

Consumer response to different discount sales promotional messages. An eye tracking and EEG experiment

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Abstract: This article presents a study of consumer behavior during the selection of products from a supermarket's leaflet. There are many factors that can determine whether a particular product attracts consumers' attention, such as price, brand, and sales discount. This study is focused on consumers' preferences among the three most common sales discount types. For the purpose of the study a leaflet that is identical to a real supermarket leaflet was designed, to resemble a real-life experience. Eye tracking and EEG were used to record participants' gaze and emotions while viewing the leaflet. The behavior of 42 participants was investigated and it was identified how valuable the clarity of the promotional message is. Moreover, EEG helped us analyze basic nonconscious preferences and cognitive processes, such as the effect of memorization, approach-withdrawal and workload in decision making.

Keywords—EEG, eye-tracking, consumer behavior, marketing, sales

I. INTRODUCTION

Supermarkets are the leaders in the Fast-Moving Consumer Goods (FMCG) industry as they can sell quickly and need to restock the shelves regularly due to the high turnover rate. Subsequently, supermarkets offer sales discounts on various products on a daily basis, and they advertise said discounts both online and offline. A consumer can find a supermarket leaflet online as well as at their doorstep, in an old-fashioned, but still very effective, way. A leaflet includes either some or all the products that are on sale for a specific timeframe, typically a week. Yet, how do supermarket managers know which type of discount attracts visual attention, thus is more effective?

This study presents how consumers respond to the three most frequently used types of sales discounts: 1+1 free, 50% discount (half price), and the use of the word 'only' on its own, without providing the original price of the product before the discount. However, to get a better perspective on customers'

visual attention and decision-making process, we used two neuroscientific tools: eye tracking (ET) and electroencephalography (EEG). A good understanding of the physiological and emotional response of consumers to advertising stimuli is essential for success in increasing sales and customer satisfaction, as well as attracting more customers [1].

Over the past 15 years, consumer neuroscience, also referred to as neuromarketing, has achieved increased degree of acceptance by the marketing research community despite its controversial backgrounds [2]. Until recently, the majority of consumer neuroscience research has predominantly used fMRI to measure brain activation in response to marketing stimuli and decision-making experiments [3,4], but there are many other options depending on the type or research objective and resources available. Eye tracking is now widely used in both settings to measure an individual's level of attention such as an advertisement on TV, print media, outdoor billboards, Web pages, product packaging labelling, branding logos, in-store promotions, and point-of-purchase displays [5,2]. On the other hand, the measurement of brain activity by EEG is an interesting technique that has recently been applied in consumer and sensory research of supermarket products; it can provide useful and detailed data to support the understanding of consumer responses to specific products [6,7,8,9]. Consumers respond to the various stimuli (colors, price, package design, etc.) in two ways: first, through a physiological response, such as changes in facial expression and autonomic nervous system activity and second, through changes in brain activity and an emotional response. Both responses outline the acceptability of a product to consumers [10].

Price promotions have emerged as an important marketing factor in the sales promotion strategy and have attracted an increasing amount of attention from both practitioners and researchers [11]. Sales promotion is defined as a direct

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inducement that offers an extra value or incentive for consumers with the primary objective of creating an immediate sale [12]. Sales promotions can be found in both monetary (price-related) and nonmonetary forms [13]. Marketers frequently use price-related promotions [14,15] as short-term incentives to attract new customers [16], draw consumers' attention to certain products or services, and trigger consumers' perception of getting a good deal [17].

The overall consumers' reaction to price promotions may take different behavioral responses such as brand switching, store switching, stockpiling, purchase acceleration, product trial, and more spending [18]. Price discount has been defined as a short-term reduction of the listed price of a service when all buyers are equally eligible for the price reductions [19]. Research has indicated that larger sales volumes can be achieved by offering price discounts [20]. The way a price-promotion is framed is likely to affect consumers' perceptions of price, quality, and purchase intentions [19]. A study by Nusair [11] indicates that coupons in general (e.g. buy one get one free, or coupons with \$, or percent discounts) can attract consumers to a particular retailer, lead consumers to purchase additional products, and strengthen the relationship between consumers and the retailer. When the same face value of a discount is phrased equivalently in terms of cents-off, percentage-off, and reduced price, a framing effect occurs [11]. When a price discount is phrased in euros off format, then the total amount of savings becomes the salient factor [11]. Similarly, when a price discount is phrased in percentage off format, the discount percentage becomes the most salient aspect of the deal [21].

Consumers perceive a price reduction framed in percentage terms as more significant than one expressed in dollar terms for the low-priced products, and the opposite was true for the high-priced products [19]. The findings of a study illustrate that compared with \$ off promotions, deep discount percentage off promotions lead to higher post-promotion price expectations [22]. Lastly, when it comes to the 'buy one, get one free' kind of discount, consumers might not be interested in two products, or there might be low conversion for the less expensive products. This type of discount is mostly used when brands have big stocks, or maybe a new season is starting, and they want to change stock with new ones [11].

The contribution of this article is: 1) to examine whether it is possible to determine the neural and behavioral, mechanisms and responses involved in consumer discount preference; 2) to investigate whether EEG is a suitable tool to study neural processes during product selection as there is a research gap around the topic; 3) to investigate whether the percentage-off discount type is associated with different memory workload, effort index and attention-withdrawal scores.

II. METHODOLOGY

It is important for marketers to recognize which sales promotion techniques efficiently generate consumer awareness and response [23]. Considering the above literature review, we used the following three types of discount framing to investigate the research hypotheses: 1) the percentage off

discount (-50%), 2) the vague 'ONLY' discount frame that are regularly seen in supermarket deals, and 3) the buy-one-get-one free (1+1) type of sale. Thus, we want to investigate whether the -50% sales discount is associated with different memory workload, effort index and attention-withdrawal (AW) scores. Hence, the hypotheses are formulated as:

Hypothesis 1a (H1a): There is at least one significant group mean difference on memorization score between the '-50%' discount, the '1+1' discount, and the 'ONLY' discount frame.

Hypothesis 1b (H1b): There is at least one significant group mean difference on workload score between the '-50%' discount, the '1+1' discount, and the 'ONLY' discount frame.

Hypothesis 1c (H1c): There is at least one significant group mean difference on approach-withdrawal score between the '-50%' discount, the '1+1' discount, and the 'ONLY' discount frame.

With regards to the eye tracking part of the experiment, the following two hypotheses are formed, as it is believed that the eye rests on items that the viewer finds interesting [1].

Hypothesis 2a (H2a): There is at least one significant group mean difference on fixation duration between the '-50%' discount, the '1+1' discount, and the 'ONLY' discount frame.

Hypothesis 2b (H2b): There is at least one significant group mean difference on number of fixation count between the '-50%' discount, the '1+1' discount, and the 'ONLY' discount frame.

During the experiment, participants were asked to select which products they would buy, based on the pricing and sales discount available on the leaflet. This is to investigate whether people tend to buy more products that come with percentage-off discount, as previously found in research articles. Consequently, the following hypothesis is formed:

Hypothesis 3 (H3): Products with the percentage-off discount are more frequently bought by consumers, compared to the two other types of discount sale.

A. Materials and stimuli

The leaflet that is used in this study was designed by an advertising agency, with the guidance of the researchers. The objective is to create a leaflet that is identical to the real-life leaflet that consumers come across in their everyday life. Thus, the leaflet's font type, font size, colors, orientation, as well as the products and the prices that are included in the leaflet are all accurate (Figure 1). In total, six double pages were created for the mock leaflet, and each page included 12 products. Hence, participants were able to select as many of the 144 products (12 pages times 12 products per page) presented in the leaflet. Since the focus of this study is to estimate which discount type is mostly preferred by customer -if any-, we agreed to include three sales discount types that are widely used by all supermarkets. The first type of discount is the '1+1 for free', which means that customers can get two products and pay only for one of them. The second discount type is the half price discount '-50%'. The third type is the appearance of the word ONLY in capital letters (MONO in Greek), which does not clearly indicate how much the consumers save if they buy the product as there is no indication of the original price or the percentage of discount.

B. Participants demographics

A total of 44 individuals (25 males and 19 females, aged 31.5 ± 8.84) participated in this study, all native Greek speakers, originating from Greece. The data from two subjects are excluded from the analysis due to high levels of artifactual contamination. Regarding the participants' education, 45.5% of them hold a Master's degree and 34.1% have a Bachelor's degree. 72.7% of the participants are not married and 18.2% are married, while only 7 participants (15.9%) have children.



Figure 1: Example from page 1 of the leaflet

C. Set up of the experiment

The experiment took place at the premises of the Information Technologies Institute of CERTH, from April to June 2022. The neuromarketing lab is in a quiet soundproof room under standard illumination conditions. After calibration, general instructions for the task were verbally given to each participant. The subjects had previously signed a consent form and were aware that they can withdraw the experiment at any time. The whole process, from completing the questionnaire to running the experiment, had a duration of approximately 45 minutes. EEG electrodes were applied on the participants' scalps. Participants were instructed to relax and reduce blinking. Participants were informed that a supermarket leaflet will appear on the screen, and they were encouraged to use the mouse to select as many products as they like in a way that represents their real-life buying behavior. They were asked to minimize sudden movements while looking at the leaflet. There was no limit to their budget and there was no time constraint attached to the experiment. The participants were able to turn the pages of the leaflet, by using the mouse, and they could go back and forth as many times as they liked.

The raw data was recorded using Wearable Sensing's DSI 24² and Tobii Pro Fusion³ for the EEG and ET data respectively. The brain activity was recorded, with a sampling frequency of 300 Hz, via 21 dry sensors, namely Fp1, Fp2, Fz, F3, F4, F7, F8, Cz, C3, C4, T7/T3, T8/T4, Pz, P3, P4, P7/T5, P8/T6, O1, O2, A1 and A2, that were placed at locations corresponding to the 10–20 International System. The Sensors A1 and A2 were the reference electrodes and were placed on

the mastoids. A detailed description of the acquired dataset is provided in our paper NeuMa [24].

D. EEG and ET analysis

Workload is described as the activity level of the frontal theta in the prefrontal cortex. Higher theta activity has been associated with higher levels of task difficulty and complexity in the frontal area. It is an indication of cognitive processing arising from mental exhaustion [25] and has been frequently studied in neuromarketing research. Memorization can be measured with EEG as different memory workload associated EEG signal patterns that make it possible to classify the corresponding memory load levels. The change in signal power in the theta band (4–8 Hz) at frontal channels is significant for distinguishing the lowest workload level from the higher workload levels [26]. The AW index measures the frontal alpha asymmetry reflected the difference between the left and right hemispheres; that is, the percentage of participation of the left hemisphere compared to the right one in the frontal alpha band [27].

Eye tracking is a behavioural tool that helps researchers understand visual attention [1,28], by detecting which point they see, how long they are staring and the path that the eyes follow [29]. Essentially, this method can provide data about the location of fixation, duration, and eye movement [29]. Fixation duration shows for how long a participant looked at a specific area of interest [29]. Fixation count demonstrates how many respondents fixated their gaze on the selected object at least once [29]. Eye tracking can significantly contribute to the study's goal as it helps marketers understand what attracts the customers in the retail environment [30].

In this study, the Preprocessed NeuMa dataset [24] was used. The EEG and ET signals are segmented on a product basis. Therefore, for each product, we obtained the EEG and ET segments that correspond to the time intervals during which the participants' gaze to a particular product. These segments are concatenated, and the concatenated signals are used to isolate the brain and ocular responses corresponding to particular products. Furthermore, in the analysis we reject concatenated signals with small time intervals (<1sec). Then, the following five indices are extracted: workload (or effort index), memorization, attention-withdrawal, fixation duration and fixation count. The first three are related to the EEG while the last two are related to the ET.

III. RESULTS

This section shows the statistical analysis to investigate the hypotheses that are presented in section II. In specific, two different statistical analyses, ANOVA and Kruskal-Wallis test, were used to test the hypotheses. Initially, it is useful to know how many times participants clicked on a product, which indicates how many products were virtually bought (purchase intention). In total, 442 clicks are counted by all 42 participants. Table I presents the frequencies per discount type. 166 clicks are recorded on products with the -50% discount type, 150 clicks are on products that come with the 'ONLY' discount

² <https://wearablesensing.com/products/dsi-24/>

³ <https://www.tobii.com/product-listing/fusion/>

frame and 126 clicks are on products with the 1+1 free discount type. As expected, the percentage-off type of discount gathered more clicks than the rest, although the difference is small.

TABLE I FREQUENCIES PER DISCOUNT TYPE

Discount type	%	N of clicks
50% off	37.6%	166
ONLY	33.9%	150
1+1 free	28.5%	126
SUM	100%	442

The ‘ONLY’ discount type covers 46.5% of the leaflet, while 25% is covered by the 1+1 for free discount type and 28.5% by the percentage off discount type (Table II). Consequently, the participants viewed 67 products that come with the unclear ‘ONLY’ discount frame, yet they only clicked 150 times on some of them. On the contrary, although only 41 products appear with the 50% off discount frame, participants clicked on said products 166 times.

TABLE II NUMBER OF PRODUCTS PER DISCOUNT TYPE

Discount type	%	N of products
50% off	28.5%	41
ONLY	46.5%	67
1+1 free	25.0%	36
SUM	100%	144

JASP, a cross-platform software programme was used to test the hypotheses. JASP offers both frequentist and Bayesian analysis methods [31]. ANOVA was used to establish the relation between the dependent variable (workload, memorization, attention-withdrawal) and the multiple independent variables (50% off discount, 1+1 for free, ONLY). The results indicate that there is no statistical significance between workload and type of discount as $p > .05$. Similarly, there is no statistical significance between memorization and type of discount ($p > .05$). Therefore, both H1a and H1b are rejected. However, there is statistical significance between AW and type of discount ($p < .05$, Table III). In specific, there is significance between the percentage off discount (-50%) and the discount type ‘ONLY’ (Table IV) as $F(2,141)=4.037$, $p < .05$. Hence, H1c is confirmed.

TABLE III ANOVA FOR AW AND DISCOUNT TYPE

ANOVA-AW					
Cases	Sum of Squares	df	Mean square	F	p
Discount id	0.121	2	0.061	4.037	0.020*
Residuals	2.120	141	0.015		

Note. Type III Sum of Squares

TABLE IV POST HOC TEST FOR AW AND DISCOUNT TYPE

Post Hoc Comparisons-Discount id					
		Mean Difference	SE	t	P_{Tukey}
1	2	0.068	0.024	2.814	0.015*
	3	0.033	0.028	1.187	0.463
2	3	-0.035	0.025	-1.388	0.350

Note. P value adjusted for comparing a family of 3

With respect to the eye tracking indices, the results indicate that there is no statistical significance between fixation duration and type of discount, nor there is statistical significance between fixation count and the type of discount ($p > .05$). Consequently, H2a and H2b are both rejected.

Finally, regarding H3, the normality assumption of ANOVA is violated, hence the Kruskal-Wallis test is used. The Kruskal-Wallis test has showed that there is significant difference in buying a product between different discount types, (Table V). Post hoc comparisons of pairs using Dunn’s test reveals a significant difference between discount type 1 (-50%) and discount type 2 (the ‘ONLY’ frame discount) (Table VI).

TABLE V KRUSKAL-WALLIS TEST FOR BUY/NO BUY AND DISCOUNT TYPE

Kruskal-Wallis Test			
Factor	Statistic	df	p
Discount id	6.156	2	0.046

TABLE VI POST HOC TEST FOR DISCOUNT TYPE AND BUY/NO BUY

Post Hoc Comparisons-Discount id					
		z	p	P_{Bonf}	P_{Holm}
1	2	2.481	0.013*	0.039*	0.039*
	3	1.311	0.190	0.570	0.380
2	3	-0.932	0.351	1.000	0.380

Note. p value adjusted for comparing a family of 3

IV. CONCLUSIONS

EEG and ET are used in this study as brain activity and eye movements can provide marketers with information not accessible via traditional marketing research methods, such as observations, interviews, surveys and focus groups [32]. The experiment presented in this paper provides insights into the possible contribution of EEG data to the prediction of consumer behavior during product selection and discount preference. The findings illustrate that the percentage-off discount is associated with participants’ attention-withdrawal. AW is related to both positive and negative feelings; thus, the findings show that participants paid more attention to the -50% discount that was presented, probably because said discount type is more preferred by consumers, which is in accordance with previous findings [19, 22].

Moreover, the findings show that people tend to buy more products that come with the percentage-off discount type, compared to others, as previously found by academics [11,19]. This is most likely because customers think that paying half price is a better deal compared to buying two products for the price of one. The three discount types used in this study are very different and leave no room for comparison between different percentages. We assume that customers perceive the ‘ONLY’ discount frame as unclear, considering the initial price of the product is not disclosed and customer does not know how much money is saved. In a similar vein, the 1+1 discount type might be perceived by customers as unnecessary if two same products are not needed. This makes the percentage-off discount type look more like a win-win situation for consumers.

A limitation for every EEG study is the subject's emotional states, the educational level of development, the age, the neurological and cognitive conditions, and the non-stationary

nature of EEG which can also affect the quality of the EEG data recordings [33]. However, the limitation was not influenced by the research design. Future research can investigate the differences between discount type and product type as it is useful to understand whether consumers change their discount preferences when a product falls under a specific category (i.e. food, household, health, and beauty, etc.). Also, further research should look at whether the findings change when respondents' spending budget is limited.

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