

# Neuromarketing

Made by: Marlien Kollé  
Mentor: Menno Gerkema  
Rijksuniversiteit Groningen  
Neurosciences  
Date: 28-06-2012

---

## **ABSTRACT:**

Neuromarketing is the application of neuroscientific methods to analyze and understand relevant behavior of consumers. Processes related to decision making, consumer preferences, product evaluations and the impact of the commercial can be analyzed. In marketing preferences for services or products are important but consumers cannot explain their preferences when explicitly asked. The main question of my thesis is can neuroimaging reveal information that is not apparent in current marketing strategies? New measuring techniques such as fMRI, EEG and MEG are available to determine which areas of the brain are activated during certain tasks. Imaging studies show the influence of a commercial on memory of consumers of different market segments and such information can be used in the future to create commercials for specific segments. Imaging techniques can provide information about if people remember/forget an advertisement, what attention they are given and whether they like/dislike the commercial. Neuroimaging can also be used to create a product which is optimally designed by using the most attractive stimuli.

**KEYWORDS:** neuromarketing, imaging techniques, memory, consumers choice making

---

# Index

- What is neuromarketing?..... 3**
- Marketing..... 3**
- Neurobiology..... 5**
- Neurobiology and memory..... 5**
- Associative memory..... 6**
- Serial position..... 6**
- Subliminal priming..... 7**
- Techniques for measuring brain activity: fMRI, EEG and MEG..... 9**
- Applications of fMRI, EEG and MEG in marketing..... 8**
- Conclusion..... 13**
- References..... 15**

## What is neuromarketing?

Neuromarketing is the application of neuroscientific methods to analyze and understand relevant behavior of consumers (Lee et al., 2007). Processes related to decision making, consumer preferences and the impact of the commercial can be analyzed. The assumption is that these techniques can provide an efficient tradeoff between costs and benefits (Babiloni, 2012). In marketing preferences for services or products are important but consumers cannot explain their preferences when explicitly asked (Higgins, 2002). In theory such information could be used to influence buying behavior of consumers and illuminate not only what people like but also what they will buy (Ariely et al., 2010). The purpose is that neuroimaging techniques can access information in the brain while the consumer is observing a commercial/ product/ advertisement (Babiloni, 2012). The question is if there are relationships between brain activity and real preferences and if the neural signal is a good predictor for the pleasure or reward at the time of consumption (Ariely et al., 2010). This leads to the main question of my thesis: can neuroimaging reveal information that is not apparent in current marketing strategies? First I am going to describe the current principles of marketing followed by insights in neurobiology.

## Marketing

The market is the group of individuals willing and able to consume what is to be produced by companies. Consumer satisfaction is an important concept of current marketing. Designing a product which fits consumers preferences is central. There are at least three dimensions in the design process, knowledge of the market as derived from *market research*, a method of informing, and approaching potential consumers and stimulate their interest called *marketing strategy* and a *marketing plan*, a system for implementing the marketing strategy (Kurowski et al., 2012). A more detailed prescription of these three dimensions is shown in figure 1.



Figure 1. Market research, marketing and plan

Marketing research is the process of designing, gathering, analyzing and reporting information that may be used to solve a specific marketing problem (Burns & Bush, 2009). The marketing strategy is acquiring market share and penetration (percentage of targeted market demand to be served by the company). The controllable elements of the marketing strategy are commonly identified as the five

P's: product, price, place, promotion and people. These elements are employed in the design of marketing instruments until a combination is found that serves the needs of the potential consumers. Marketing research and marketing strategy are the basis for predicting sales programs for different market segments and selection of distribution channels . The marketing plan specifies how to carry out the marketing strategy. My main focus is on the marketing research because neuroimaging fits most in that dimension. Both deal with consumer behavior and analyze data about issues related to marketing products and services. The fundamental purpose of market research is to identify potential consumers with sufficient purchasing power so that the product can be designed to serve them (Kurowski et al., 2012). It consists of several steps namely identification of the information which is needed, collection of data, analysis of data, dissemination of information and the use of information (Burns & Bush, 2009). The main factor of interest here is how consumers make their decisions on what and how much to consume, how they choose between alternatives and to what degree they can be influenced by factors in the external environment. To answer such questions data must be collected, not only about markets per se, but the entire spectrum of factors on which they are dependent. The information needed can be found in official published data, reports, surveys, tests, interviews, observations and in house data. An example of in house data is customer data base in which the company keeps track of the customers information for instance, purchases, wishes and expectations. Designed products can be tested by using a virtual test market. New products or marketing and distribution strategies can be tested by computer simulations of consumers, companies and the market environment. Before a product is launched a test marketing can be done. A small-scale of the product is launched to determine the likely acceptance of the product when it is introduced into a wider market. Prototypes can be introduced and information of consumers can be used to change or add functions to the product (Burns & Bush, 2009). A problem here is that the cost of obtaining the information must be compared to the value of the gathered information. Another problem is that this way of gathering information is not detailed because people cannot clarify their preferences. The assumption is that a consumers brain contains more information about their true preferences (Ariely et al., 2010). Neurobiology, the science of the biology of the nervous system, can analyze and understand human behavior related to decision making and product evaluations. So neurobiology could offer a solution for this problem. In the next section I will give an overview of the new developments and techniques of neurobiology.

## **Neurobiology**

Neurobiology is thus the study of cells of the nervous system and the organization of these cells into functional circuits that process information and mediate behavior. During the second half of the twentieth century the study of neurobiology has increased rapidly. For example it is possible to understand the complex processes in neurons such as signal transmission and the origin of neurodegenerative diseases. Recently, with the rise of modern methods and measuring techniques, such as neuroimaging, many new and deep insights about the mechanisms of memory have emerged. These observations provide insight about the mind and about brain functions that mediate cognition, emotion, behavior and consciousness (Eichenbaum, 2002). The major aim of research on brain modules and systems is to identify and distinguish the roles of specific brain structures and which neurons are activated during particular aspects of memory processing. New measuring techniques such as fMRI, PET, EEG, MEG and SPECT are used to view activation of brain areas in humans during certain tests. The development of imaging techniques determines what kind of research can be done. Current techniques provide information about localization of activity in certain brain areas.

## **Neurobiology and memory**

With regard to marketing, for example remembering an advertisement/product, it is interesting when and how memories become permanent, called consolidation. Memories are first labile and later become resistant to loss and a process causes the permanent form. Changes in connections between neurons, caused by molecular and cellular events, form a permanent memory. Memories can also become permanent when brain structures interact with each other with the outcome that new information is integrated in already existing parts (Eichenbaum, 2002). Most of the time humans have no control over which information is facilitated and which irrelevant information is inhibited, this enables us to be more flexible when interacting with our environment (Depue, 2012). The process of saving information from the working memory (WM) or hippocampus to the long term memory (LTM) or cortex is called encoding. Using that information, or the movement of information from the LTM to the WM, is called retrieval. The amount of information retrieved is dependent on previous attempts to encode information so I consider both processes. If new information is available via sensory pathways (seeing, hearing, tasting and feeling) the medial temporal lobe (MTL) is a major terminus with regarding to encoding (Depue, 2012). Attention to a certain stimulus causes neurons to fire whereby a binding process within the hippocampus and its surrounding MTL cortices occurs. This leads to increased communication between pre- and post-synaptic cells which provide the neural mechanisms of consolidation which is the basis for LTM (Depue, 2012). If the memory is stored, a particular internal or external sensory cue may allow for retrieval. The memory of the initial event is retrieved through activation and focused attention on it. This activation of any linked representation of the original event in sensory regions leads to feed-back activation from the hippocampus to sensory regions that originally encoded the event (Depue, 2012). Attentional resources then maintain the firing of these representations as a composite memory. In the maintenance of these retrieved memories the posterior cortex communicates with the prefrontal cortex. The selective/controlled maintenance and updating of these representations is the basis for which information is accessible for WM and finally what is recalled (Depue, 2012). Identifying the

involved parts of the brain with memories could be interesting for marketing, for example which and how parts of an advertisement are remembered and which are not. In the following part I am going to discuss different topics related to consumers.

### **Associative memory**

Commercials and marketing must have a connection with the products in order to sell the product, a positive association. Consumer brand associations are perceptions, preferences and choices in memory related to a brand. These associations can vary, from physical product attributes to perceptions of people and places (Henderson et al., 1998). Associations help consumers process and retrieve information and can evoke positive affect (the experience of feeling or emotion), as well as cognitive considerations of benefits that provide a specific reason to buy. The study of G. Henderson et al. shows that knowledge is represented as “associative networks” and that these structures are comprised of concept nodes (units of information such as person and place) and prepositional links (liking that person or liking that place). When a person is reminded of a certain stimulus (for example an advertisement) activation of the node corresponding to that stimulus occurs, activation spreads to other nodes with the degree of spreading dependent upon the distance from the stimulus node. As a result associated memories become temporally activated, or primed, to become more easily retrievable. The degree to which one stimuli speeds up the ability to recognize or recall another reflects the strength of the mental association. The shorter the path between the concepts, the stronger the association (Henderson et al., 1998). In line with this, people have a regulatory focus, a prevention or promotion focus. If the given information fits their regulatory focus, people feel right about that action and it leads to positive product evaluations (Higgins, 2002).

### **Serial position**

Another topic of interest in marketing are the effects of serial position, also called the primacy and recency effect. When people are exposed to a list of items they have a natural tendency to best recall those at the beginning of the list, the primacy effect, and those at the end of the list, the recency effect, than those in the middle of the list. For marketing this can be interesting because the position of an commercial can have an effect on which commercials are being recalled during a commercial block. In a study done by R. Pieters et al. is investigated how consumer memory for advertising is affected by both ordinal and time-lag aspects of serial position (Pieters et al., 1997). The ordinal aspect of serial position is the location of a commercial relative to other commercials in a sequence (i.e., first, second, third etc.). The time-lag aspect of serial position specifies how much time has elapsed from the start of the block of commercials until the onset of a particular commercial (i.e., 20 seconds, 30 seconds, etc.). The elapsed time from the start of a commercial block until the onset of a particular commercial has a significant negative effect on brand-name recall, while the first and the last commercial have significant advantages over intermediate ones in terms of brand-name recall. Although, there is a high variation between individuals in remembering commercials. The advantage of the last commercial only emerges when the effect of elapsed time is controlled for. Other effects have more influence. Duration has the largest effect, followed by elapsed time and finally primacy and recency (Pieters et al., 1997). Associative inferences contribute to primacy and recency effects on memory for television commercials. Contextual theories propose that when an item contrasts with its context it will stand out and is likely to be stored in memory with that context. When a person tries to recall this item, the context acts as a retrieval cue. So if being the first or last in a block

increases an advertisements distinctiveness because of contrast, serial position acts as an effective episodic retrieval cue in recall (Pieters et al., 1997).

### **Subliminal priming**

An old method, which was used by James Vicary a private market researcher in 1957, is subliminal priming (Karremans et al., 2006). Subliminal stimuli are any kind of sensory stimuli below threshold for conscious perception. So the individual is not being aware of stimuli he/she is exposed to. James secretly flashed the message "Drink Coca Cola" and "Eat Popcorn" and increased his sales of Coca Cola and Popcorn in a movie theatre. Argued is that subliminally priming a brand name for drink can increase the likelihood that people will choose that drink but only when they are thirsty. Although the effects were not completely clear, Australia, Britain and the United States banned subliminal advertising. Till 1988 studies failed to find evidence for the influence of subliminal messages (Karremans et al., 2006). A possible cause for no evidence could be that the messages were too long. To be processed subliminal verbal primes have to consist of one or perhaps two words. Findings of J. Karremans et al. suggest that subliminal primes will affect a person's behavior mainly if the prime is relevant to the current goal of the person. In their study thirsty and no thirsty participant were subliminally exposed to "Lipton Ice" or a neutral word consisting of the same letters. After that, choice for and intention to drink that brand were measured. The findings showed that subliminal advertising could be feasible. Subliminally exposing the participants to the brand name "Lipton Ice" increased choice for, and intention to drink Lipton Ice only for thirsty individuals. No effect was found for participants that were not thirsty. It could be that participants have started to evaluate Lipton Ice more positively during the priming phase which could have influenced their choice. But such explanations are not in line with previous research findings, suggesting that brand (supraliminal) prime can increase the probability of retrieval and consideration of the primed brand, without altering the evaluation of the primed brand (Karremans et al., 2006). So subliminal priming in the right setting (for example a cinema, supermarket or a restaurant) where consumers have a certain goal could be useful. For subliminal priming in advertisements and commercials on television the duration of the effects should be investigated.

## **Techniques for measuring brain activity: fMRI, EEG and MEG**

A lot of different techniques are available for measuring brain activity. Measuring of activity is important for studies because visible is which parts are activated and thus involved with certain actions. In the following section I will give an overview of different techniques used in research and in the next section the application and studies of these techniques with regard to neuromarketing. The most popular brain imaging technique used in the neuromarketing field is functional magnetic resonance imaging (fMRI). Cerebral blood flow is measured which returns a sequence of images. The images show 10 seconds of activity so short changes of activity cannot be measured (Babiloni, 2012). But the images are of high spatial resolution that no other methods can offer. The activity of a few cubic millimeters can be detected in deep brain structures such as the amygdale and nucleus accumbens (Babiloni, 2012). Another used technique is Electroencephalography (EEG). This technique is sensitive to changes in electrical fields that are induced by electromagnetic brain activity. EEG can detect rapid changes in neural activity in milliseconds and has a spatial scale of centimeters (Vecchiato et al., 2012). The spatial resolution is lower than that of fMRI but temporal resolution is much higher, therefore EEG can be used to detect changes of activity during exposure to rapid sequences of different stimuli. EEG devices are relatively inexpensive, robust, and wearable by subjects, making this technology suitable for the investigation of marketing stimuli (Vecchiato et al., 2012). Activity correlated with an increase of attention, memory and emotional engagement can be measured during the observation of commercial advertisements. Magnetoencephalography (MEG) makes it also possible to follow a millisecond of brain activity during the exposure to relevant marketing stimuli but has poor spatial information (Vecchiato et al., 2011). Brain activity can be mapped by recording magnetic fields produced by electrical currents occurring in the brain. Cerebral areas involved with consumers choices when they have to make decisions can be measured. Cerebral activations induced by multiple choices reflect the level of familiarity or preference for a certain product. This information can be used to give insight in the relationship between the current choice of a product on the shelf and the relative choice and usage of that product in the past (Vecchiato et al., 2011). In the next section I will give an overview of these techniques as application for neuromarketing.



## Applications of fMRI, EEG and MEG in marketing

A subject is seated in front of a computer screen on which a documentary with series of TV ads is running in the study done by G. Vecchiato et al. (Vecchiato et al., 2012). A distinction is made between consumers (people who use the product in the advertisement) and non-consumers (people who do not use the product in the advertisement) to investigate the effect of familiarity. The temporal trend of cortical activities

could provide information to identify particular key frames within each advertisement that are crucial for eliciting a good brain response in terms of memory and attention (Vecchiato et al., 2012). The results show that cortical spectral patterns vary in the different groups. The activity of the consumers group during the observation of the TV commercial is significantly higher than during the documentary. The results are shown in figure 2. The high peaks are located among prefrontal and parietal areas of the cortex (theta activity) which are active during the transfer of sensory percepts from short-term to long-term memory storage (Vecchiato et al., 2012). Conversely, the patterns of the non-consumer group did not show differences in activity during the commercial compared with the documentary. It shows that some commercials are only suitable for consumers who already use the product and not for new consumers. It is important that consumers can associate the advertisement with something they already know. The question here is if higher EEG activity

actual increases the chance of remembering the advertisement. Analyses of memorization index and the percentage of spontaneous recall show that EEG activity is positive correlated to an increase in the chance to remember a commercial (Ariely et al., 2010). So EEG can be used to make commercials suitable for different market segments.

Neuroimaging can also provide us with information about the distinction between liked and disliked parts of a commercial or even a movie trailer. This information can be used for creating a TV advertisement which only contains the liked parts even when it is not clear why these parts are liked. It is for the marketing industry important to understand the role of unconsciousness and

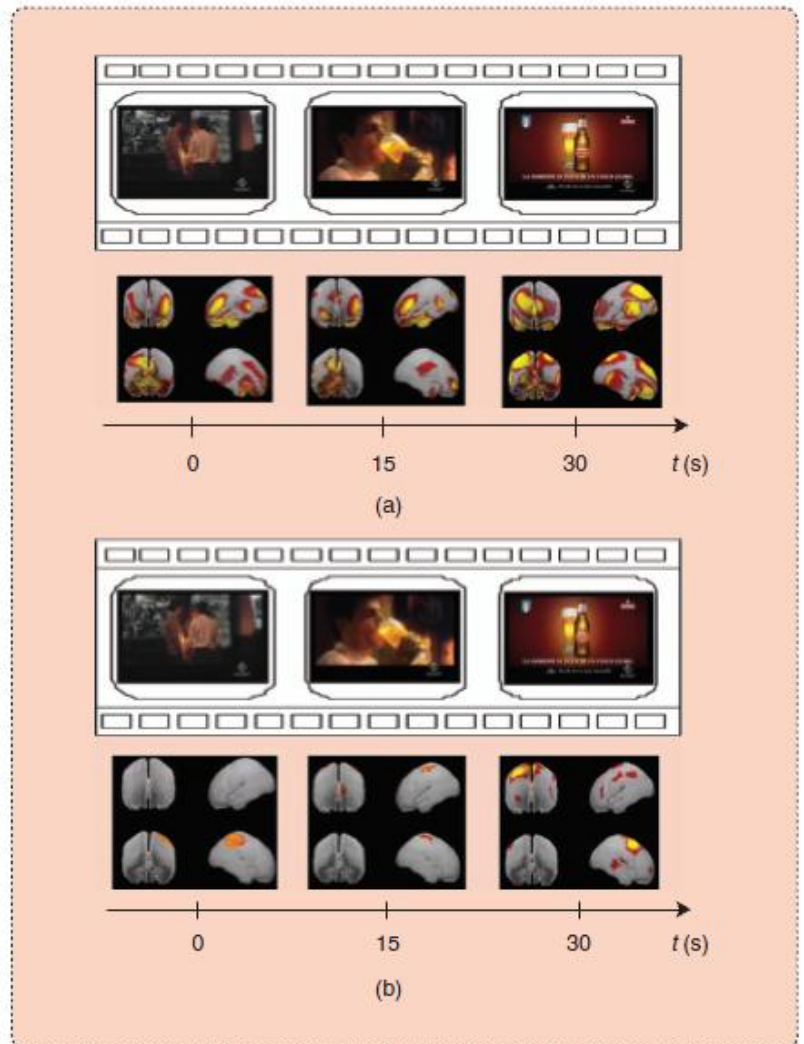


Figure 2. Brain activity related to the observation of advertisements for the two experimental groups: (a) consumers and (b) non-consumers. Red and yellow colors show significant increase of theta activity.

emotions in advertising and shopping behavior. The conscious is merely for 5% involved with decision making so people do not always know why they like parts or why they buy a product (Eichenbaum, 2002). I will provide this with an example of an very popular commercial in 2005 of Sony Bravia for a new LCD TV. 250.000 bouncing balls were catapulted in streets and recorded. The message was that Sony Bravia has the best color and hence the best picture (Ohme et al., 2012). Thanks to the successful advertising campaign Bravia sold out like no other brand. But it was not clear what exactly made this campaign such a great success. R. Ohme et al. conducted a neuromarketing test to analyze subconscious reactions. Respondents watched the commercial and brain waves were recorded by using EEG to reveal their emotional engagement regarding each scene from the advertisement. Their findings are shown below in figure 3.

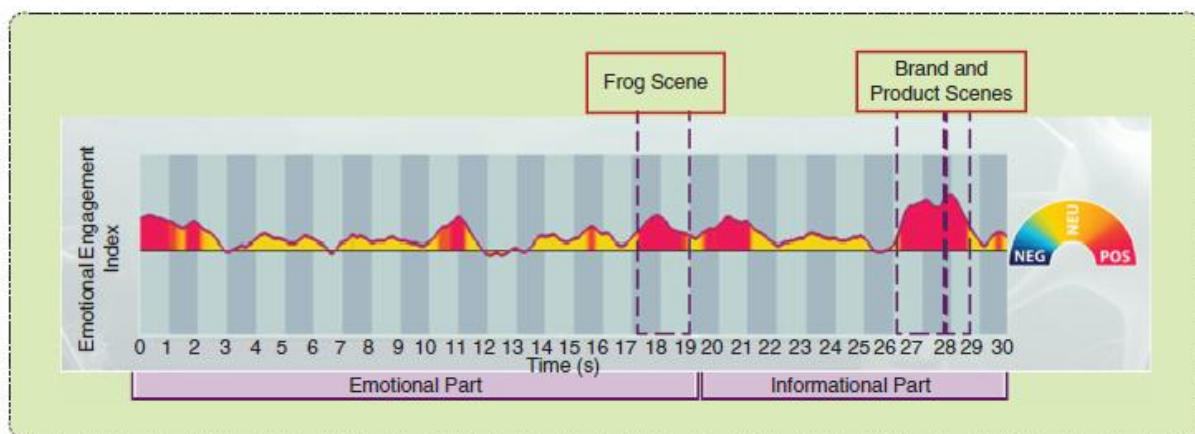


Figure 3. The flow approach/avoidance reactions, which represent the emotional engagement of consumers.

According to figure 3 the opening scene elicits an intense approach reaction, i.e., a positive emotion (Ohme et al., 2012). Then there is a scene of beautiful images of bouncing balls and music which calms the emotional responses. It remains stable until a shot that many people from outside the advertising industry cannot even remember (Ohme et al., 2012). That shot was accidentally and visible is a frog jumping out a drainpipe. This small detail turns out to be a peripheral cue which was considered to be irrelevant. After this finding different parts of the commercial were taken out to investigate which part was most important for the positive feelings. It turned out that the frog scene clearly produced positive reactions toward the benefit and brand information (Ohme et al., 2012). Such analyses go far beyond descriptions of viewers emotional experience. Such neurophysiological measures could be useful to test commercials before they are launched. Emotional response for different cuts can be measured making the most profitable commercial. These emotions not only make advertisements more likeable but also more persuasive.

An important part for marketing is to design a product that fits the preferences of the consumer. Neuroimaging techniques such as fMRI can be used to get images of the cerebral activity. It cannot be used for rapid changing stimuli but it can give insights into how the brain processes differently designed goods. Studies of fMRI showed that activation in the left anterior cingulate, the left orbitofrontal, bilateral prefrontal cortex and right ventral striatum are related to the perceived attractiveness of the products (Hubert et al., 2008). Known is that these regions are involved with motivation, the encoding of rewarding stimuli, the prediction of rewards and decision-making (Hubert et al., 2008). For an optimal design of a product activation of the ventral striatum can be measured, the more attractive the subject perceived a product (in this study a car), the stronger the

detected activation (Hubert et al., 2008). So the relative activation of the ventral striatum can be seen as an indicator for how attractive a visual stimulus is evaluated to be. In figure 4 is shown which parts of the brain show certain activity, the participant liked the stimuli if the color is red and for blue areas the stimuli where disliked. So fMRI can be used to optimal design a product before it even exists. But individuals differ in their preferences and an optimal design does not directly mean that the consumer will buy the product. Although it can partly predict the purchasing decision.

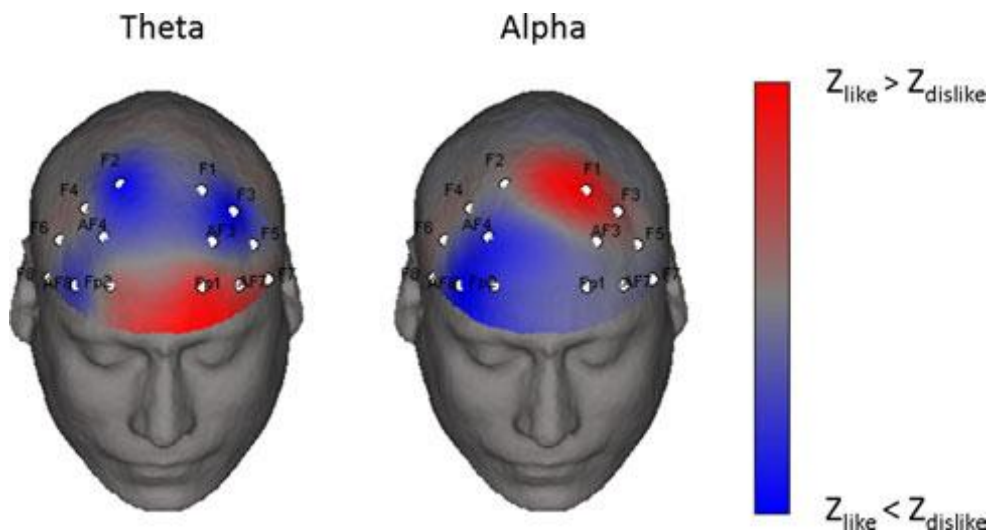


Figure 4. The two scalps present the population analyzed(9). Color bar codes scalp areas in which the LIKE spectral activity is greater than the DISLIKE (red) and regions in which the DISLIKE spectral activity is greater than the LIKE (blue). Gray indicates regions with no difference between the two experimental conditions.

fMRI images can also be used for determining prices for products. In a study done by B. Knutson et al. subjects where lying in a fMRI scanner and saw different products followed by the same products including the price. At the end they had to decide if they want to buy the product or not. Results show that activation of the nucleus accumbens correlates with product preferences, the insula with high prices and the activation of the medial prefrontal cortex with reduced prices (Knutson et al., 2007). This supports the assumption that activity in the insula could reflect the perception of a loss or the neural representation of a negative price effect. This kind of information can be used to determine the price limit consumers are willing to pay.

MEG can be used to study the relationship of cerebral areas involved in consumers choices when they have to make decisions among different items (Braeutigam, 2005). S. Braeutigam et al. analyzed the cerebral areas during simulated shopping. The participants had different choices between product advertisements that were showed during a clip and by measuring the cerebral activations the level of familiarity or the preference for certain products could be estimated. These factors can be considered by taking into account the current choice of a product on the shelf and the relative frequency of choice and usage of that product in the past (measured using a questionnaire)( Braeutigam, 2005). The results showed that choices with a high probability are faster than those less

predictable. Supposed is that difficult choices have a more complex cortical activity than those simple to make. There are two paths namely predictable choices, associated to products already used in the past or said to prefer, and unpredictable choices or unfamiliar products (Breutigam, 2005). The first stage in the decisional process has been individuated after 100 ms after the stimulus with activity in the occipital cortex. The WM is located here and at that stage the subject compares the product with of a list seen before (Vecchiato et al., 2011). 280 and 400 ms after the beginning of the decisional process the selective attention of the participant is orientated towards images of products to classify, identify and compare those stored in memory related to the preferred products and brands. This memory can involve the past experience of buying the particular item or watching the commercial of the specific brand. This kind of information is of interest because the participants could not verbally tell or where unaware of the parts of the clip that they could remember. The memory process could be tracked with MEG on a millisecond base so a clue on which particular scene of the clip is working and which is not could be obtained (Vecchiato et al., 2011).

## Conclusion

Whether neuromarketing potentially could solve product related questions for companies depends on the results of investigation to estimate the pleasure or reward at the time of consumption. Is the neural signal obtained by imaging techniques at the time of, or slightly before, the decision a predictor for consumer behavior? Measurements such as willingness to pay are done by fMRI. Subjects could bid on the right to eat during the experiment. The amount they were willing to pay correlated with activity levels in the medial orbitofrontal cortex and the prefrontal cortex. Similar activations of these areas are shown when subjects anticipate a pleasant taste, look at pretty faces, hear good music, receive money and experience a social reward (Ariely et al., 2010). Such close correspondence in brain activity between rewarding events, the consumption of enjoyable goods and willingness to pay suggests that the representation of expected utility may rely on systems that evaluate the quality of consumption experience (Ariely et al., 2010). Such similarities show that neuroimaging can be used to measure preferences. If consumers actually will buy the product is not sure but it can partly predict the purchasing decision. So neuromarketing can be used to estimate the chance of pleasure or reward of the consumer. The main question of my thesis was can neuroimaging reveal preferences which are not apparent in current marketing strategies. The answer is yes. For marketing research it is important to get answers to questions like this: How do commercials impact people? Is the produced advertisement or commercial interesting? Will it be liked by people? Will people remember the advertisement? Just asking will not be adequate because people cannot articulate their preferences and their brain contains information such as activation of parts that are involved with memory. Imaging studies show the influence of a commercial on memory of consumers of different market segments (consumers or non-consumers) and this kind of information can be used to create commercials which fit specific kinds of consumers. It can also be used to show which parts of a commercial are liked. Companies can investigate what the best commercial or even movie trailer is before it will be launched. So they have the opportunity to make the most profitable campaign. A product can be optimally designed by using the most attractive stimuli. Another tool of imaging is in determining the price limit consumers are willing to pay. So companies can maximize their sales volume. Neuromarketing can thus be very interesting in investigating the effects of a commercial/advertisement/product before it even exists. Imaging techniques can provide information about if people remember/forget an advertisement, what attention they are given and whether they like/dislike it (Vecchiato et al., 2011). Besides, imaging tools such as EEG are relatively cheap so it can be an efficient trade-off between costs and benefits. Another side of neuromarketing is already reported by the press. According to them neuromarketing has some dangers, including concerns that advertisers may find a “buy button” or “magic spot” in the brain. Others have concerns that neuromarketing might one day threaten individual autonomy if this technology were able to effectively manipulate consumer behavior (Fisher et al., 2009). The current state of imaging technology does not allow for accurate, deterministic predictions of human behavior and cannot effectively manipulate consumer behavior at the time of consumption (Fisher et al., 2009). At the present others can understand and access certain things in our heads but only with our express permission. However it is possible that in the future this may be achieved without our knowledge (MacDonald, 2011). This leads to many ethical questions including who should be able to view our brain activity and to what use should such information be put? I think that, in case of neuromarketing, information about the consumers brain that is only aimed to better match the demand of the consumers, is a progress for both consumers and advertisers. If future technology is

able to manipulate consumer behavior at the moment of buying consumption, some new laws should be determined to protect the consumers free will and individual autonomy. Currently, neuromarketing is newborn and it seems to need more time to be better developed. C. Fisher et al. did a study to examine how companies, that claim to make use of neuromarketing, present themselves and neuromarketing itself and what kind of claims they make. They identified 16 companies offering neuromarketing services on the internet. 9 of them offered EEG services, only 5 offered fMRI, the other 12 offered some other neuroscience related technology and one of them did not offer any technology. The descriptions on the websites were often insufficient to determine what was being done and little evidence was provided for their claims (Fisher et al., 2009).

Neuromarketing companies appear to be providing links to media rather than to scientific literature. The media has an important role in communicating scientific discoveries but direct communication between neuroscientists and the public is better than relying on the media alone to disseminate scientific results (Fisher et al., 2009). For neuromarketing to become useful for companies, individual neuromarketing companies should avoid unfounded claims and offer services more closely to accepted scientific methods. Maybe neuromarketing companies can make use of neuromarketing techniques to become a potential part of the current way of marketing.

## References

- Ariely, D., Berns, G.S. (2010). Neuromarketing: the hope and hype of neuroimaging in business. *Nature* 11: 284-292
- Babiloni, F. (2012). Consumer neuroscience. *IEEE PULSE* 12:21-23
- Braeutigam, S. (2005). Neuroeconomics—From neural systems to economic behavior. *Brain Research Bulletin* 67 (5): 355–360
- Burns A., Bush F. 2009. *Marketing research* (6st edition) US: Prentice Hall
- Depue, B.E. (2012). Review: A neuroanatomical model of prefrontal inhibitory modulation of memory retrieval. *Neuroscience and biobehavioural Reviews* 36:1382-1399
- Eichenbaum H. 2002. *An Introduction: Cognitive Neuroscience of Memory* (2<sup>nd</sup> edition). New York: Oxford University Press. Inc.
- Fisher, C.E., Chin, L., Klitzman, R. (2009). Defining Neuromarketing: Practices and Professional Challenges. *IEEE PULSE* 18 (4): 230-237
- Henderson, G.R., Lacobucci, D., Calder, B.J. (1998). Brand diagnostics: Mapping branding effects using consumer associative networks. *European Journal of Operational Research* 111:36-327
- Higgins, E. (2002). Self-Regulation Creates Distinct Values: The Case of Promotion and Prevention Decision. *Journal of Consumer Psychology* 3 (12): 177-191
- Hubert, M., Kenning, P. (2008). A current overview of consumer Neuroscience. *Journal Consumer Behavior* 7: 272–292
- Karremans, C., Stroebe, W., Claus, J. (2006). The impact of subliminal priming and brand choice. *Journal of Experimental Social Psychology* 6 (42):792-798
- Knutson, B., Wimmer, R.S., Loewenstein, P.D. (2007). Neural predictors of purchase. *Neuron* 53(1): 147–156
- Kurowski, L., Sussman, D. (2011). Market Research and Marketing. *Investment Project Design: A Guide to Financial and Economic Analysis with Constraints* :54-117
- Lee, N., Broderick, A.J., Chamberlain, L. (2007). What is ‘neuromarketing’? A discussion and agenda for future research. *International Journal of Psychophysiology* 63 :199–204
- MacDonald, M. (2011). Some ethical issues in brain imaging. *Cortex* 47 (10): 1272-1274
- Ohme, R., Matukin, M. (2011). A Small Frog That Makes a Big Difference. *IEEE PULSE* 10:28-34
- Pieters, R.G.M., Bijmolt, T.H.A. (1997). ) Consumer Memory for Television Advertising: A Field Study of Duration, Serial Position, and Competition Effects. *Journal of Consumer Research* 23 (4):362-372
- Vecchiato, G., Astolfi, L., Fallani, F., Toppi, J., Aloise, F., Bez, F., Wei, D., Kong, W., Dal, J., Cincotti, F., Mattia, D., Babiloni, F. (2011). Review Article: On the Use of EEG or MEG Brain Imaging Tools in

Neuromarketing Research. *Hindawi Publishing Corporation Computational Intelligence and Neuroscience* 2011: 1-12

Vecchiato, G., Kong, W., Maglione, A.G., Wei, D., (2012). Understanding the impact of TV commercials. *IEEE PULSE* 12: 42-47