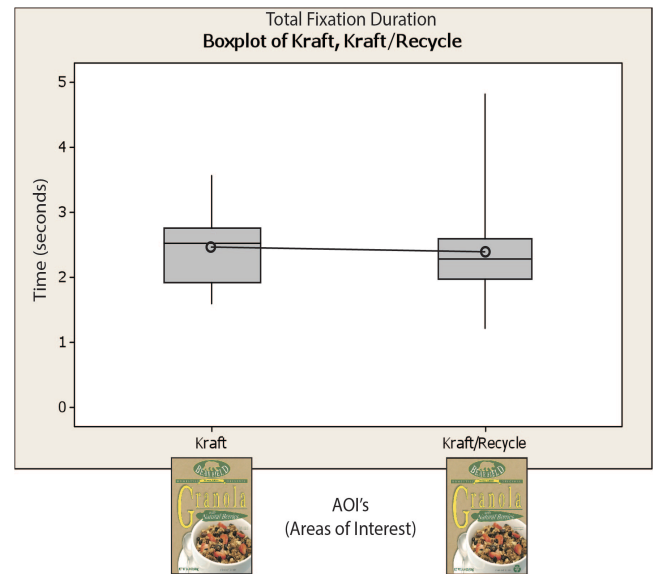


Figure 18: TFD Boxplot comparing Kraft without recycle logo vs. Kraft with recycle logo AOI's.

Discussion

With this study, we were looking to see if recycle logos play a significant role in determining whether the customer thinks the package is more eco-friendly. Our first hypothesis was to determine if the type of paperboard would be more influential for the customer to determine if it was eco-friendly. However, the results were not significant enough to determine the validity of the hypothesis. Our second hypothesis was to that the recycle code goes unnoticed. Based on the heat maps, the recycle code was barely fixated upon. However, the data analysis concluded there was no significant difference either.

The four comparison images showed to have no significant differences between them, regardless of what type of paperboard and location of the recycle logo. On the contrary, that may have been the consequence of the short duration of time, which was five seconds.

The recycle logo seeks to inform the consumer that the package is recyclable. Consequently, the consumer will place the package at the end of its use to be recycled. The survey gave us cognitive information about what the consumers think of recycling. Most participants felt that the type of paperboard used had more influence over the packages recyclability than the recycle logo. Furthermore, most felt that the presence of the recycle logo did not affect their decision regarding choosing the package they felt was most eco-friendly.

Conclusion

We have presented a new method for understanding the role of recycle logos on packaging. From the results, there is no significant difference between the type of paperboard used and the recycle logo when determining the recyclability of a package. However, we feel that viewing comparison images in a short amount of time may have affected the results. Perhaps viewing single images versus a comparison image may provide more information in determining the influence of

recycle logos. We feel eye tracking is a beneficial apparatus to use in determining the effectiveness of recycle logos. There have been few, if any, studies done using eye tracking of recycle logos. Therefore, expanding this area of research is advantageous to help increase recycle rates.

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