

An Eye-Tracking Methodology for Testing Consumer Preference of Display Trays in a Simulated Retail Environment

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ABSTRACT

Display trays have traditionally been used to support distribution packaging and retail stocking. Yet, it is becoming increasingly common to find display trays as devices to garner attention and increase the shelf presence of packaging. This paper presents a method for testing consumer preference of display trays for liquid dish soap and canned tomatoes in CUShop™, a consumer experience laboratory, using eye-tracking technology. It was hypothesized that display trays would increase total fixation duration and decrease time to first fixation on the respective products tested. However, it was determined that attention to products in a display tray was less favorable to products not in a display tray. Experimental results are limited because of the many variables that exist for display trays. If further studies were to be conducted on a larger variety of display trays using the methodology described, the appeal and attention value of display trays could be comprehensively understood.

Key Words: *packaging design, display trays, CUshop, eye tracking*

1.0 INTRODUCTION

Package design is a critical aspect of selling products in the retail environment. Store shelves are crowded with a variety of packaging styles

promoting their item, and this number is constantly increasing. More and more companies are realizing that in order to be successful in this industry they need a packaging system that will break through the ‘clutter’ on shelves [1].

Consumer behavior at the point of purchase (POP) is influenced by out-of-store memory-based factors (brand preference) as well as by in-store attention-based factors (product display). In today's retail environment, establishing memory-based influence is not sufficient, thus designers work to create a "visual lift," or increased in-store visual attention, for their brands [2]. To accomplish this, marketers have begun setting aside larger percentages of their promotional budgets to be used for point of purchase marketing [3]. Point of purchase marketing revolves around the idea that an increased visual salience of a product will make it stand out when compared to those next to it, encouraging consumer purchase decision [4]. The easiest way to heighten a product's shelf presence is through display. There are a variety of types and sizes of displays ranging from a large pallet display to a small display tray, all thought to elicit more attention from the consumer.

The value of point of purchase marketing is documented by a number of studies using a variety of methods; however few are able to distinguish the contributions of point of purchase display from consumers' past experience with a product [5]. Field experiments have only able to determine large effects of point of purchase marketing due to the lack of control over environment conditions at the time of purchase [5]. Eye-tracking technology can now be used to effectively collect quantitative data on the effectiveness of point of purchase marketing in a controlled environment with a set methodology.

2.0 BACKGROUND

Consumer product companies are consistently looking for ways to increase the shelf presence of their products [6]. In today's crowded shelves, companies attempt to set apart their products from the rest through the use of point of purchase

marketing. Point of Purchase (POP), or point of sale, display is the broad term referring to any type of display found in a retail environment. POP marketing is based on the belief that an increased visual salience, a quality of an item that stands out relative to neighboring items, at the point of sale will encourage a consumer to choose one item over another [4]. It has been found that packaging which is able to command consumer attention, correlates directly to a positive opinion of the product [7]. POP marketing claims to be effective because consumers often arrive at a store undecided about what to buy and are often lured and distracted by in-store displays [8,9]. Marketers have begun setting aside a growing percentage of their promotional budgets for in-store marketing [3]. The effectiveness of POP marketing is documented by a number of studies using a variety of methods, however only a few are able to distinguish the contributions of POP marketing from memory-based factors that consumers already have from previous product experiences [5]. In the past, field experiments could only detect the large effects of POP marketing because of the lack of documentation describing the environment conditions at the time of purchase, as well as the logistical difficulty of experimental methods [5]. An advantage to display trays is that they fall under the category of pretty darn quick (PDQ) displays which are placed directly on retail shelves or counters in effort to minimize labor, assembly or cost. PDQ's are intended to display the product, but unlike most other displays are not to be permanent; once empty, the display should be disposed of properly and replaced, not restocked [10].

3.0 MATERIALS AND METHODS

3.1 RETAIL AUDIT

To determine the appropriate size for the test stimuli, a retail audit was conducted to establish

common or standard tray sizes in different product categories such as pet care, home improvement, cleaning supplies, and canned tomatoes. For the audit, the height of the product in a display tray was measured, as was the front height of the tray. These values were recorded and then averaged. The ratio of product height to tray height was calculated in attempt to determine if product height was an influencing factor on the height of the display tray and to also determine an average height of a display tray.

3.2 STIMULUS PACKAGE DESIGN

Two different products were utilized in the study: liquid dish soap and canned diced tomatoes. Canned tomatoes are commonly found in a display tray while dish soap is not. Therefore, the benefit of testing dish soap, is the opportunity to observe participant behavior when faced with something unexpected and uncommon, which may potentially act as a true indicator of the impact of a display tray. Brand names were not included because they may bias participant preference. Instead, two

fictitious brands were created with similar designs for each product. The designs were created to parallel those in the market thus minimizing participant confusion and increasing recognition. Two designs were created for each product to force the participants to make a selection and utilize exploratory search opposed to given a specific task enabling the use of goal-directed search (Figures 1-2). The products were also rotated on the shelf to determine if shelf placement played role in this study. The dish soap label was created to fit an Ultra Gain® bottle while the tomatoes were created to fit a standard 14.5-ounce can.

3.3 RETAIL AUDIT DATA

Dish soap exists within the cleaning product category. Based on data collected during the retail audit, the average height of a display tray for cleaning products was 1.9 inches, while the average product height to tray height ratio was calculated to be 0.295. Should the ratio be used, the dish soap would have a tray height of 2.88 inches (9.75 inch product). However, this is much



Figure 1. Dish soap design to fit an Ultra Gain® bottle



Figure 2. Canned tomato design to fit a standard 14.5 ounce can



Figure 3. Dish soap tray (left), canned tomato tray (right)

larger than the heights of the other trays in the cleaning product category, and therefore the tray design is based on the category average of 1.9 inches. The tomato category had consistent values among all products at 1.5 inches for the tray height and 0.343 for the ratio value, thus 1.5 inches was used. The other dimensions of the tray were based on product size. The number of products chosen for display was determined by lining up products to fill at least 12 inches of space, enabling accurate eye-tracking data. Both trays were designed to be two products deep in the shelf. The dish soap tray was designed to hold a pattern of 4 across by 2 deep coming to a size of 16.5 inches x 4.5 inches and the canned tomato tray had a pattern of 5 across and 2 deep coming to a size of 14.75 inches x 6.125 inches (Figures 3). The graphics on the trays were designed to be consistent with that of the design stimulus.

3.3 EYE -TRACKING APPARATUS

Tobii eye tracking glasses were used to record eye movements in the study. The eye tracking glasses are monocular video-based pupil and corneal reflection glasses, sampling from the right eye. They have a sampling rate of 30 Hz with a 56° x 40° recording visual angle.¹¹ The glasses plugged into a Tobii Recording Assistant, which collected and stored the eye-tracking data onto a standard digital card for easy extraction. The Recording Assistant gathered the eye-tracking data, as well as a video of the participant's visual

field. Tobii Studio, the supporting software, was used to analyze and aggregate data for all eye-tracking metrics. Infrared (IR) markers were used in conjunction with the glasses and Recording Assistant to define areas of analysis (AOA) in the viewing field. An AOA is defined as a 2D plane created by the placement of four or more IR markers. Within these AOA's are areas of interest (AOI) that are used to produce visualizations and statistics to help analyze specific items of a store shelf. These AOI's were specified in the Tobii Studio software using a 'snapshot' taken with the Tobii glasses that reference the location of the IR markers.

3.4 EXPERIMENTAL DESIGN

The experiment took place in a simulated shopping environment called CUshop™, located at the Sonoco Institute of Packaging Design and Graphics at Clemson University in Clemson, South Carolina. The shopping environment is composed of gondola shelving, refrigerators, produce stands and signage to create an immersive atmosphere. Number tags were placed on the shelves below each product to enable participants to define which item they preferred. Pricing was eliminated in the study. Shopping lists were created for participants to write down their purchase selection while in the shopping environment with pasta and cookies used as filler products to distract participants from the research objective. The order of the items on the list was randomized.



Figure 4. Testing control day with no products in display trays



Figure 5. Second day testing of products with (left) and without display cases (right)

Dish soap and canned tomato stimuli had a 2 (products) x 1 (display tray) experimental design. The study lasted two days. The first day was for testing control conditions in which no products were in a display tray (Figure 4). The second day tested Suds dish soap and Debbie's canned Figure 3 (page 52). Dish soap tray (left), canned tomato tray (right) tomatoes in a display tray next to products without one (Figure 5). Thirty participants were tested in each condition. All stimuli were placed side by side at eye level to achieve maximum eye tracking accuracy and the shelves remained fully stocked with the products throughout the whole study.

3.5 PROCEDURE

Each participant who agreed to participate in this study was informed that it would take

approximately eight minutes and that they could leave at any time. Once a participant gave consent, the researcher escorted them to the calibration area. After calibration was completed, the researcher lead the participant to the entrance of CUshop™ where they were handed a shopping list and instructed to shop for each item on the list as they would normally. When the participant made a selection, they were instructed to write the corresponding product purchasing number in the related white box on the shopping list. When a participant finished shopping, they were asked to complete a short survey consisting of demographic questions as well as preference questions. Participants were asked what factors influence their purchase choices during a shopping trip.

3.6 DATA COLLECTION AND EYE-TRACKING METRICS

Three eye tracking metrics from Tobii Studio were studied to determine participant preference. The metrics collected were time to first fixation (TTFF), total fixation duration (TFD) and fixation count (FC). TTFF is the time (in seconds) it takes a participant to first fixate on an AOI after entering the surrounding area. TFD is the total time in seconds a participant fixated on a particular AOI. FC is the number of fixations on a particular AOI. For eye tracking data analysis, an independent t-test was performed between the two stimuli each day. This t-test was conducted with the data for each of the eye tracking metrics being measured (TTFF, TFD and FC). An independent t-test was also conducted to compare data between the control and variable conditions of each product. Recorded eye movement data was exported from Tobii Studio and statistically analyzed in SPSS. A 95% confidence interval was used for all applicable statistical analyses. Shopping list data was analyzed with a chi-square test of independence to determine significance between products in a display tray and those not.

4.0 RESULTS AND DISCUSSION

There were a total of 65 participants in this study. Five subjects had unmeasured eye tracking metrics due to a weak calibration and were discarded from data analysis. A weak calibration is common for eye-tracking devices which can be caused by the shape and structure of the participant's facial features, the color of their eyes, or the need for prescription glasses to be worn. Shopping list and survey data was analyzed for all 65 participants.

4.1 EYE TRACKING RESULTS AND STATISTICS

The AOI's for the stimuli in a display tray were split to determine eye-tracking data for the display tray only, the product only, and the two pieces as a whole. Generally, in both product categories it took longer for participants to first fixate on the product in a display tray compared to when it was not and products were fixated on for a longer period of time and a greater length of time when not in a display tray for both dish soap and canned tomatoes (Table 1). This was not the case with Debbie's tomatoes where the participant fixated an average of 1.78 seconds on the tray and 2.46 seconds on the product. This discrepancy might have occurred because on the tray of the tomatoes read, in large letters, "diced tomatoes" informing the participant quickly what they were looking at. However, it was in small type that the dish soap tray said "dishwashing liquid" so participants may have spent more time searching the product label to determine their purchase decision. Similar to total fixation duration, the display tray of Suds dish soap was fixated on a greater number of times than the product while the opposite occurred for Debbie's tomatoes. Again this may have been due to the size of the type used to describe the product, causing the participant to look in different places for the needed information.

Independent t-tests were performed to test for significance, which compared TTFF, TFD, and FC between the stimuli in each product category (Suds and Zuds dish soap and Debbie's and Robert's canned tomatoes). Significance was determined by a p-value less than 0.05. This was completed for both the control and variable testing conditions. Additionally, independent t-tests were performed to statistically compare TTFF, TFD, and FC of stimuli between their control and

variable conditions (Suds day 1 and Suds day 2, Zuds day 1 and Zuds day 2). No significance was found when comparing the two stimuli in the control conditions for either product category which is a desirable result that supports a consistent experimental design. Due to the fact that there was no significance, the introduction of one new factor (display tray) can be deemed responsible for the cause of any created significance.

Suds dish soap in a display tray took significantly longer to first fixate on than Zuds dish soap (not in a tray). Additionally, Debbie’s tomatoes in a display tray took a significantly longer to first fixate on than Robert’s tomatoes (not in a tray). Both items in a display tray took longer to fixate on than the

alternate choice within the product category (Table 1). This may have occurred because the participant was overwhelmed by the presence of the tray and therefore delayed observation. Another possibility is that the participant initiated their search with a general idea of shape and colors to look for, in order to find the prompted product, but the presence of the display tray impeded the recognition of the product. There was no significance found for total fixation duration or fixation count, potentially indicating that participants equally considered both products and were not immediately drawn to one over the other; the display tray did not grab attention nor elicit a larger amount of fixation (Table 1).

		Sig (2-tailed)
Dish Soap	Time to First Fixation	0.008
	Total Fixation Duration	0.064
	Fixation Count	0.095
Canned Tomatoes	Time to First Fixation	0.019
	Total Fixation Duration	0.126
	Fixation Count	0.16

Table 1. t-test table of p-values for TTF, TFD and FC between stimuli in variable conditions

		Sig. (2-tailed)
Suds	Time to First Fixation	0.977
	Total Fixation Duration	0.012
	Fixation Count	0.008
Zuds	Time to First Fixation	0.293
	Total Fixation Duration	0.695
	Fixation Count	0.814
Debbie’s	Time to First Fixation	0.031
	Total Fixation Duration	0.153
	Fixation Count	0.242
Robert’s	Time to First Fixation	0.529
	Total Fixation Duration	0.541
	Fixation Count	0.337

Table 2. t-test table of p-values for TTF, TFD and FC between stimuli Day 1 and Day 2

Debbie's tomatoes showed significantly longer amount of time to first fixate on when in a display tray opposed to when not (Table 2, pg. 55) Again, this could be due to the tray causing delayed product recognition. Additionally, Suds dish soap was fixated on for a longer amount of time and a greater number of times when it was not in a display tray (Table 2). This may have been caused by the participant needing to spend longer periods of time differentiating Suds from Zuds dish soap when no display tray was present. If that were the case, this would indicate that the display tray helped communicate to the participant what the product was. Another possibility is that the participant simply did not care for the display tray and therefor focused attention on Zuds dish soap.

Heat maps of aggregate fixation counts from participants can be seen in Figures (6-9). Figures 6-7 illustrate the samples in the control conditions (Zuds left and Suds right than rotated, and Debbie's left and Roberts left than rotated) while Figures 8-9 are the samples in the variable conditions with a tray and without a tray. In the control condition there seems to be a greater amount of fixations on the product in the right shelf position opposed to the left, even with product rotation (indicating that participants preferred the shelf position not the product).

In the variable conditions, there also seems to be a greater amount of fixations on the product in the right shelf position opposed to the left, even with product rotation (Figures 8-9).

4.2 SHOPPING LIST RESULTS AND STATISTICS

Purchase decisions were tallied and analyzed. Some participants selected items not within the prompted product category and therefore were

discarded. In the control conditions, Suds dish soap and Debbie's tomatoes were purchased more frequently than their competition, Zuds and Roberts. It is possible that Suds dish soap was purchased more frequently than Zuds dish soap because the brand was more realistic. Possible reasons for Debbie's tomatoes to be more popular than Robert's may be that participants preferred the image on the can of Debbie's tomatoes to Robert's, or perhaps participants had a preference towards gender (e.g. Debbie as female and Robert as male). Once placed in a display tray, Suds dish soap and Debbie's tomatoes were both purchased less than when directly on store shelves.

Shopping lists were statistically analyzed using a chi-squared test for independence to compare product selection within each product category in the control and variable conditions as well as each stimulus across testing conditions. Only one instance of significance was found; Debbie's tomatoes were purchased significantly more than Robert's tomatoes when no display tray was present. Again, this could have been due to participant preference of image or brand name. The presence of a display tray caused no instances of statistical significance on participant purchase decision.

4.3 SURVEY RESULTS

All subjects completed a short survey containing demographic, immersion and preference questions after the study. In the survey, participants were asked what factors influence their purchase choices during a shopping trip (Figure 10, page 58). It is logical that factors pertaining to the product have the most influence on purchase decision because consumers are purchasing the product, not the display. Participants were also asked if they would perceive a product in a display



Figure 6. Aggregate heat map of dish in control conditions for both rotations

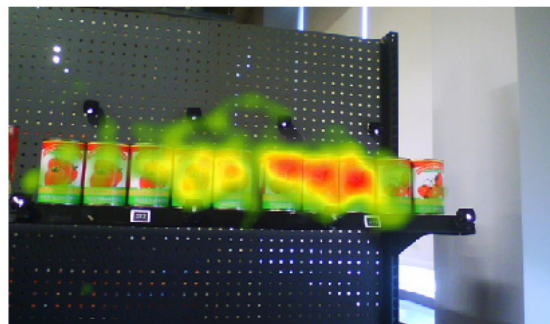
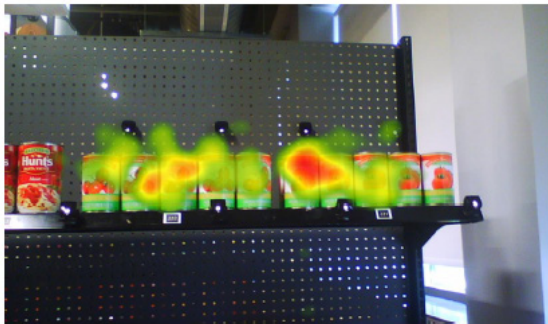


Figure 7. Aggregate heat map of canned tomatoes in control conditions for both rotations



Figure 8. Aggregate heat map of dish soap in variable conditions for both rotations

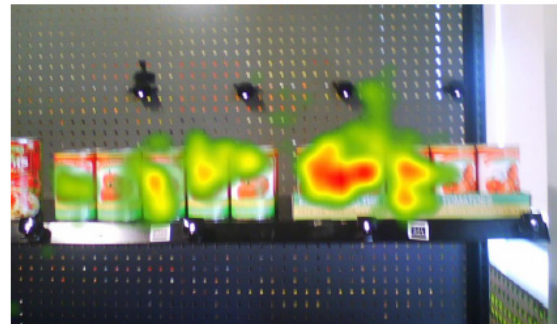
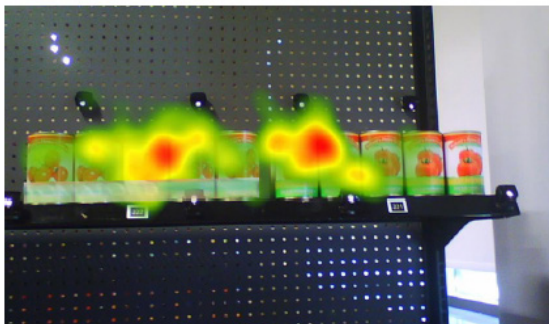


Figure 9. Aggregate heat map of canned tomatoes in variable conditions for both rotations.

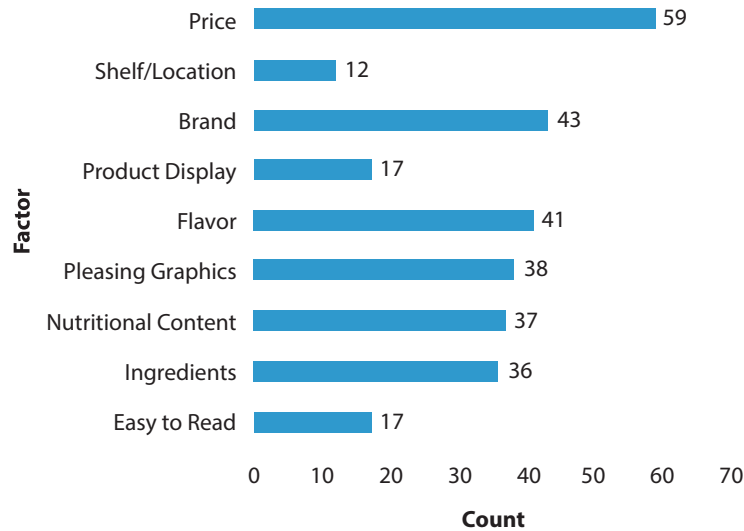


Figure 10. Influential factors of purchase decision on a normal shopping trip

tray as higher quality; 20 participants said yes a display tray would increase perceived quality while 45 indicated a display tray has no effect. Based on participant feedback when leaving the study, some stated they liked the display tray on one product and not the other, some stated they did not notice the tray and others said not to like it because it covers the product. The predominant age range was 21-25 and a household income of \$0 – \$24,999. This demographic suggests that the majority of participants were college students, so the results of this study are more than likely indicative of a preference in a lower scale shopping experience such as Wal-Mart. This would align with the stimuli designs created using an audit of Wal-Mart and Target stores.

5.0 CONCLUSIONS

The use of display trays is typical in the packaging industry. They are utilized to improve shipping, decrease stocking time as well as to create extra space to advertise the product and brand. Prior experimentation on point of purchase

marketing is unable to differentiate the effects of package display from opinions of consumers' past product experiences as well as other environmental factors. In attempt to control environmental effects and brand bias, packaging was designed for dish soap and canned tomatoes, which were tested in an immersive retail laboratory, CUshop™. Eye-tracking and survey data was collected and analyzed for the designed products when placed into a display tray and when placed directly onto the retail shelf to better understand the effects of this specific type of display.

Statistically significant results indicated an increase in time to first fixation for both dish soap ($p=0.008$) and canned tomatoes ($p=0.019$) when the tested packaging when placed into a display tray. Significance was not found ($p>0.05$) for total fixation duration, fixation count, or purchase decision when a display tray was introduced to the shopping environment. Additionally, survey results indicated that 69 percent of participants did not perceive a product in a display tray as higher quality and some noted that they simply

did not like the display because it covers some of the packaging. Overall, eye-tracking data and purchase decision were consistent with the survey results that the presence of a display tray does not seem to increase consumer perception of or attention to a product.

While there are many other practical reasons for display trays, in respect to consumer appeal, they may not have an advantage over direct shelf stocking. Limitations to this study include selfdesigned packaging and perfectly stocked display trays. However, the study acts as an exploratory body of work that could be used as a method for determining the consumer-declared value of display trays.

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