



# Eye blinks as an objective measurement of consumers emotional and motivational attitude towards brands

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Thesis by

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## 1. Summary

The aim of this paper is to investigate whether eye blink behavior can be used as an objective measurement of consumers' emotional and motivational attitude towards brands. This research consists of four parts:

1. Pilot-test
2. First experiment
3. Second experiment
4. the expansion of the first experiment

In the first part we designed a pilot test with the aim to verify whether we can use the eye blinks rates to measure levels of desire for a certain brand. Seven subjects participated in the pilot test, where they were exposed to visual stimuli divided in three categories (food, sexual stimulation and smoking) and a control category with neutral pictures (undesirable, neutral objects). Secondly, in the first experiment seven subjects were instructed to sit in front of a monitor to watch some pictures in two product categories, namely lingerie and food each divided in two classes: cheap brands and expensive brands. The purpose of this experiment is to measure a level of desire for a specific brand (cheap or expensive) in the product categories food and lingerie.

We then developed a second experiment which is a combination of pictures of desirable products in combination with the subject imagining themselves in a purchasing situation. The experiment consists of two stages, the observation stage and the active stage. The second stage contains: three imaginary tasks and a brand awareness and recognition task. In the last experiment we used the format of the first experiment and we increased the subjects from seven to sixteen.

The results of the pilot-test suggest that we can use the eye blink rates as a measurement of desire and attraction, although a small variation between the resting stage and the observation stage. This allowed us to start with the next experiment, which has the same format as the pilot, but we increased the number of lingerie and food. The results of experiment 1 are inconsistent with the findings of Walla *et al.* (2011), which suggest that individuals blink more when they are exposed to desirable objects. The structure of the second experiment was too complex for the participants, which influenced the subjects' attention during the experiment. The results of last experiment suggest a statistical significant relation between the eye blink behavior in the two product categories, food and lingerie. On the other hand, we did not find such statistical significance between the cheap and expensive brands for both product categories.

We conclude that our experiment cannot confirm the findings of Walla *et al.* (2011). However, we do not feel that the research setup is to blame. Indeed, we did find a different behavior in eye blinking between lingerie and food, thus proving that eye blinking can be used for marketing research purposes. The nature of our data is based on sixteen female participants who regard shopping for lingerie as a much more complex matter than merely its functionality. Women tend to assess both the lingerie as well as the model wearing it. Therefore lingerie evokes both feelings of sexual desire as well as the wish to possess the physical features of the model wearing the lingerie. Food however lacks this aspect, which is possibly why we find different eye blinking behavior towards it.

## 2. Introduction

The purchasing behavior and the consumers' behavior towards advertising/marketing actions is often used to measure brand attitude, but the emotional and motivational evaluations of consumers are more complex to measure, since these evaluations are rooted in the mind of consumers.

### **Why emotional and motivational evaluations of consumers?**

Most of the studies and discussions aim to explain consumer behavior using brand attitude as a measurement of evaluative tools, such as questionnaires, rating systems or the purchasing behavior of consumers' scales<sup>1</sup>. These evaluative tools do not succeed to observe the emotional and motivational aspects of brand attitude, since self-reported measures are most often cognitively polluted<sup>2</sup>. The emotional aspects are a strong component of brand attitude<sup>3</sup>, since brand attitude is defined as the extent in which a brand is able to create strong emotional ties with its customers<sup>4</sup>. The study of Schaefer *et al.* (2006) shows that famous brands evoke prefrontal cortex activity: The subjects used in the study were instructed to imagine using the familiar branded cars. This finding suggests that emotion plays a big role to brand attitude, since the prefrontal cortex is involved in emotion-related information processing.

In the research of Knutson *et al.* (2007) the functional MRI is used on subjects, while the subjects were exposed to images of products, which were available to purchase during the experiment. First, the subjects were shown images of various products, and then the price of the product appears. Finally the subjects have to decide whether or not to purchase the different products used during the experiment. The researchers could predict whether the subjects will purchase a product for a certain price or not with a linear combination of brain activity in three areas: the *nucleus accumbens* (reacts on rewards), the *insula* (emotions and pain, also price-pain) and the medial prefrontal cortex (unconscious decision making). The unconscious decision making process in the prefrontal cortex is a better predictor of purchasing-behavior than the conscious decision. The answers of the subjects on the question whether they want to buy the product predicts 20% of the purchasing behavior, where the results of the functional MRI, measuring activity in the three brain areas, could predict 70% of the purchasing behavior of the subjects. The correlation between the results of the functional MRI and the actual purchasing behavior is stronger (predicting 70%) than the correlation between the results of the questionnaires and the actual purchasing behavior (predicting 20%). The study of Knutson *et al.* (2007) tries to predict the purchasing behavior by measuring the emotional and motivational evaluations which are rooted in the

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<sup>1</sup> Mitchell and Olson (1981); Batra and Ahtola (1990)

<sup>2</sup> Walla, Peter *et al.* (2011)

<sup>3</sup> Thompson *et al.* (2006)

<sup>4</sup> Lemon *et al.* (2001)

brain areas - *nucleus accumbens* and the medial prefrontal cortex - and by measuring the financial pain in the insula.

Traditional market research is used to ask the consumers directly about a certain brand or product: “what do you think of the price, quality, service, attributes, package, website, logo” in order to gather knowledge about the consumer or purchasing behavior. The outcome of such questionnaires is considered as explicit knowledge. The studies of Erk *et al.* (2002; 2003) show that the decision making process in economic situations depends on two components; the explicit knowledge and implicit information, where explicit knowledge is considered as knowledge of prices and the attributes of a product. The implicit information or the “intuitive” process can contribute in the decision making process by filtering relevant objects by limiting the decision process and reducing the uncertainty. Walla *et al.* (2011) find that the explicit knowledge is more objective compared to the implicit information and explicit knowledge is easier to measure in a questionnaire than implicit knowledge, because the implicit knowledge is cognitively polluted.

The study of Deppe *et al.* (2005) shows that the decision making process with the favorite or liked brands of the subjects participated in the experiment lowers the activity in brain areas related to the working memory and reasoning. At the same time the activity in the brain areas associated with processing emotions and self-reflection increased. Apparently the favorite or liked brands weaken or strengthen the emotions that are related to a certain brand. The research of Deppe *et al.* (2005) also suggest that the favorite brand simplified the decision making process which make it possible for a consumer to act efficiently and quickly in a decision making process.

### **Eye blinking**

Eye blinking can be caused by voluntary, reflex or spontaneous response to incentives of the outside world. The eye blinking behavior of individuals varies substantially. The reflex and voluntary eye blinks have a shorter duration and have smaller amplitude (Perry 2007; Wallace *et al.* 2006). Due to the difference in duration and amplitude of the reflex and voluntary eye blinks, the eye blinks caused by a spontaneous response can be distinguished. Spontaneous eye blink rates can be used as an objective tool to measure emotions that are related to brand attitude. This is a new way to quantify emotion-related aspects of relevant to marketing.

Several studies in cognitive neuroscience and psychology have shown that the spontaneous eye blink rates (EBR) are related to levels of dopamine (chemical neurotransmitter) activity in the brain. See for example Blin *et al.* (1990), Karson (1983) and Kleven *et al.* (1996). The dopamine activity occurs in the reward and pleasure centers in the brain<sup>5</sup>. The spontaneous eye blink rates of individuals are related to the level of attention when the individuals are

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<sup>5</sup> Dopamine. Definition, Psychology Today website: <http://www.psychologytoday.com/basics/dopamine>

exposed to visual stimuli. Also the spontaneous eye blink rates influences the cognitive decision making process of individuals. The study Leigh *et al* (2004) shows that there appears to be a direct relation between variation of eye blinks and other physiological signs during the decision making process and the evaluation of choices.

The decision making process consist of two parameters, the psychological and the physiological. Examples of psychological parameters are thoughts, emotions and behavior. Heart rate, eye movements, skin conductance and spontaneous eye blinks are examples of physiological parameters. The physiological measures are dependent variables on independent variables such as visual, smell and auditory stimuli which influence the physiological state of an individual according to Andreassi (2000).

Other studies in cognitive neuroscience and psychology show that "*the eyes are the window of the soul*", this can be found in the research of Taylor *et al.* (1999) and Laeng *et al.* (2012), which have shown that spontaneous eye blink rates are related to levels of dopamine - a chemical neurotransmitter - that is involved in the brains pleasure and reward centers. If dopamine activity is enhanced, the eye blink rate increases, and if the dopamine activity is blocked the eye blink rate decreases. Spontaneous eye blink rates are directly related to emotional responses, attention and attraction.

The article of Walla *et al.* (2011) tests the hypothesis that the likes and dislikes of individuals occurring in relation to brand attitude can be objectively evaluated. The subjects used in their experiment rated common brands pertaining to subjective preference. Then, the subjects participated in an experiment where the most liked and disliked brand names were visually presented while three different objective measures were taken:

1. eye blink rates
2. skin conductance
3. heart rate.

The authors find a significantly reduced eye blink amplitudes related to liked brands compared to the disliked brands. This finding suggests that the visual perception of liked brands provokes higher levels of pleasantness and more positive emotions compared to visual perception of disliked brand names.

The conclusion of the before mentioned article is that all physiological measures (eye blink rates, skin conductance and heart rate) mark emotion-related differences which depend on the liked and disliked brands of individuals. The authors suggest that objective measures should be used more frequently to measure emotion-related aspects of brand attitude during the product development, product design and other elements relevant to marketing.



## **Brands**

Brands do play a certain role in our every day life, they stand for products sold under their name and are associated with the consumers: product knowledge, experiences related to firms producing and selling products. The overall emotions of an individuals forms the individual brand attitude.

Positive attitude towards an object influences the individual object-related behavior<sup>6</sup>. Therefore, positive attitudes towards a brand have a positive influence on purchase behavior and brand loyalty. The strategy to promote positive touching responses to a brand can increase the value of the brand which is the basis for high brand equity and brand profitability<sup>7</sup>. In the long run, consumer attitudes towards a brand can significantly shape a firm's economic performance. A common approach of (traditional) marketing studies is that the creating of favorable brand attitudes leads to building brand equity (Keller 1993; 2003)

The creation of favorable brand attitudes can be achieved by various marketing tools such as; advertisements, loyalty programs, sponsorships, product placements, customer services and other promotion tools. Thus we performed an experiment with the aim to test if the desire and pleasure level, measured by the eye blink rates, of the subjects differs when they are exposed to visual stimuli of high and low quality product's ads.

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<sup>6</sup> Friedkin (2010)

<sup>7</sup> Sweldens *et al.* (2010); Chaudhuri and Holbrok (2001)

### 3. Research setup

We investigated the eye blink behavior of test subjects for our research. This research is setup as three separate tests. Firstly, we did a pilot test to practically verify whether we can use eye blink behavior as a tool to measure a level of desire for a certain brand of product. We do this by putting the test subject in front of a screen, which will show pictures. In total we will employ two types of products, each split into two versions: one cheap version and one version of a desirable or popular brand. The two types of product we use are food and lingerie.

Therefore, our setup can be classified by the table hereunder. The abbreviations used in this table will be used further throughout this research paper.

<b>Table 1 - product classification and abbreviation</b>		
<b>product</b>	<b>classification</b>	<b>abbreviation</b>
food	expensive	FE
	cheap	FC
lingerie	expensive	LE
	cheap	LC

**Table 1:** we use three product categories for our research, those being food (food condition) and lingerie (sexual stimulation condition). Each category is divided into two classifications. The product is either perceived as cheap or an unknown brand, or as expensive or of a popular brand. Each of the four combinations is abbreviated for ease of reference.

Then, we executed the first experiment which is to be considered a pre-test. The purpose of this pre-test is to determine whether eye blink behavior is an actual signal of dopamine activity in the subjects' brain. Lastly, we executed a test which consists of a combination of pictures of desirable products in combination with the subject imagining themselves in a purchasing situation.

#### **3.1 Pilot test**

The eye blink rate is directly related to emotional responses, attention and attraction. The eye blink rate is also related to the dopamine activity in the brain. When there is a high eye blink rate the dopamine activity is high, whereas a low eye blink rate indicates a low dopamine level. In the pilot test we wanted to examine whether we could use eye blink rate as a measurement of desire, attention or attraction though the level of dopamine activity in the brain. We used visual stimuli in the form of pictures for our seven subjects with the categories: food, sexual stimulation, smoking and a control variable "neutral" in the form of pictures of undesirable objects.

Each subject sits in front of the monitor and gets connected with several electrodes under and above the eyes, as well as behind the ears. After this we leave the subject alone and

close the door. The experiment starts with a “resting” state of four minutes. This means that there is no picture projected on the monitor and we instructed the subject to relax. This allows us to measure the eye blink behavior in the resting condition for all subjects. The neutral state consists of the test subject watching pictures on the monitor of undesirable objects. The purpose of this is to function as the basis of our research. We use this data to compare it to the number of eye blinks when the test subject sees an image of a desirable object. Then we monitored 30 pictures (during two minutes) of each category (food, sexual stimulation, smoke). We selected and used these categories, because sexual stimuli and food are natural rewards which elicit activation of the ventral striatum, a reward center in the brain area (Erk *et al.* 2002; Pfaus 2011; Small *et al.* 2001).

From the pilot test we get the data depicted in the table hereunder as a result.

<b>Table 2 - average eye blink rate</b>	
<b>N = 7</b>	
<b>condition</b>	<b>blinks per minute</b>
rest condition	12.13
neutral condition	17.25
food condition	16.58
sexual stimulation condition	19.33
smoking condition	13.50

**Table 2:** this table shows the average eye blink rate in number of blinks per minute of the seven test subjects during the pilot study. During the “resting” state of four minutes, the average eye blink rate was 12.13. During the neutral state in which test subjects were viewing pictures of undesirable objects, the average eye blink rate was 17.25. When pictures of food were displayed, the average eye blink rate was 16.58. When pictures of naked women were displayed, followed by pictures of cigarettes, the average eye blink rates were 19.33 and 13.50 respectively.

At the end of our session, we inquired with the test subject whether he or she was a smoker or not. In case of a positive answer, we also inquired when they consumed their last cigarette. This information is relevant since we hypothesized that only test subjects who smoke would be stimulated by pictures of cigarettes.

We found that out of the total of seven test subjects, three were classified as not being representative for the sample, as their eye blink rate was either extremely high or extremely low. In other words, three out of seven test subjects either blinked extremely often, otherwise rarely. One out of seven blinked much less than the average whereas two out of seven blinked extremely often. We concluded that the findings as depicted in table 2 were invalid with this sample composition. Therefore we eliminated the extreme observations from our sample and recalculated the average number of eye blinks per minute. The results can be found in table 3.

<b>Table 3 - average eye blink rate after filtering</b>	
<b>N = 4</b>	
<b>condition</b>	<b>blinks per minute</b>
rest condition	10.50
neutral condition	17.25
food condition	17.00
sexual stimulation condition	20.63
smoking condition	11.13

**Table 3:** since the sample on which table 2 is based contained extreme observations, we had to eliminate these observations in order to recalculate the average number of eye blinks per minute, which gives us the eye blink rate after filtering. During the “resting” state, the average blinks per minute is 10.5, whereas it is 17.25 while the valid test subjects are viewing pictures of undesirable objects in the neutral condition. The average blinks per minute are 17, 20.63 and 11.13 respectively for the sessions in which food, naked women and pictures of cigarettes were displayed. Note that these numbers differ considerably from the results we found in table 2.

Upon closer inspection of the sample data used to create table 3, we find that another test subject shows extreme eye blinking behavior. Upon elimination of this test subject, we recalculate the new averages as shown in table 4.

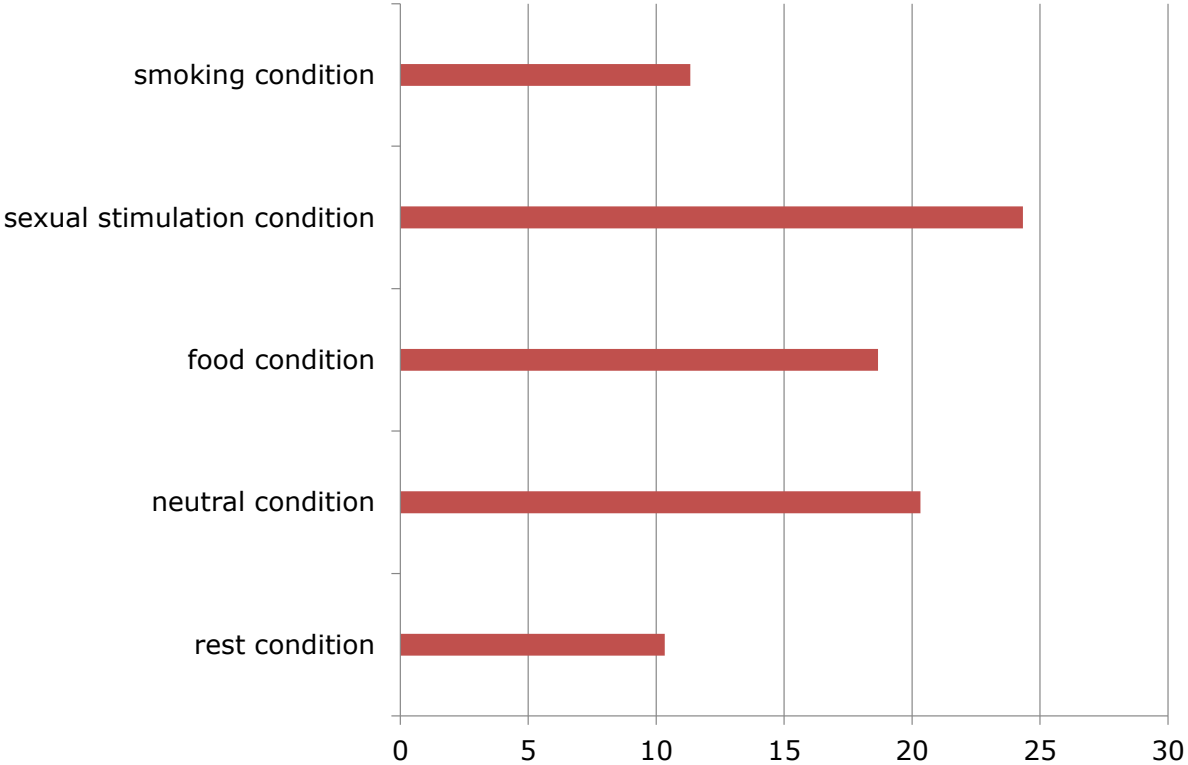
<b>Table 4 - average eye blink rate after second filtering</b>	
<b>N = 3</b>	
<b>condition</b>	<b>blinks per minute</b>
rest condition	10.33
neutral condition	20.33
food condition	18.67
sexual stimulation condition	24.33
smoking condition	11.33

**Table 4:** one of the four test subjects shows extreme eye blinking behavior according to the data used to create table 3. Upon elimination of this extreme observation, we acquire the results as displayed in table 4. The average number of eye blinks per minute in the “resting” condition remains close to its former value with 10.33. The average number of eye blinks during the neutral condition has increased to 20.33. The average number of eye blinks during the three sessions all have increased to 18.67, 24.33 and 11.33 for pictures of food (food condition), pictures of naked women (sexual stimulation condition) and pictures of cigarettes (smoking condition), respectively.

When there is a high eye blink rate the dopamine activity is high, whereas a low eye blink rate indicates a low dopamine level. I

From the table we can see that the eye blink behaviors of the test subjects are quite variable. The condition which the most eye blinks per minute is the condition in which pictures of naked women were shown (sexual stimulation condition). This one is followed in average number of eye blinks per minute by the pictures of undesirable objects (neutral condition). The recalculation of the average eye blink rates (table 4) shows a greater difference between the neutral condition and sexual stimulation condition, compared to the

results in table 2 and 3. The eye blink rate for the sexual stimulation condition (24.33 blinks per minute) is 19.68 % higher compared to the neutral condition (20.33 blinks per minute). We also see that the test subjects blink less per minute when pictures of food are shown, as well as when pictures of cigarettes are shown – the food condition and smoking condition, respectively. It is worth noting that only one test subject was an actual smoker. Graph 1 below summarizes our findings.



**Graph 1:** the above graph summarizes our findings of the pilot test. It shows average number of blinks per minute on the x-axis, and the condition in question on the y-axis. We employ the neutral condition in which test subjects are shown pictures of undesirable objects as our basis of measurement. If we compare the average number of eye blinks between the neutral condition and the sexual stimulation condition, we can conclude that eye blinking behavior can indeed be used as a measure of desire, attention or in this case, attraction.

Since the average number of blinks per minute between the sexual condition and the neutral condition – our basic point of measurement – differ significantly between each other, we conclude that eye blinking behavior indeed can be used as a mean to measure desire, attention or attraction.

#### 4. Experiment 1

The pilot test validates our hypothesis that it is indeed possible to use eye blink behavior as a measure of desire for certain products. In our research, we will continue to focus on two product groups, namely food and lingerie. Both products are divided into two categories, being the cheap category and the expensive category. Recall the product classifications as specified in Table 1.



Food cheap (FC)



(2) Food expensive (FE)



Lingerie cheap (LC)



(4) Lingerie expensive (LE)

The reasons for this classification are due to social implications which cheap and expensive products are associated with. For example, lingerie comes in both cheap brands and expensive brands. Women however do not only classify a product by its functionality, but also by emotional value: they experience extreme feelings of satisfaction when purchasing an expensive brand of lingerie, as the women not only associate with the brand, but also with the model wearing said lingerie. Therefore we find that expensive brand lingerie is

considered more desirable than cheap brand lingerie. Next we use the product category food, which also comes in either cheap or expensive brands.

For our experiment at the laboratory of Erasmus University we selected a total of seven female participants. The reason for the selection of women has been argued previously: men have a more functional viewpoint on the purchase of products – as well as lingerie, which could distort our experiment. During this experiment, participants were confronted with printed advertisements of both cheap and expensive brands of lingerie and food. Of each product class, a total of thirty-five advertisements were displayed. Table 5 summarizes the setup of the experiment.

<b>Table 5 - product and class setup</b>		
<b>N = 7</b>		
<b>product type</b>	<b>product class</b>	<b># advertisements displayed</b>
Food	FE	35
	FC	35
Lingerie	LE	35
	LC	35
<b>total</b>		<b>140</b>

*Table 5: for our experiment, we employed a total of 140 printed advertisements. These 140 printed advertisements are equally divided amongst the two product types and four product classes. For the product type of Food, we employed a total of 70 printed advertisements, as well as another 70 printed advertisements for the product type Lingerie. 35 of these 70 printed advertisements for Food can be classified as expensive brands of Food (FE), whereas the other 35 printed advertisements for Food are classified as cheap brands of Food (FC). In the same manner, we can classify the 70 printed advertisements for Lingerie in 35 printed advertisements of expensive brand lingerie (LE) and 35 printed advertisements of cheap brand lingerie (LC).*

The participants were informed beforehand that the experiment concerned itself with a brand memory test, which would take approximately twenty minutes. Due to technical limitations of the eye blink system employed, each product class would have to last one minute. We also took into account that the total timeframe had to be kept brief in order to prevent the participants becoming bored or annoyed, which could be detrimental to our experiments' results.

Thus, our experiment's timeframe could be summed up as following:

Four minutes of rest, in which the participants were not confronted with any advertisements at all.

- Presentation of the first product class for the duration of two minutes.
- A one minute break where no advertisements were shown.
- Presentation of the second product class for the duration of two minutes.
- A one minute break where no advertisements were shown.
- Presentation of the third product class for the duration of two minutes.

- A one minute break where no advertisements were shown.
- Presentation of the fourth product class for the duration of two minutes.
- Classifying new or previously shown printed advertisements.
- Filling out a questionnaire in regard to brand awareness.

At the end of this experiment, participants were informed that they would then be shown printed advertisements which were either shown previously or new printed advertisements. Each participant had to press a specific key on the keyboard when he believed he had seen the printed advertisement before, or press another key on the keyboard to indicate he believed it was a printed advertisement he had not seen before.

To wrap up the experiment, a questionnaire was distributed amongst the participants. The questionnaire consisted of three questions, which were to verify which brands the participants already knew, and which brands they would purchase related to food and lingerie. For each question, the choices were limited to either two expensive or two cheap brands.

The results of the experiment show different averages of eye-blinking rates per product class and type. The average number of eye blinks for Food is 50,1 blinks per minute, whereas that for Lingerie is 48,6 blinks per minute. Note that for both the Food Expensive (FE) class as well as the Lingerie Expensive (LE) class, subjects blinked more often per minute than they did with the cheap (FC and LC, respectively) classes.

<b>Table 6 - Average number eye blinks per condition, per class of product</b>			
<b>N = 7</b>			
<b>product type</b>	<b>product class</b>	<b>average number eye blinks</b>	<b>product class average</b>
Food	FE	51,7	50,1
	FC	48,4	
Lingerie	LE	49,1	48,6
	LC	48,1	

**Table 6:** the average number of eye blinks per class of product as displayed above. The classes concern itself with Food Expensive (FE), Food Cheap (FC), Lingerie Expensive (LE) and Lingerie Cheap (LC). The average number of eye blinks for Food is 50,1 whereas this is 48,6 for Lingerie. It is worth nothing that for the expensive brands, people blinked more often on average per minute than they did with the cheap equivalents. This applies to both Food as well as Lingerie.

When we look closer upon the data we find that four out of seven participants (57,1%) blinked more on average when watching cheap brands of lingerie than when they were watching expensive brands. This in contrast to 42,9% of the participants which did the opposite: they blinked on average more while watching expensive brands of lingerie than when they were watching cheap brands. Two out of seven participants (28,6%) blinked on average more when confronted with cheap brands of food, whereas this number is 71,4%

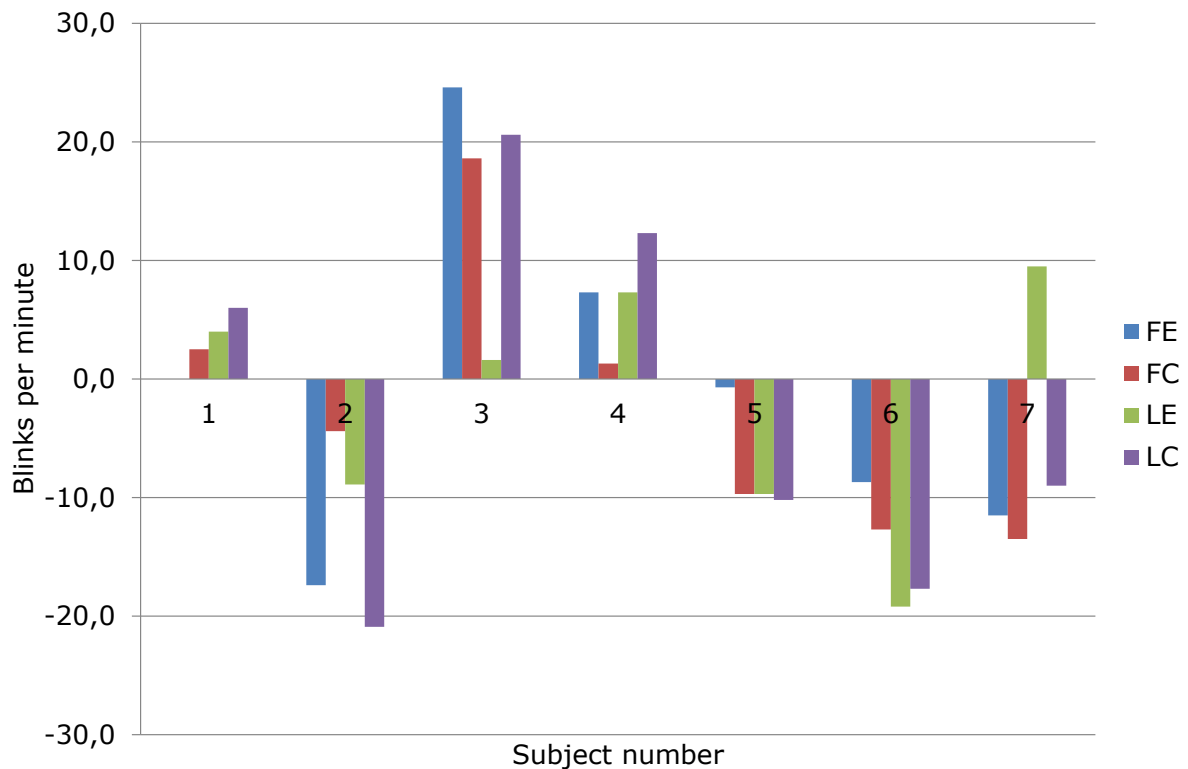


for participants which blinked on average more when watching expensive brands of food in comparison to the cheap brands. Details are displayed in table 7 hereunder.

<b>Table 7 - Eye blinks per participant, per class of product</b>									
<b>N = 7</b>									
<b>product type</b>	<b>product class</b>	<b>Subject number</b>							
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	
Food	FE	17,0	27,0	46,0	38,5	19,5	26,5	6,5	
	FC	19,5	40,0	40,0	32,5	10,5	22,5	4,5	
Lingerie	LE	21,0	35,5	23,0	38,5	10,5	16,0	27,5	
	LC	23,0	23,5	42,0	43,5	10,0	17,5	9,0	
Resting		17,0	44,4	21,4	31,2	20,2	35,2	18,0	
Both Products	Expensive	19,0	31,3	34,5	38,5	15,0	21,3	17,0	
	Cheap	21,3	31,8	41,0	38,0	10,3	20,0	6,8	

**Table 7:** table 6 is based on the details displayed in this table. We find that the seven participants can be divided into two groups which show opposing eye blinking behavior from each other. Four out of seven participants blinked more than in the resting condition when they were confronted with cheap brands. Three out of seven participants blinked more when they were confronted with expensive brands.

We also added the average number of eye blinks in the resting state for all participants. This tells us that the participants 1, 3 and 4 blink more when confronted with printed advertisements than they do in the resting state. These participants can be considered “high blinkers”. These participants also blink less when confronted with expensive lingerie (LE) than they do when confronted with printed advertisements of cheap lingerie (LC). Participant 1 however blinks less when confronted with expensive food (FE) than when she is confronted with cheap food (FC). The other participants, being number 2, 5, 6 and 7 blinks less when they are confronted with printed advertisements than they do in the resting state. Let us call these participants “low blinkers”. Three out of four blink more when confronted with expensive lingerie (LE) than when they are confronted with cheap brands of lingerie (LC). We find the same for food. Graph 2 below summarizes our findings.

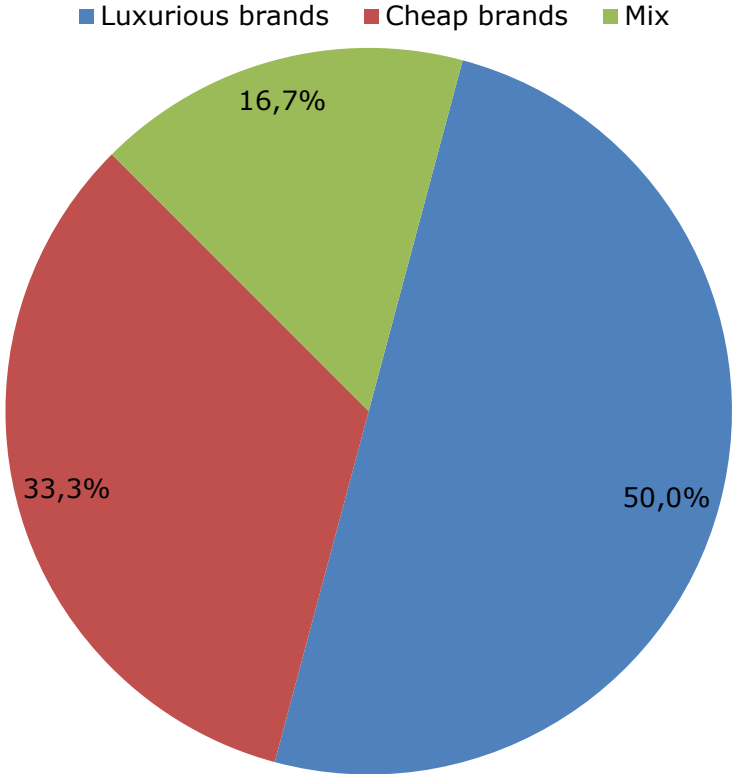


**Graph 2:** we summarized our findings on participant level with the graph above. The experiment consisted of a total of seven female participants (x-axis) which were confronted with printed advertisements of expensive brands of food (FE), cheap brands of food (FC), expensive brands of lingerie (LE) and finally, cheap brands of lingerie (LC). We plotted the average number of eye blinks per minute (y-axis) when confronted with printed advertisements to the average number of eye blinks per minute in the resting state. Therefore the values of the bars for each of the four product classes show the average number of eye blinks for that product class relative to the resting state. As can be clearly seen, participant 1, 3 and 4 blink more when confronted with printed advertisements than they do in the resting state. The other participants blink less in this case, since their values are negative.

Recall that the article of Walla *et al.* (2011) find significantly reduced eye blink amplitudes related to liked brands compared to the disliked brands. This finding suggests that the visual perception of liked brands elicits higher degrees of pleasantness, more positive emotions and an approach-oriented motivation than visual perception of disliked brand names. This matches with our findings as displayed in Graph 2 for three out of seven participants. The overall picture is however inconsistent.

Finally, we analyzed the data acquired from the questionnaires. These questionnaires were distributed amongst the participants in order to determine brand preferences and brand awareness. The data shows that three out of seven participants were familiar with a majority (50% or more) of the fourteen brands listed whereas two out of seven participants only knew a few (less than 50%) at best. Two out of seven participants did not fill out the questionnaire at all.

With regard to the questions inquiring about the purchase behavior of the participants, half of them (50%) stated they would be willing to buy lingerie and food of luxurious brands (LE and FE, respectively), whereas 33,3% stated their preference towards cheap brands of lingerie and food (LC and FC, respectively). Two out of seven participants showed inconsistent purchase behavior. Graph 3 hereunder depicts our findings.



**Graph 3:** half of the participants indicated that they have a preference for expensive brands of food and lingerie, whereas a third of the participants indicated a preference for cheap brands of food and lingerie. The remainder of the participants showed inconsistent purchasing behavior.

Reviewing the tables as discussed in this paragraph, we cannot confirm with certainty the findings of Walla *et al.* (2011). We cannot confirm whether people blink consistently more or less when confronted with printed advertisements of expensive and luxurious lingerie and food, in comparison to their reaction when they are confronted with printed advertisements of cheap alternatives.

We argued at the beginning of this experiment that women regard the act of shopping as a creative process, whereas men regard items more for their functionality. Women visit new stores and carefully research a product class they are interested in prior to making a purchase. The selection process this entails deals with a large number of possible variables: not only price and product are relevant, but also prestige, social acceptance, popularity and beauty. Chermahini and Hommel (2010) find that such variables are highly correlated with the levels of dopamine in the brain. The correlation appears as a reverse U-shape which suggests that an average level of dopamine results in major creativity in the selection

process of brands. Observing one's favorite brand however differs from actually purchasing it. Thus as a consequence, the dopamine levels – and with that eye blinking behavior – are affected negatively. Therefore we deem it necessary to allow participants to be more engaged in the next experiment. We believe we can achieve this by allowing participants to mimic their purchasing behavior in the laboratory of Erasmus University.

The results of the questionnaires about the participants purchase behavior suggest that the majority of the participants are willing to buy lingerie and food of luxurious brands, whereas the results of the eye blink behavior do not show the participants preference for luxurious brands. Thus there appears to be a mismatch here. The variations of the eye blink rates per participant on each product class are not major. So, we cannot reach a conclusion or confirm the findings of Taylor *et al.* (1999) and Laeng *et al.* (2012), that if dopamine activity is enhanced, the eye blink rates increase or vice versa. We used the eye blink behavior in our experiment as a biomarker, which is a biological process in the brain. This process is also formed by external factors such as environment and culture according to Yoon *et al.* (2012). Another factor which shapes the biological process is the context, the so called reciprocal determinism. "*Which is the interaction between individuals and their environment*", a citation from McAlister *et al.* (2008) about the definition of reciprocal determinism: Environmental factors influence individuals and groups, but individuals and groups can also influence their environments and regulate their own behavior.

The next experiment (experiment 2) has a new and active approach and we increased the sample of participants. The role of these participants in the experiment 2 is more active compared to setup of experiment 1, where the participants' role was too passive. The aim of the usage of specific shopping scenarios in the next experiment is to confront the subjects with pre-specified situations.

## 5. Experiment 2

In order to allow for participants to mimic their purchasing behavior in a laboratory setting, our second experiment aims to encourage participants to imagine themselves into specific shopping situations. Henceforth they were not only asked to specify their brand preferences as the previous experiment had proven that approach was too passive. This new, active approach asks the participants to imagine taking part in a specific shopping scenario. These scenarios can be regarded as matters of preference with respect to given, pre-specified situations.

For the second experiment we have chosen to increase our sample size from seven participants to twenty-five female participants. The decision to increase the sample size can be motivated through our findings based on the data of the first experiment, which simply were too inconsistent to be able to draw a straightforward conclusion. The twenty-five participants were asked to sit comfortably and in a relaxed manner in front of a monitor with electrodes attached to their upper and lower eyelids as well as behind their ears. Along with the monitor they are given a keyboard so they can give us their input when prompted to.

The participants were instructed that the experiment consists of two stages, with the whole experiment taking approximately ten minutes per participant. The first stage can be classified as the observation stage; the second stage is classified as the active stage. The first stage is from point one until point five. The second stage is from point six until point eight. The timeframe of the experiment is as follows:

1. **Resting phase.** During this phase the participant was sitting in front of the monitor for two minutes. During this phase, the screen was empty. The purpose of this phase is to observe the eye blinking behavior of the participant when resting.
2. **Neutral pictures phase.** In this phase the participant was confronted with pictures on the monitor screen which displayed neutral objects which cause no particular desire or preference.
3. **Thirty seconds break.** Like in the resting phase, the participant is confronted with a blank screen for thirty seconds.
4. **First product type phase.** During this phase, the screen displayed pictures of the first type of product for two minutes.
5. **Second thirty second break.**
6. **First imaginary task.** Participants were asked to imagine a given shopping scenario for thirty seconds. After this, a thirty second break was given.

7. **Second and third imaginary task.** Participants were asked subsequently to imagine a second and third shopping situation. In between each, a thirty second break was given.
8. **Brand awareness and recognition.** Finally, the participants were asked which of the presented brands they prefer by pressing a button on the keyboard. This phase is repeated for each product type.

The product types we tested are listed and defined in Table 1 in the previous chapter. For each product type, the monitor displayed a total of seventy-five images including three popular brands for each product type. Thus the participants were confronted with a total of one-hundred-and-fifty images of lingerie and food, both of expensive and cheap brands, respectively.

In regard to points six and seven, the participants were asked to imagine themselves in a total of five shopping scenarios, of thirty seconds each. A total of three shopping scenarios were available for Lingerie, and two for Food. The table hereunder specifies the scenarios employed.

Table 8 - Eye blinks per participant, per class of product		
product type	scenario number	scenario description
Lingerie	1	Imagine you wearing the previously shown lingerie brands.
	2	Imagine you buying the previously shown lingerie brands.
	3	Imagine you are getting ready for a date with somebody you recently met and really like. You have big plans for tonight. Imagine you wearing the previously shown lingerie brands in front of that special somebody.
Food	1	Imagine you have recently got a new job. It is your dream job and you had been struggling for it for a long time. For a friendlier work environment, you decided to organize a dinner for your new colleagues. If you had the budget, which dessert from the previously shown brands would you purchase?
	2	Imagine you and your boyfriend decide to get married. You have been together for a long time and you both feel ready to take the next step. In order to announce it to your families, you decided to organize a special dinner. If you had the budget, which dessert from the previously shown would you purchase?

**Table 8:** for each of the two product classes, a total of three scenarios exist. For Lingerie, the participants were confronted with three scenarios. For Food, the participants were again confronted with yet three different scenarios.

From the data acquired in combination with the experiences and knowledge we gained from the first experiment, it had become obvious that the findings of Walla *et al.* (2011) were not straightforward to mimic. In fact, based on the data acquired from the second experiment, we find it necessary to divide people into two groups, being “high blinkers” and “low

blinkers” in order to achieve meaningful results. The reason for this is that the participants in both the first and the second experiment vary when it comes to eye blinking behavior: one blinks more when he is confronted with an image that they are interested in, whereas the other would blink less in such a situation. Therefore we divided the participants into one group which blinks less when confronted with undesirable images in comparison to the resting phase, and a second group of participants which blink more when confronted with undesirable images in comparison to the resting phase.

Secondly, our data reveals us that the second stage containing the imaginary scenarios was too complicated for the participants. During the experiment, some participants displayed signs of disinterest or even fatigue. Another point of critique is that even though the participants were asked to imagine themselves in a predefined scenario, there is no scientific proof of the participant in question actually imagining themselves the scenario we wished them to. As a consequence, the analysis did not indicate any significant differences between cheap and expensive brands of either Lingerie or Food, even after the participants had been divided into the two groups previously discussed.

Additionally, the data shows no significant difference in eye blinking behavior when participants were asked to imagine themselves in predefined scenarios. Consequently, we find no significant indication that when participants were imagining themselves wearing or consuming an expensive brand or cheap brand for that matter, that their eye blinking behavior differed from the observed resting state. Details of this find can be found in Appendix I, which shows the participant’s eye blinking behavior, and Appendix II which shows their eye blinking behavior during each phase. As can be seen from the values in Appendix I-A, all participants blink more often while watching the screen with images than during the predefined scenarios. However, in between the product types (Lingerie and Food) there is no difference in the eye blinking rates. We find the same for in between product classes (LC versus LE and FC versus FE, respectively). Appendix I-B shows the details to the previous table. Note that we did not yet sort out the participants in classifications of high blinkers and low blinkers in this table. Obviously there is variety amongst the participants in regard to their eye blinking behavior. Appendix II and III displays the eye blink rates per participant, after we classified them into high blinkers and low blinkers. Here we see that amongst these two classifications, we draw our conclusion that the data lacks a sufficient degree of variety in relation to the product classes to be statistically significant.

In contrast to the second stage, the first stage did yield one statistically significant result. The dependent variable which refers to the product types, being Lingerie and Food, is significant at the 5% level. Details can be found in Appendix IV. Note however that this means that

there is a statistically significant difference in eye blinking behavior between the product types of Lingerie (Type 1 in the table) and Food (Type 2 in the table). This does not mean that there is a statistically significant difference in eye blinking behavior in between classes of each type, those being LE versus LC and FE versus FC, respectively.

This contradiction between the first stage of the second experiment and the second stage, leads us to conclude that the research setup may have affected the results. Some participants informed us that since point six, seven and eight of the second experiment were repeated for each product type, a learning effect occurred. In other words, over time, the participants were not approaching our experiment in the same way as they did at the beginning of the experiment. Because they knew from the first product type which questions were going to be asked, they looked at the images of the second product type differently, in anticipation of the scenario questions. On top of that, participants were expected to go through the first stage of the experiment as well as the second one. With this, it is now obvious that the second experiment required too much concentration of the participants, which may have affected the data.



## 6. Expansion

With the shopping scenarios being too complex to serve their intended purpose, we believe it is appropriate to review the first experiment we did. We want to repeat this experiment with a larger sample in order to achieve a straightforward conclusion. Our preference goes to the first experiment as it is practically fairly simple in regard to structure, yet effective as participants do not get fatigued as easily or manifest any learning phenomena during the experiment.

For the first experiment, we had employed seven female participants. Now, we will employ sixteen female participants<sup>8</sup>. As with the first experiment, the participants were informed beforehand that they would be participating in an experiment in the Erasmus University laboratory with respect to brand awareness. They were put in front of a monitor that shows images of food and lingerie advertisements. The whole experiment would last approximately sixteen minutes, in which a total of one hundred and forty advertisements would be shown. These one hundred and forty advertisements can be equally divided amongst the two product types, respectively the four product classes, as specified previously in table 5. The timeframe of this expansion upon the first experiment is as follows:

1. **Four minutes of rest.** In this stage, the monitor remains blank. The participant's eye blinking behavior is measured while in the resting stage.
2. **Expensive lingerie (LE) advertisements.** For two minutes, the monitor displays advertisements of expensive lingerie brands.
3. **Rest.** Due to technical limitations of the measuring equipment, one minute of resting time is added after each product class.
4. **Cheap lingerie (LC) advertisements.** For two minutes, the monitor displays advertisements of cheap lingerie brands.
5. **Rest.** Again, one minute.
6. **Expensive food (LE) advertisements.** For two minutes, the monitor displays advertisements of expensive food brands.
7. **Rest.** A small break of one minute.
8. **Cheap food (LC) advertisements.** For two minutes, the monitor displays advertisements of cheap food brands.

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<sup>8</sup> Note that we reused the data we had from the first experiment. We added the data of the nine new participants in order to reach our desired dataset.

Throughout the entire timeframe, the eye blinking behavior of the participants was measured with electrodes attached to their upper and lower eyelids, as well as behind their ears. We find that the average number of eye blinks during the lingerie advertisements is 49,5, whereas this number is 51,8 for food. Table 9 discusses the details per product class.

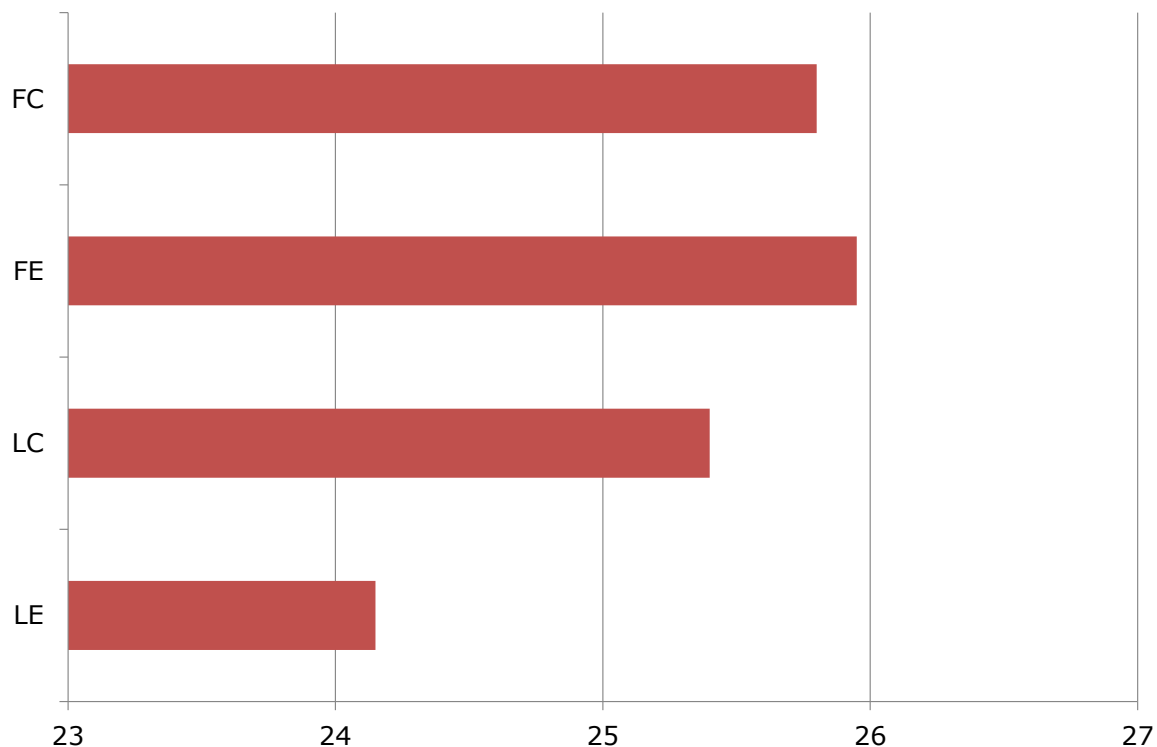
<b>Table 9 - average number of eye blinks per product class</b>			
<b>N = 16</b>			
<b>Product class</b>		<b>average per class</b>	<b>average per type</b>
LE		48,3	49,5
LC		50,8	
FE		51,9	51,8
FC		51,6	

**Table 9:** a total of sixteen participants were employed for the expansion of the first experiment. This time we find that for expensive (LE) and cheap lingerie (LC) the average number of eye blinks are 48,3 and 50,8, respectively. For food, these numbers are 51,9 and 51,6. The averages seem to differ, mainly due to the wide variation we see between expensive and cheap lingerie. This variation is not found in the product type food.

When we divide the numbers in table 9 by two as every product class was displayed for two minutes, we get the average number of eye blinks per class, per minute. Table 10 below displays the results. Graph 4 is a graphic display of the four product classes of table 10.

<b>Table 10 - average number of eye blinks</b>			
<b>N = 16</b>			
<b>average number of eye blinks...</b>			
per minute			27,32
during resting			27,76
during viewing LE			24,13
during viewing LC			25,41
during viewing FE			25,97
during viewing FC			25,78
during viewing of products			25,32

**Table 10:** during the course of the experiment, the average number of eye blinks per minute was 27,32 for all participants. During the resting phase (point 1, 3, 5 and 7), the average number of eye blinks was 27,76. For lingerie, the average number of eye blinks was 24,13 for the expensive brands and 25,41 for the cheap brands. For food, this was 25,97 and 25,78, respectively. The average for viewing all four product classes is 25,32.



**Graph 4:** the y-axis displays the product class; the x-axis displays the number of eye blinks per minute. The average number of eye blinks per class clearly differs between LC and LE. The difference between FC and FE is barely significant as well as in the opposing direction in comparison to LC and LE. Between product types lingerie and food however is a clear difference visible.

Following our methodology of the first experiment, we again divide the sixteen female participants into two classifications. These are:

**1. High blinkers**

These are the participants who blink more when they are watching a product on the screen than when they are in the resting phase.

**2. Low blinkers**

These are the participants who blink less when they are watching a product on the screen than when they are in the resting phase.

When we divide up the participants in these two classifications, it is of influence to the measurement of the average number of eye blinks per product. Recall that the reason for us splitting up the participants into these two groups is because people show different behavior when they see an item that interests them: some blink more than in the resting state, others blink less than in the resting state. We find that the high blinkers blink more when they are

confronted with expensive brands of lingerie (LE) than they do with cheap brands of lingerie (LC). We also find that these high blinkers blink more when confronted with expensive brands of food (FE) than when they are confronted with cheap brands of food (FC). On the other hand, the low blinkers blink less when confronted with expensive brands of lingerie (LE) than they do when confronted with cheap brands of lingerie (LC). In the case of food, low blinkers blink less when confronted with expensive brands of food (FE) than they do with cheap brands of food (FC). Table 11 summarizes the data of these findings.

<b>Table 11 - average eye blinks per product - participants divided</b>				
<b>N = 16</b>				
<b>product class</b>		<b>high blinkers</b>		<b>low blinkers</b>
LE		24,7		23,6
LC		22,3		28,5
FE		21,9		30,1
FC		19		32,6

**Table 11:** we sorted the data based on the classifications of high blinkers and low blinkers. The values displayed are the average eye blinks per classification, per product class. We see that the high blinkers are consistent in their eye blinking behavior in regard to cheap and expensive brands. For both lingerie and food we find that  $LE > LC$  and  $FE > FC$ . In contrast, we find that low blinkers show a similar form of behavior, just in a different direction. We find that low blinkers blink less when they are confronted with expensive brands than they do with cheap brands, thus  $LE < LC$  and  $FE < FC$ .

When we analyze the data further, we find that there is a statistically significant relation at the 5% level between the products lingerie and food with respect to eye blinking behavior. In other words, people show different blinking behavior when being confronted with images of lingerie than they do when they are confronted with images of food. At the same time, we find that there is no statistically significant relation between product classes. Thus, we must conclude that our findings as depicted in table 11 are spurious at best. Again, we fail to find confirmation for the findings of Walla *et al.* (2011). Details can be found in Appendix V.

Reason for this finding may be the fact that our sample group consists of sixteen female participants. As discussed earlier, women view lingerie differently than men do. In that same fashion, women view lingerie differently than they view food. Since lingerie evokes a certain degree of excitement in the shape of sexual desire, it also may function as means of comparison as women tend to view both the lingerie as well as the model wearing it. Since most lingerie advertisements display slim and attractive models, women viewing the advertisement will desire both the lingerie as well as the model's physical features. Food, in contrast, is limited to feelings of desire for the product.

## 7. Conclusion

Marketing research finds that certain human emotional and motivational evaluations can be used to determine whether an individual is interested in a product or not. Walla *et al.* (2011) find that explicit knowledge in this matter is more reliable than implicit knowledge. The advantage of this is, is that explicit knowledge is less contaminated and can simply be acquired through the use of questionnaires. Perry (2007) and Wallace *et al.* (2006) find that eye blinking is caused as a reflex or because a factor from the outside world evokes a spontaneous response. This can be employed to determine whether a person has any desire for a product, as is done in the study of Leigh *et al.* (2004). We employed a similar approach, following the findings of Walla *et al.* (2011) using eye blinking behavior in three experiments with a small sample group. More specifically, we are interested to see whether the participants show different behavior between expensive and cheap brands. Thus we employ cheap brands of lingerie, expensive brands of lingerie as well as cheap brands of food and expensive brands of food.

Our first experiment can be regarded as a pilot test to determine whether we can eye blinking behavior as a measurement of desire or interest in a product. We employ a small sample of participants in the laboratory of the Erasmus University. They are instructed to take place behind a computer screen which will display printed advertisements of lingerie and food with breaks in between. We are interested to see whether we can find a sufficient degree of variation between the resting periods and when the participant is viewing a product on the screen.

Our pilot test allowed us to proceed with our first, true experiment. This experiment is a continuation of our pilot-test as it is similar in setup. The only difference is that we employ a larger number of images of lingerie and food. Our data analysis shows an inconsistent behavior with respect to the findings of Walla *et al.* (2011), as the participants do not seem to blink more in a consistent fashion when they are confronted with a desirable brand of lingerie or food. Following Walla *et al.* (2011) we want to expand our research to include a few predefined scenarios and a questionnaire.

The expanded, second experiment again shows inconsistent eye blinking behavior as well as a few non-responses from participants. Unfortunately, the experiment had become too complex for some participants, or simply caused to participants to suffer from fatigue. Since we were repeating the predefined shopping scenarios for every product, an unintended learning effect occurred amongst some participants: they were anticipating the shopping

scenario and therefore they indicated to us that they were no longer viewing the images of lingerie and food on the screen in the same fashion as they did at the beginning of the research. Since we contaminated our data unintentionally, we decided to continue with the data of the first experiment, but in a more expanded version.

The expansion employs the data of the first experiment and adds nine new participants to the pool. The same experiment is done again with those nine new participants. With this bigger dataset, we find a statistical significant relation between the eye blinking behavior with respect to food and lingerie. However, we find no such statistical relation between cheap brands of lingerie and expensive brands or between cheap brands of food and expensive brands of food.

We conclude that our experiment cannot confirm the findings of Walla *et al.* (2011). However, we do not feel that the research setup is to blame. Indeed, we did find a different behavior in eye blinking between lingerie and food, thus proving that eye blinking can be used for marketing research purposes. The nature of our data is based on sixteen female participants which regard shopping for lingerie as a much more complex matter than merely its functionality. Women tend to assess both the lingerie as well as the model wearing it. Therefore lingerie evokes both feelings of sexual desire as well as the wish to possess the physical features of the model wearing the lingerie. Food however lacks this aspect, which is possibly why we find different eye blinking behavior towards it.

Avenues for further research are thus to suggest that human biology in this manner is far more complex than we anticipated. Maybe other factors such as gender, age, education and wealth must be taken into account for further research into eye blinking as a tool for measuring desire.

## Appendix I

<b>Appendix 1-A - average eye blinking rates</b>	
<b>Observation phase</b>	<b>Average</b>
LE	41
LC	42
FE	47
FC	54
<b>Scenario 1</b>	
LE	13
LC	12
FE	12
FC	12
<b>Scenario 2</b>	
LE	12
LC	12
FE	13
FC	14

<b>Appendix I-B - eye blink rates per participant</b>							
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
EBR	85	187	146	97	63	103	61
EBR per minute	21,25	46,75	36,5	24,25	15,75	25,75	15,25
break per minute	17	44,4	21,4	31,2	20,2	35,2	18
product per minute	19,8	35,8	38,2	40,6	13,7	20,1	11,6
LE	21	35,5	23	38,5	10,5	16	27,5
LC	23	23,5	42	43,5	10	17,5	9
FE	17	27	46	38,5	19,5	26,5	6,5
FC	19,5	40	40	32,5	10,5	22,5	4,5

## Appendix II

<b>Appendix II - eye blink rates per minute, after division of participants</b>				
<b>Product class</b>	<b>Low blinkers (break)</b>	<b>High blinkers (break)</b>	<b>Low blinkers (neutral)</b>	<b>High blinkers (neutral)</b>
LE	21	52	23	63
LC	24	52	23	66
FE	31	56	30	69
FC	32	66	33	80
<b>Scenario 1</b>				
LE	9	13	9	16
LC	9	14	7	19
FE	8	14	7	17
FC	8	14	10	14
<b>Scenario 2</b>				
LE	10	13	8	16
LC	8	14	7	18
FE	8	15	9	17
FC	9	17	8	20



## Appendix III

<b>Appendix III - average blinks per minute, after division of participants</b>				
<b>product class</b>	<b>Low blinkers (break)</b>	<b>High blinkers (break)</b>	<b>Low blinkers (neutral)</b>	<b>High blinkers (neutral)</b>
LE	9	13	8	15
LC	8	14	7	18
FE	8	14	8	17
FC	8	15	9	17
Scenario 1	8	14	8	17
Scenario 2	8	15	8	18

## Appendix IV

<b>Within-Subject Factors</b>				
<b>Type</b>	<b>Class</b>	<b>Dependent Variable</b>		
1	1	Lingerie Expensive (LE)		
	2	Lingerie Cheap (LC)		
2	1	Food Expensive (FE)		
	2	Food Cheap (FC)		
<b>Pairwise Comparisons</b>				
<b>Type</b>	<b>Type</b>	<b>Mean Difference</b>	<b>Std. Error</b>	<b>P-Value</b>
1	2	-8,95*	1,968	0,000
* significant at the 5% level				

## Appendix V

<b>Within-Subject Factors</b>				
<b>Type</b>	<b>Class</b>	<b>Dependent Variable</b>		
1	1	Lingerie Expensive (LE)		
	2	Lingerie Cheap (LC)		
2	1	Food Expensive (FE)		
	2	Food Cheap (FC)		
<b>Multivariate Tests</b>				
<b>Effect</b>	<b>Wilk's Lambda</b>	<b>F</b>	<b>df</b>	<b>P-value</b>
Type	0,284	17,688	1	0,004
Class	0,678	3,330	1	0,111
Type x Class	0,944	0,417	1	0,539

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