

# Eye Tracking Application on Emotion Analysis for Marketing Strategy

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**Abstract**—This paper present on understanding the human behavior with eye tracking studies related to consumer cognition in marketing product. The study of human behavior using eye tracking is a growing multidisciplinary field that links electronics, psychology and cognitive science to study the human behavior on problem solving and decision making. In this paper, we particularly investigate the human behavior in consumer cognition. We conducted experiments to track the human eyes by using the Tobii TX300 eye tracker. The eye–mind relationship can help to use eye motions activity measurements expressing to some degree about human behavior. The result shows that the visual attention of human is very much related to the cognition of the products.

**Index Terms**—Emotion Analysis; Eye Tracking Application; Neuromarketing.

## I. INTRODUCTION

According to Holbrook & Hirschman (1982), for the past two decades, marketing researchers tended to neglect the emotional part of consumer behavior while much focusing on decision oriented models of information processing [1], while all marketers hope to understand customers and their purchase decisions. However, when explicitly asked, most people cannot fully and sometimes, do not even want to explain their choices. Somehow, they are not aware about the inner processes that drive their reactions and decisions. This is because 95% of the decision making process occurred subconsciously [2]. How does the brain decide and initiate preferences probably one of the most crucial questions in neuroscience, psychology and economics today?

Consumer neuroscience is a growing multidisciplinary area of study that include psychology, neuroscience, and economics to understand how the brain is physiologically influenced by advertising and marketing [3]. The term “Neuromarketing” suggests a combination of marketing research and brain research [4, 5]. Approximately, 25% of the brain regions related to vision. Based on Neuromarketing studies advertising images can elicit different degree of local brain activity and these changes can be measured in term of emotional arousing picture [6].

“The eyes are the windows to our soul”. This well-known proverb about the sense of vision might be the spark to the emergence of eye tracking technology. Humans have five traditionally recognized senses including sight or vision

(Ophthalmoception). Through sense of vision, information is provided by the eye that functioning almost like a camera. From the eyes, several visual pathways travel to many parts in the brain such as visual cortex, a part required for conscious vision. Though, the human eye is not a one-way communication channel. Emotion similarly is expresses through our eyes. Latest technologies have made it possible to utilize recorded data associated with both functions of the eyes [7, 8].

## II. BACKGROUND OF EYE TRACKING

In 1879, Louis Emile Javal [9], a French ophthalmologist was amongst pioneers, defining eye tracking measurement through text reading. She observed that people do not read smoothly and continuously across a page, but pause (fixations) on some words while moving quickly (saccades) through others. Edmund Huey [8] later built a device that was used to track eye movement using small contact lens provided with a hole for pupil. The lens was connected to an aluminum pointer to observe the gaze direction during reading and he could study which words a reader would pause on.

Dodge and Cline [8] developed photochronograph, the first accurate and non-invasive eye tracker based on corneal reflection. It was the result from their study regarding the velocity of eye movements. However, the photochronograph plate can be used only to record horizontal eye movements. Nonetheless, after four years, in 1905, a photo device that can records motions of eyes on film in both direction, horizontally and vertically is developed by an American psychologist and education reformer, Charles H. Judd [8].

Eye tracking was used for educational research as well as by medical researchers and physicians for a long time, more than elsewhere because the device is considerably very expensive. Only recently that it became more accessible to a new niche: marketers [8, 9].

## III. EYE TRACKING APPLICATION IN NEUROMARKETING

In general, eye tracking is used to determine the direction of human gaze based on the position of the eye of a person at a duration time and its moving sequence. This technology covers for example human computer interaction, brain computer interaction, assistive technology, eLearning, psychology investigation, and virtual and augmented reality.

Some of the vendors that developed and brought eye tracking technology to the market are SensoMotoric Instruments, Tobii, iMotions, MyGaze. These technologies are dedicated on camera-based eye-tracking systems. The light source and camera are perpetually attached to a monitor. Most eye trackers are contained of three main mechanisms. These are a set of illuminators or projectors, cameras, and systems for vision and mathematical analysis and calculations. The computer that is connected to the eye tracker is use to run the algorithms using a specified processing system.

Most modern eye tracker practices a method called corneal reflection to detect and track the location of the eye as it moves. This method uses a light source to illuminate the eye. Then a reflection is produced that is detected by a high-resolution camera. The reflection of the light source on the cornea and in the pupil, is identified by the image captured by the camera. Advanced image processing algorithms are then used to establish the point of gaze related to the eye and the stimuli [10]. For this research, Tobii TX300 eye tracker will be used for the purpose of data acquisition and analysis.

#### *Eye Tracking Metrics*

The usability of eye tracking systems is evaluated by metrics that are relevant to the tasks and their inherent cognitive activities. The most important specific metrics are [8, 11]: **Fixation**: the duration to process the image by fovea (80ms to 27ms for visual search). **Saccade**: the interlude between two fixations (3 degrees for visual search). **Gaze Duration**: accumulative duration and average spatial setting of consecutive fixations series within an area of interest. **Area of interest (AOI)**: area of visual display and environment that is of interest to the research or design team and thus defined by them (not by the participant). **Scan Path**: spatial organization of fixations sequence.

The raw data graphical depictions of an eye tracking experiment can be shown in various ways, but two most frequently used are gaze plot and heat map. Heat maps show fixation concentration, represent by three different colors; red, yellow, and green. Red specifies ranges of high fixation attention, followed by yellow, and then green. Gaze plots show the fixations, saccades, and scan path. Each participant is represented by a different color of circle of gaze plot. Each fixation is denoted by a chronologically circle numbered. The circle diameter corresponds to the length of the fixation in milliseconds [12].

#### IV. EXPERIMENTAL DESIGN

The experiment was designed to happen under the most realistic conditions as if they were realistically shopping in the retail environment. Nine respondents participated in this study. The experiment was conducted inside the closed room at Bio cognition laboratory. A sequence of five images was displayed on the Tobii TX300 screen for four minutes per image. The images represent different parameters in order to find human visual attention on the main parameters. The parameters are position of product on shelf (shelf number), price, brand, advertising, design of packaging, and size. These parameters were defined as the AOI. All the images displayed represent the actual product available at local Malaysia's market and

were familiar to the respondents based on the post experiment interview conducted.

After the participant's eye movements are recorded, areas of interest (AOI) are drawn using the Tobii Studio 3.4.1 software. This is to extract fixations for specific area in the stimulus given. It helps researchers analyze the various components of a visual scene. Each AOI is a polygon encompassing an attribute of interest within the image. After the AOIs were defined, the data were exported to the statistical software of the Tobii Studio 3.4.1 for every AOI. The eye tracker collecting several metrics such fixation count (number of fixations), fixation duration (length of fixations in milliseconds), total fixation duration (fixation count times fixation duration), percent fixated (percent of sample who fixated in the AOI), time to first fixation (in milliseconds), and scan path (chronological fixations and saccades) for each AOI.

#### V. RESULTS AND DISCUSSION

The eye movement data in this research is illustrated using gaze plots and heat map. While eye tracking camera records several metrics, the results shown below only for total fixation count. This is because fixation counts are often used to investigate consumer behavior because information acquisition occurs during fixations. The total fixation counts for nine respondents were depicted using bar chart. Each AOI represent by different color of polygon corresponds to the color of bar on the bar chart. From the multiple fixation points and saccades, we can tell the participant looked back and forth between elements several times. These repeated movements suggest they weighed each option, unsure which product they want. Highest number of fixation count shows the main focus of attention.

In the following each different parameter explained briefly with figures of corresponding result of response attention.

##### *A. Size of products*

Figure 1 shows comparison between a bottled Coca Cola and a canned Coca Cola to identify which size is more preferable by the respondent. The AOI for bottled Coca Cola is pink and yellow for canned coca Cola Based on Figure 1, the total fixation count for bottled Coca Cola is higher compared to the canned Coca Cola. Form post experiment interview, the respondents who chose the bottled Coca Cola stated that they preferred the bigger size.

##### *B. Design of Packaging*

The original image of Nutella spread in Figure 2 compares the three jar of Nutella in term of packaging's design. The bar chart in Figure 2 shown that fixation count sum is highest for the first jar (yellow AOI), followed by second jar (green AOI), and third jar (blue AOI). The product and its packaging influence attention, evaluation, and ultimately, impact the consumer purchasing decision on the product [13]. The buying choice and the time spent detecting the packaging shows that participants preferred the one with generally recognized packaging. Based on the post experiment interview, the respondents who chose the first jar commented on their answer, saying that their choice is due to the first jar is the design of Nutella spread that is used in local market. The

cognitive information had prevented them from choosing the second or third jar because the design is not familiar to them [14].

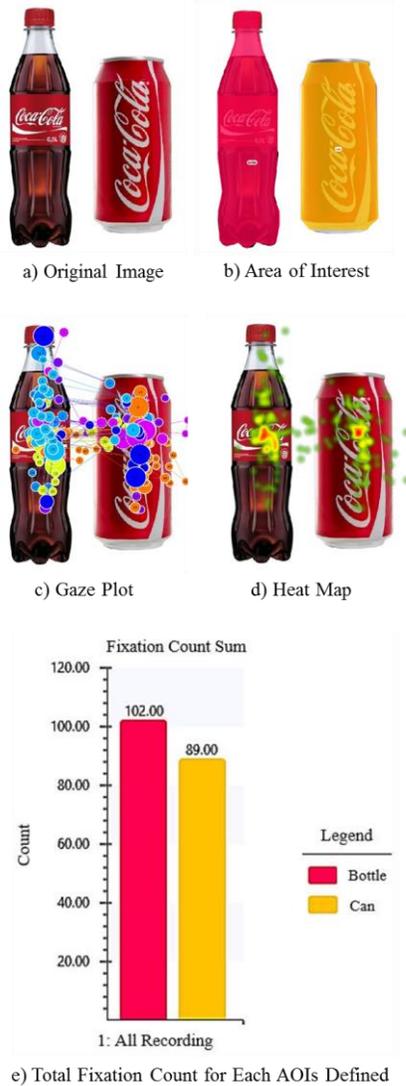


Figure 1: Comparison between a bottled Coca Cola and a canned Coca Cola

C. Position on Shelf

The AOI for position of product on the shelf is defined by the row number of the shelf. Starting from the upper row as ‘1st’ denoted with dark orange coloration, followed by second row as ‘2nd’ with mint color, ‘3rd’ with pink, ‘4th’ with light orange, and yellowish-green for ‘5th’ row. From the bar chart in Figure 3, the third row caught the most attention since it got the highest fixation counts. Meanwhile, no fixation count was recorded at the first row. When shopping, consumers observe and evaluate only some division of the hundreds of choices available on supermarket shelves. The actions of consumers at the point of purchase is therefore subjective by visual attention factors: the product arrangement on the shelf, colors, and other factors [13].

D. Advertisement

Three AOIs were defined for the KFC advertisement in Figure 4. The AOIs defined were the ‘food’ (blue), the ‘price’

(yellow), and the ‘description’ (turquoise). The number of fixation on the food setup recorded as shown in Figure 4 was the highest at 202 counts followed by 26 count at the price and 13 counts at the description.

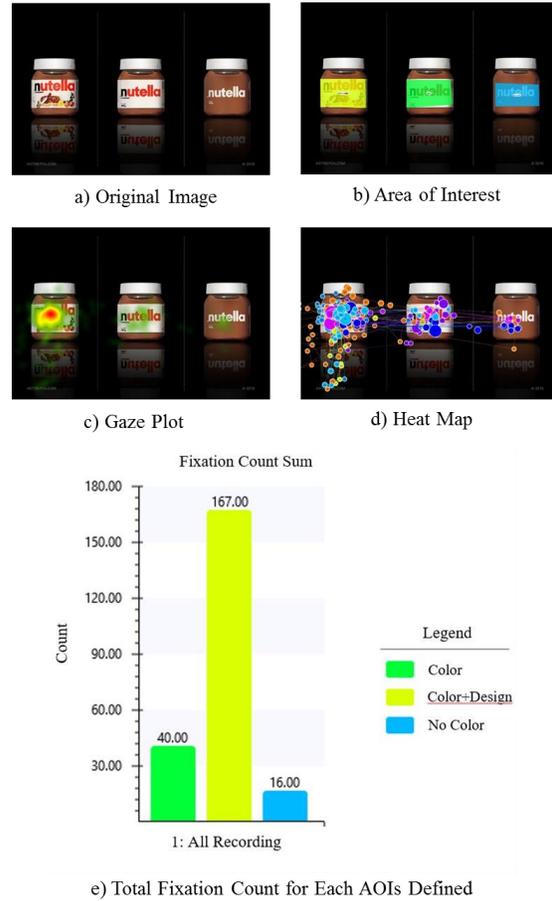


Figure 2: Comparison of three jar of Nutella in term of packaging’s design

E. Brand and Price

Brand and Price: In this section, two products that is almost identical to each other is compared to find out the element that attract respondent attention when choosing between two similar products. In Figure 5 compared two cars with similar physical appearance but from different brand, one is local (Perodua Nautica) and another is from international brand (Toyota Rush). The AOI is narrowed down to only at the car emblem. This is done to figure out if respondent prefer normal brand or strong brand. From Figure 5, it is clearly that majority of the respondents’ attention were on the turquoise polygon (Toyota Rush) compared to green polygon (Perodua Nautica).

VI. CONCLUSION

From the research conducted and post-experiment interview, we can conclude that the product that a person is likely to buy is the one that has the highest number of fixation. “Look More Like More”. The experiment also proves that the visual attention of human being reflects their consuming and purchasing behavior. This can be seen from the result of the heat maps. The effects of purchaser behavior, promotion,

marketing, pricing, products circulation and decision making can be analyze on a much more scientific basis. A further research on consumer cognition and its visual attention will allow researchers to have greater understanding of human behavior for many applications e.g. human emotional behavior in marketing, health care, personal traits, wellness, and many more.

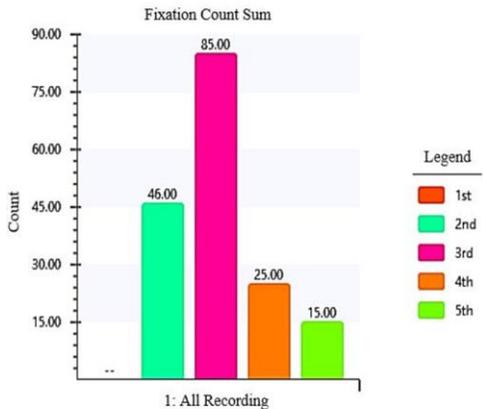
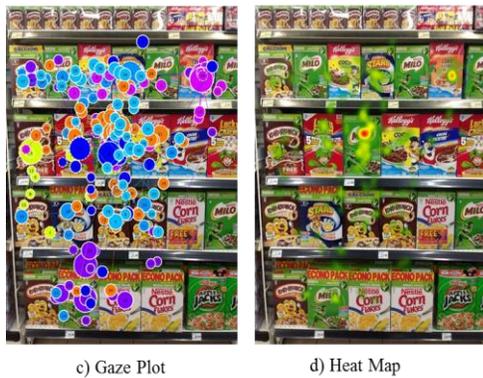


Figure 3: Comparison of position of product on shelf

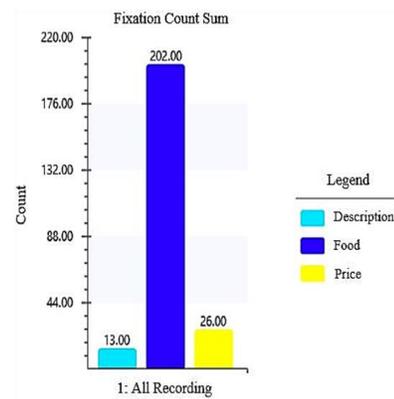


Figure 4: Result of advertisement on visual attention

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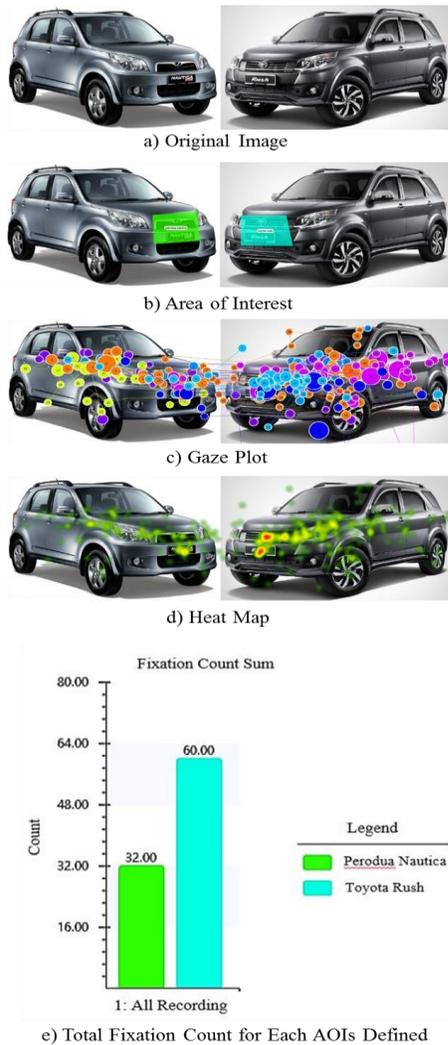


Figure 5: Compared two cars with similar physical appearance but from different brand