

Predicting Consumer's Behavior Using Eye Tracking Data

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Abstract: This study aimed at using eye tracking data to predict consumer's decisions. Previous research [1, 2] suggests that consumer's gaze is actively involved in preference formation. First fixation and the total fixation duration are the commonly reported measures of visual attention in consumer research. However other measures of eye tracking data like Fixation Count, Time to First Fixation have not been investigated much for their role in consumer decision. Purpose of this study was to investigate the components of eye tracking data that can predict consumer's final choices with better precision. The results suggest that fixation counts and total fixation duration predict consumer's decision to a large extent.

Keywords: Fixation Count, Total Fixation Duration, Eye Tracking, Consumer Decision Making

I. INTRODUCTION

With the advent of advanced sophisticated methodologies like eye tracking, researchers have tried to understand processes like scene perception, reading, visual attention and decision making into more detail. Eye movements are highly task dependent and are linked to our cognitive goals [3]. In comparison with reading, there have not been as many studies dealing with visual search [4]. Using eye tracking data, studies have tried to come up with models that can uncover the timeline of gaze behaviour in decision making task. Different models like Natural Decision Segmentation Model (NDSM) and Russo & Lleclerc's (R&L) model [5] have divided decision process into three phases: orientation, evaluation and verification. These models differ basically in the way they define the evaluation phase in their respective models. R&L model has segregated orientation and evaluation phase on the basis of first re-fixation while NDSM model has incorporated gaze cascade model and has used first fixation on the chosen product as a cut-off where the orientation phase ends and evaluation phase begins. Gaze Cascade Effect provides evidence for the relationship between choices and observer's gaze [6]. Consumer is likely to buy the item that he/she has looked at maximum amount of time. It is a positive feedback loop between what we look at and what we prefer. Studies have explored these using tasks where subject is shown pairs of human faces and are instructed to decide which face is more attractive. They

found that initial gazes were distributed evenly between the two choices but later the gaze shifts towards the face that they eventually chose. They concluded that gaze is actively involved in preference formation [6]. Recent studies have observed Down-stream effect of visual attention on consumer choice. This effect refers to the causal effect of visual attention on consumer's decision. For example experimentally directing fixation towards an alternative can increase its likelihood of being chosen [7].

Purpose of the study was to investigate if consumer's choices can be predicted using different parameters of gazing behaviour provided by eye tracker. We were interested in looking at whether eye tracking can be used to predict consumer's final decision or not? We were also interested in looking at the component that can precisely predict consumer's choices as eye tracking provides us with a number of parameters of gazing behaviour that can help one to predict consumer's choices. Some of them are Total Fixation Duration, Time to First Fixation, First Fixation Duration, Fixation Counts, and Pupil Dilation etc. Previous research work [8] suggests that Total Fixation Duration Predicts consumer's choice but we want to investigate further into the topic.

II. METHODOLOGY

Purpose of the experiment was to investigate the measures of eye tracking data that can predict consumer's choices. For this purpose we designed an experiment on Tobii Studio Software. Details of the experiment which include stimulus and procedure are given below.

A. Stimuli

The experiment was designed in such a way so as to represent a snacks shop with various food items (both vegetarian & non-vegetarian) and beverages. Total of 12 items were presented in 4 slides with 4 items in each slide. Common snacks such as Pizza, hot-dog, burger, and pastry; and drinks like Coca-Cola, Fanta, Mazza, and Coffee etc. were included in the study.

B. Procedure

Experiment started with a fixation cross which was followed by a food slide. There was a fixation cross following each food slide to re-calibrate the eyes at the centre of the screen. Subjects were asked to report the selected item after each food slide when the fixation cross appears. To begin with the next food slide they had to press the SPACE KEY. Food slides were presented for 7 seconds (which was found to be maximum duration required from a pilot study) and fixation cross was presented till the participants made their choices verbally after each trial.

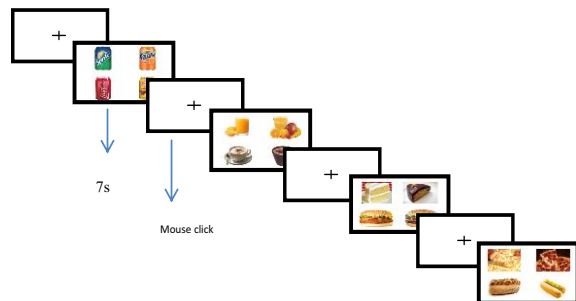


Figure 2. Trial structure of the experiment

Subjects were asked to look at the items for 7 seconds. They were then asked to select an item that they would like to buy. The experiment lasted for 3-4 minutes. We had four food slides and subjects had to report four items (one from each slide) that they would like to buy. Pictorial outline of the experimental design is shown in the Figure1.

Tobii TX300 eye tracking and Tobii Studio Software was used for recording the participants' eye gaze behavior. Eye movements were recorded at 300 Hz. The recording was binocular. Following calibration, eye position errors were less than 0.5 degree. Screen was divided into four areas of interest (AOI). For each trial, four measures (Fixation Counts, Total Fixation Duration, First Fixation Duration & Time to First Fixation) were recorded for each AOI. Four parameters of gazing behavior were collected. Time to First Fixation (TFF) measures how long it takes before a participant fixates on an AOI for the first time. First Fixation Duration (FFD) measures the duration of the first fixation on an AOI. Total Fixation Duration (TFD) measures the sum of the duration for all fixations within an AOI. Fixation Count (FC) measures the number of times the participant fixates on an AOI.

In this study 12 participants took part. All participants were recruited from the IIT Gandhinagar Campus. They all had normal or corrected to normal vision. They were paid Rs.50 for the participation.

III. RESULTS

Data consisting of four measures as described above for each AOI was standardized by divided individual values by their average. Further analysis was done on these standardized scores. As a preliminary analysis standardized scores of all the items were plotted to identify the general trend in data. Figure 4 shows the mean values of Fixation

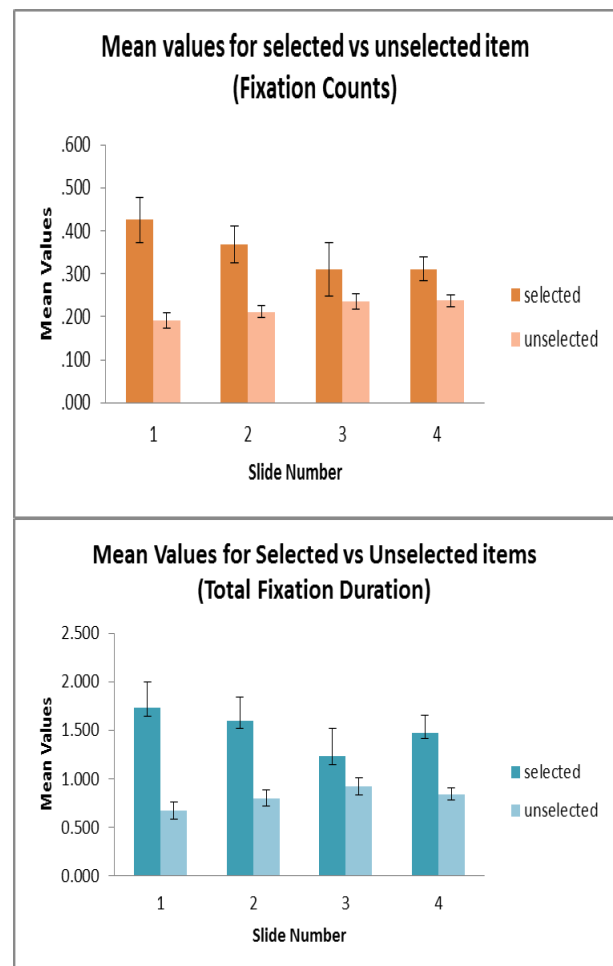


Figure 1. Mean Fixation Count (n) and Mean Total Fixation Duration (ms) Values of selected and unselected items are plotted in the graphs. Mean values for the selected items are higher in all the slides.

Counts, Total Fixation Duration, First Fixation Duration and Time to First Fixation are plotted for each item. This figure shows that Fixation Count and Total Fixation Duration predict choices whereas First Fixation Duration and Time to First Fixation fails to do so (as indicated by the arrows). Statistical analysis included t-test to analyze the difference between the mean values of different eye tracking measures

for selected and unselected items. Two way repeated measures ANOVA (Analysis of Variance) was done to check which of the measures could predict the choice of the participant.

Total number of selected items across 12 participants was 48, and the total number of unselected items was three times 48. To make the N equal, values for all the unselected items

and unselected items for all the four measures. Figure.2 illustrates the mean values of Fixation counts and Total Fixation Duration while Figure.3 illustrates the mean values of Time to First fixation and First Fixation Duration. Data was further analyzed with the analysis of variance (ANOVA) for repeated measures. Analysis yielded significant effect of Fixation counts and Total Fixation Duration at $p < 0.05$, $F(1,48) = 11.34$ & $F(1,48) = 14.23$. It can be interpreted as a

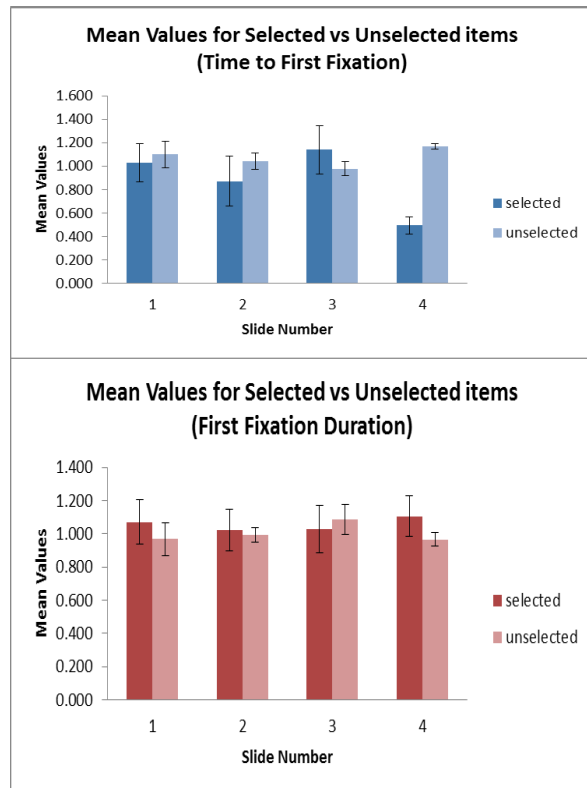


Figure 4. Mean values of First Fixation Duration (ms) and Time to First Fixation (ms) are plotted in the above two graphs.

for each slide were averaged. These values were then subjected to t-test and 2-way repeated measures ANOVA. Mean fixation count values for the selected (mean $\pm$ standard error: 0.3536 ± 0.1674) and unselected (0.2187 ± 0.056) items were significantly different at $p < 0.00001$. Similarly, mean Total Fixation Duration values for selected (1.511 ± 0.83) and unselected (0.808 ± 0.288) items were found to be significantly different at $p < 0.00001$. However significant difference between selected and unselected items was not found for Mean First Fixation Duration values. Similarly no significant difference between selected and unselected items was found for mean Time to First Fixation Values. Figures 2 and 3 plot the mean values for the selected

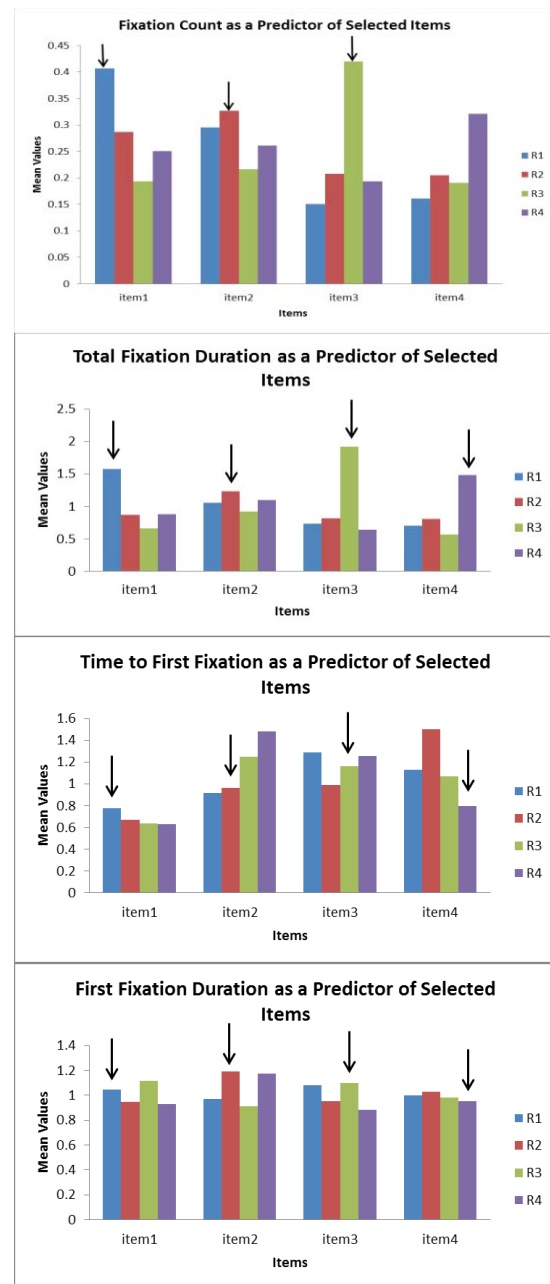


Figure 3. Mean values of Fixation Count ,Total Fixation Duration, Time to First Fixation and First Fixation Duration for all items are plotted to understand the general trend in data.

significant effect of Fixation Counts and Total Fixation Duration on the final choice.

TABLE I. SUMMARY TABLE OF ALL THE MEASURES MENTIONED IN THE RESULTS SECTION

Measures	Selected Items	Unselected items
Fixation count	0.35 ± 0.17	0.22 ± 0.06
Total Fixation Duration	1.51 ± 0.83	0.81 ± 0.29
Time to First Fixation	0.89 ± 0.59	1.07 ± 0.24
First Fixation Duration	1.04 ± 0.41	1.01 ± 0.23

(Mean ± Standard Deviation)

IV. DISCUSSION

The study aimed at finding out the parameters of eye tracking data that could predict consumer's choice. Options were not varied between vegetarians and non-vegetarians as we were trying to present a real shopping scenario. Various studies have shown that attention plays an important role in preference formation [6]. Shimojo et.al (2003) found that individuals focus more on the object that they would most likely buy. Studies have also found that manipulating attention changes preference to the object that is given more attention (because of the experimental manipulations) [6] [4] [11].

Started by Russo (1978) eye tracking has now become one of the important methodologies to study cognitive processes underlying choice and decision making. Given that attention plays such an important role in preference formation it is required to study its various components provided by eye tracking for their role in preference formation. Previous research has given a lot of attention on Total Fixation Duration. Total fixation duration has been reported as a predictor of choice by various studies [8] [12]. Various other measures still need to be studied for their role in predicting consumer's choice.

This study was an effort to add to the better understanding of consumer decision making process. Our single subject data analysis suggests a general involvement of Fixation Counts and Total Fixation Duration in predicting consumer's choice. No significant effect of AOI position was found on the consumer's choice. This clarifies that their decision was not affected by the location of the object.

Fixation Count and Total Fixation Duration correlated significantly with the consumer's choice. This is supported by the t-test and 2 way repeated measures ANOVA (Analysis of Variance). Figure 4 also supports this. We did not find significant correlation between Time to First Fixation, First Fixation Duration and choice. These results support the study done by [13] where they have reported fixation counts and visit duration as predictors of consumer's choice. Our findings suggest that position of the object does not play a significant role in buying behavior. It also suggests that Total Fixation duration and Fixation Count successfully predicts consumer's choice.

These findings will help sellers to improve their suggestions. Using these two parameters they can predict the

items that the consumer is interested to purchase. This will not only help sellers address consumers need in a better way but will also make shopping more satisfying and enjoyable to the consumers.

This study can be further extended to a real shopping scenario to validate the results found in the lab setting with the help of portable eye trackers.

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