The Relationship Between Visual and Olfactory Stimuli In A Retail Environment

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ABSTRACT

This study investigates consumers' behavioral response to ambient scent in a retail setting. An eye-tracking analysis was performed to observe the visual attention of 135 participants at Pack Expo International 2012, an international packaging trade show in Chicago, Illinois. A mock office supply store was erected and an essential oil nebulizer was used to covertly emit realistic scents of lemon or coffee within the store while the study took place. A Tobii® head mounted eye tracker was used to obtain the eye movements of the participants as they shopped for items on a pre-established shopping list. Analysis of the data attempted to determine if a correlation exists between ambient scent and the visual attention of participants to retail items that correspond to the ambient aroma. This study found no statistical significance between the ambient aromas of coffee and lemons and visual attention to coffee products or lemon scented cleaning supplies, however further explanation for this inconclusiveness is offered in the discussion.

Keywords: eye tracking, packaging science, olfaction, retail environment, $CUShop^{TM}$

INTRODUCTION

This study investigates consumers' behavioral response to ambient scent in a retail setting. As markets approach saturation and consumer segments are strained, companies are pushed to find new ways to secure market shares. This field of consumer psychology has gained significant momentum in recent years and companies are devoting more research efforts into sensory marketing. Research suggests that consumer evaluation of products is a partially subconscious and automatic function where prior experience and emotional cues reinforce seemingly cognitive assessments. Furthermore, subconscious interpretations are based consumer largely on environmental cues [2]. This notion has spawned yet subcategory of another market research called atmospherics, which examines how consumers receive stimuli in a retail environment.

While there are many ways a retailer can redesign the consumer experience to communicate product image, this

study will explore how ambient smell can be used to gain the attention of consumers toward the product most closely correlated to the aroma. The experiment will be conducted in a simulated office supply retailer and a simulated grocery mart. The purpose of the experiment is to determine whether exposure to the intrinsically associated scent of a product evokes attention to that product (i.e. coffee and lemon). Metrics will be obtained using eyetracking glasses. Items in the office store will consist of office supplies including; pens, paper, electronics, coffee, coffee makers, and cleaning supplies. Prior to each study, the store will be filled with an ambient scent that correlates to one of the items of interest displayed on the store shelves. Participants will carry out a shopping task while wearing eye-tracking glasses; survey data will be collected and analyzed using interlinked computer software. The data collected should provide insight to consumer perception of the environment as well as consumer self-perception.

BACKGROUND

Designers and marketers help businesses find new techniques to gain advantages over competitors. To do this, they must determine what drives consumers to choose their product or service over others. Traditional marketing methods have indicated that strong advertising and high quality packaging are successful ways to communicate value to the consumers [2]. In marketing, the effort to influence consumers through environmental sensory stimuli is called atmospherics. "Individuals' feelings of pleasure and arousal are influenced by their cognitive evaluation of store environmental cues, such as music and aroma" [2]. More retailers are realizing the benefits of improved ambience and interest in the field of atmospherics is growing. Baker, Parasuraman, Grewal and Voss outlined that "Numerous variables guide retailers' and service firms' design of store environments including in-store music, aroma, merchandise quality, service quality and price perceptions" [12]. Within the field of atmospherics, we will be conducting our study regarding olfactory applications. Smell is known to be a powerful influence of emotion, closely tied to memory and mood and many cultures have used aromatics as a therapy technique [6]. Most people know and have experienced the memory recall effects of olfactory and audio cues and this well known, yet under

researched topic, is being used more by retailers and marketers alike. This method of sensory marketing is growing rapidly due to advances in diffuser technology, although extensive scientific research supporting this trend is not yet available. Businesses that utilize these methods are simply field testing their techniques and their success is primarily based on speculation. While the use of aroma as an attention grabber is fairly well understood, market effects of the emotion and mood altering capacity of smells are vague. Bone and Ellen (1999) found that smell is difficult to research because it is considered, "the most enigmatic sense" [4]. Following the late 1990's there was market demand for research in olfaction and researchers devoted more attention towards this field. Today, researchers have been working to characterize scents and responses but there remains potential yet investigated fully that can give a verdict to the suspicions of the market.

HYPOTHESIS

A correlation between the presence of the lemon and coffee olfactory stimulants and the visual attention of the participants to the corresponding products is anticipated. To what degree or to what extent there may be a correlation is unknown because of the lack of previous studies conducted in similar fashion. An alteration of visual focus from the listed item categories on the shopping list to the item corresponding to the ambient aroma is anticipated as well as participants fixating on the corresponding shelf items for varying lengths of time when the aroma is present.

METHODOLOGY

Context

The goal of this research was to determine if ambient scent attracts consumer focus and attention to specific products in the simulated retail environments that are directly correlated to the ambient scent. Eye-tracking methods were used to capture participants' visual attention data and an exit survey provided additional demographic and qualitative insight to the consumer decision-making process. Metrics of interest for eye-tracking data were total fixation count, total fixation duration, and time to first fixation.

The experiment was completed at Pack Expo International 2012 at McCormick Place in Chicago, Illinois (see Figure 1). The conference offered the opportunity for a large number of participants in a short amount of time. Our test took place in Clemson University's booth: The packaging Test Track (see Figure 2). The Sonoco Institute of Packaging Design and Graphics' students and faculty designed, installed, and ran the experiments taking place at the booth. The show occurred over the course of 4 days with over 100 participants.



Figure 1: Site, McCormick Place; Chicago, Illinois



Figure 2: The Packaging Test Track booth at Pack Expo



Figure 3: Entrance of CUOffice







Figure 4: Store Entrance and Aisle 1 with Office Products

Figure 5: Aisle 2 with Stimuli

Figure 6: Aisle 3 with Office Products

A total of five consumer behavior studies were taking place at various simulated shopping environments. The five stores include CUOffice, CUShopTM, CUmart, CUCafé, and CUAuto. Each study was independent of each other. This olfactory study took place in a simulated office store named CUOffice (see Figure 3 on previous page).

The space for The Packaging Test Track and CUOffice was donated by PMMI, a packaging industry not-for-profit. Tobii® Eye Tracking Research donated the use of mobile eye tracking glasses and IR markers for the duration of the experiment.

Participants

Participants of the study were registered attendees of Pack Expo International 2012 held at McCormick Place in Chicago, Illinois. PMMI provided advertisements throughout the convention center to lead interested attendees to the booth. Clemson University graduate students in Packaging Science also developed signs that were scattered throughout the large convention center. Participants were offered reusable grocery bags; drink koozies, and information postcards as an incentive after participating in a study. The information on the postcard explained how eye tracking technology works to study consumer behavior and preferences with a link to the Sonoco Institute's website for more information.

Stimulus

CUOffice consists of a 7x4m space that housed two adjacent double-sided gondola shelving systems, each 1.2m wide, 2m tall, with shelves 0.4m deep. The retail displays were stocked with office supplies including paper, notebooks, binders, legal pads, writing utensils, and small electronics, along with several stimulus products. Two product types were used to determine correlation between ambient scent and consumer focus. The product types are coffee and lemon variety cleaning supplies. These products were displayed on shelves between 24 and 48 inches from the ground on the center-most gondola to ensure that subjects had to pass by them during completion of the shopping task (see Figures 4, 5, and 6). The shopping list included item categories that were within near vicinity of the items correlated with the ambient scent. However, the shopping list does not include the products correlating with the ambient scent (coffee and lemon variety cleaning supplies).

The experiment area was permeated with ambient aroma using an essential oil nebulizer assembly under the same dilution ratio and diffusion settings. There were three aroma treatments; control (no scent), coffee (Arabica compounds), and lemon (lemon scent).

A multi-setting essential oil nebulizer was placed inside a 1'x1'x2' sealed box constructed from medium density fiberboard. A 6" square hole in a face of the box was fitted with a multi-speed exhaust fan to expel the coffee and lemon aroma from the essential oils in the nebulizer. The airflow through the fan was measured in cubic feet per minute (CFM). The oil nebulizer operates by combining water moisture vapor and the essential oils prior to emitting the aroma. Measured dilution increments of 1 milliliter of essential oil vs. 10 milliliter of water were added to the nebulizer and the box was closed. 15 minutes prior to the start of each testing day, the nebulizer was turned on and given sufficient time to fill the room with ambient scent. The essential oils used were cold-press extracted samples obtained from credited scientific supply companies that provide concentration ratings and specific gravity ratings of the oils.

Apparatus

The Tobii® Glasses Eye Tracker system consists of eye tracking glasses, a recording assistant, IR markers, and Tobii® Studio eye tracking software. The head-mounted glasses are equipped to follow eye pupil movements, record sound, and record first person perspective video of the subject's view. Eye movements are tracked at a rate of 30Hz from the right eye only through corneal reflection of



Figure 7: Desk holding nebulizer



Figure 8: Detail of Nebulizer

infrared light and perspective view is recorded with a visual angle of $56^{\circ} \times 40^{\circ}$. The recording assistant acts as a control interface and is hardwired to the glasses (see Figure 10). It is used to calibrate and to record tracking and visual data via standard transferrable secure digital (SD) memory card. IR markers have a transmission range of 60-250cm at angles between 90° - 150° . They are positioned around the visual areas of analysis (AOA) where 4 or more markers are used in conjunction to form a plane on which tracking metrics including any areas of interest (AOI's) are plotted based on the subject's pupil movements. All data is transferred to the Tobii® Studio eye tracking software via SD card for analysis.

Experimental Design

The environment used for testing was the CUOffice consumer retail experience at Clemson University's Packaging Test Track at Pack Expo International 2012. The shelf arrangement can be seen in Figures 4, 5, and 6 on the previous page.

The apparatus containing the nebulizer and the fan equipment was placed inside a desk located inside the retail environment (see figures 7 and 8). This ensured that during



Figure 9: Lemon and coffee essential oils used in the nebulizer



Figure 10: Tobii[®] mobile eye tracking glasses

studies it was not visible to participants. Each participant in the study performed only one trial.

Procedure

Participants who volunteered were asked to participate in a 10-15 minute research study. The study consisted of a three-step process with varying times for each participant.

Step 1: Calibration

Participants were shown the applicable IRB forms and fitted with the Tobii® Eye-Tracking glasses. The participant was positioned to stand 1 meter away facing a blank, vertical wall. They were prompted to follow the moderator's handheld IR marker by only moving their eyes and keeping their head as still as possible. The recording assistant displayed a nine-square registration pattern, which the moderator traced on the wall in front of the subject. As the registration marks turned green, the equipment calibrated to the user's eye movements. If the recording assistant rated the quality of the calibration at 3.5 stars or higher, the calibration was accepted. If the calibration was rated below 3.5 stars, the calibration was reinitiated to ensure accuracy in the study

Step 2: Shopping

After calibration of the eye-tracking glasses, the participant was given a shopping list with 6 items to shop for (see Figure 11). The items included file folders, highlighters, envelopes, Pack Expo Pocket Guide, toner cartridge, and wireless router. Participants were instructed to shop as they would normally shop and to select one of each of the items located in the shopping list. Selections were made by placing the purchasing number corresponding with the chosen item in the empty box located on the shopping list.

Step 3: Survey

After shopping was completed, participants were asked to complete a short follow-up survey including demographic and study related questions. The moderator led the participant to a survey computer for completion.

DEPENDENT MEASURES

Eye Tracking Metrics

The metrics of study included time to first fixation (TTFC), total fixation duration (TFD), and fixation count (FC).







Figure 12: Floor Plan of CUOffice

Post-Experiment Survey

A 13-question survey was issued after participants had completed the study. The survey included demographic questions and questions pertaining to the participant's personal impression of and experience in the retail environment for the purpose of potential future studies.

Statistical Analysis

A 2-way ANOVA test was used with fixed factors of product type and aroma treatment where correlation metrics are compared.

RESULTS

148 subjects participated in the study; however, 13 subjects were removed from the analysis due to poor calibration, leaving 135 participants. All recorded eve movement data was exported from Tobii® studio, then statistically analyzed using Microsoft Excel 2010. Pairwise t-tests were performed to compare data obtained under scented conditions to data obtained during the control periods of no scent for the collected metrics of: time to first fixation (TTFF), average fixation count (AFC), and total fixation duration (TFD). TTFF was defined as the time in seconds it took a participant to fixate on an area of interest (AOI) after the participant had entered the area of analysis (AOA), which was the region located directly in front of the shelving containing the cleaning supplies and coffee products (see Figure 12). TFD was defined as the total time in seconds a participant fixated on an AOI (coffee products and lemon scented cleaning supplies). FC was defined as the number of fixations on a specific AOI (either lemon scented cleaning supplies or coffee products).



T-Test TTFF	
Coffee Products	0.316275
Lemon Products	0.967219

Figure 13: (Left) Bar chart showing results for time to first fixation (TTFF). (Right) T-Test Table for time to first fixation (TTFF).



T-Test AFC	
Coffee Products	0.74511
Lemon Products	0.235619

Figure 14: (Left) Bar chart showing results for average fixation count (AFC). T-Test Table for average fixation count (AFC).



T-Test TFD	
Coffee Products	0.872868
Lemon Products	0.426789

Figure 15: (Left) Bar chart showing results for total fixation duration (TFD). (Right) T-Test Table for Total Fixation Duration (TFD).

Pairwise *t*-tests showed no significant statistical differences in any of the metrics tested (p > 0.05).

Some significance can be observed in the TTFF of the coffee products, where an average of one second less in TTFF of the coffee products was found when coffee scent was present.

Though this is not a statistical significance, where p=0.316275 (p > 0.05), this trend may have had some psychological significance and a follow-up study may be performed to further investigate the trend as explained below.

DISCUSSION

According to the results, there was no correlation found between the ambient aroma and the visual attention of the participant base. This may be due to a few extraneous causations. Firstly, the location of CUOffice was directly



Figure 16: Scan path for coffee stimulus



Figure 17: Heat map for coffee stimulus

adjacent to a pizza vendor at Pack Expo that was baking pizza each morning and afternoon of the study. The resulting aroma from the pizza baking would overpower the stimulus aroma in CUOffice, weakening the strength of the scent, causing difficulty in detection. Secondly, the ceiling in CUOffice was especially high at 18 feet and the room was not closed in, as the walls were modular and not ceiling-high. The area beyond the modular walls consisted of a vast space spanning tens of thousands of square feet. This resulted in a very large area that was difficult to saturate with the stimulus aroma, which again resulted in a weak coffee or lemon aroma at times.

Due to these detrimental external factors, it is highly likely that many of the participants were not able to sense or detect the stimulus aroma.

A follow-up study in the more controlled environment of CUShopTM, located in the Harris A. Smith building at Clemson University will be performed. This study will expand on the trends observed in the study described in this report. Unlike CUOffice, CUShopTM is a closed-in environment and will be much easier to saturate with the stimuli aroma, making it easier to detect and have a possible effect on the visual attention of the participants.

CONCLUSION

The results presented in this report show comparisons between the visual attention of 135 participants to products displayed in a simulated retail environment while an ambient scent corresponding to those products was either present or not present. The results obtained show there was little to no correlation between olfactory stimuli and visual stimuli. As explained, the study was plagued by detrimental external factors and the results are therefore inconclusive.

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