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## EEG MAPPING PROCESS OF DECISION MAKING

**Summary:** Decision making is one of the biggest mysteries of human brain and behavior. Every decision is a choice that, in principle, could have gone differently. It is a fork on the road of decision making. Standing before that choice, you can choose to go one way or the other, but after you have chosen, you cannot go back. Every human being knows very well what it feels like to make a decision. But what we generally do not realize is why we make choices we make. We cannot identify the sources of our decisions. Especially when they are the everyday choices we make like as consumers. We offer in this paper the way of better understanding of decision making process using the EEG. In this paper we try to identify what happened in consumer brain during each step of decision making process.

**Keywords:** decision making, EEG, consumer, decision.

### Introduction

Market researchers used to believe that consumer decisions were based on rational calculations using available information to balance costs and benefits. According to this rational premise, this is how consumers are supposed to make decisions. And sometimes they make decisions that appear rational and logical. Much of the time, consumers do not act rationally and logically. Modern brain

science shows why the consumers sometimes make decisions rationally and logically and sometimes not. Human brains do not operate the way we used to think they do [Wänke, 2009]:

- Our conscious brains are lazy controllers of our nonconscious minds, preferring fast, efficient and easy solutions to deep deliberation.
- We are naturally curious and drawn to novelty, but we do not quite trust it.
- We do trust familiarity and make many of our decisions based on what is familiar.
- We like things that are easy to process, to such an extent that we often mistake processing fluency for inherent goodness, truth, persuasiveness, safety and likeability.
- Our thinking is highly reliant on a process called “priming”, which links one idea to other both consciously and nonconsciously, and has a large impact on our chain of thought and reactions.
- Our judgments and preferences are highly influenced by emotional markers that operate largely below our conscious awareness and have significant impacts on what we notice and what we remember.
- We are often motivated by goals we are not aware that we are pursuing, the success or failure of which affects our moods and performances in ways that are inaccessible to us.
- Much of our behavior is governed by habits, which get triggered by environmental cues and play out without conscious thought, goals or intentions

Given all these nonconscious and automatic forces that operate outside the traditional domain of logical, thoughtful decision making, we should not be too surprised that consumer choice remains a mystery and that the nice stories consumer tell market researchers often fail to match up with what actually happens in the marketplace.

## **1. Process of decision making**

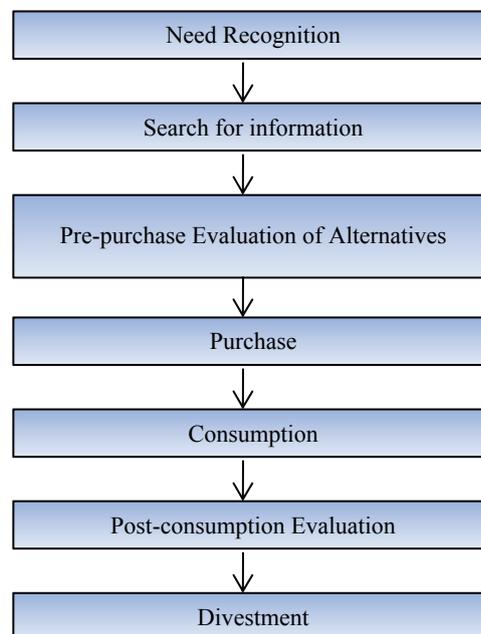
Because what we buy and use is ultimately the result of some decisions we have made. Understanding consumer behavior requires appreciating how people make purchase and decisions. We introduce a model of the consumer decision process, which features the seven major stages of decision making and the variables that affect activities in these stages. The model shows how consumers purchase products to solve problems [Solomon, 2009].

The consumer decision process is shown in Fig. 1 and represents “roadmap” of consumers’ minds that marketers and managers can use to help

guide product mix, communication and sales strategies. The model captures the activities that occur when decisions are made in a schematic format and shows how different internal and external forces interact and affect how consumers think, evaluate and act [Sheth et al., 1999].

No one buys a product unless they have a problem, a need or a want. The Consumer decision process model shows how people solve the everyday problems in life that cause them to buy and use products of all kinds. This model, in its earlier state, was developed by Kollat and Blackwell at The Ohio State University [Blackwell et al., 2001].

As the model shows, consumers typically go through seven major stages when making decision: need recognition, search for information, pre-purchase evaluation, purchase, consumption, post-consumption evaluation and divestment.



**Fig. 1.** Consumer Decision Process (CDP) model

Source: Blackwell et al. [2001, p. 71].

The starting point of any purchase decision is a customer need (problem). Need Recognition occur when an individual senses a difference between what perceives to be the ideal versus the actual state of affairs. Consumer buys things when they believe a product's ability to solve a problem is worth more than the

cost of buying it, thereby, making recognition of an unmet need the first step in the sale of product [Blackwell et al., 2001].

Once need recognition occurs, consumers begin looking for information and solutions to satisfy their needs. Search may be internal, retrieving knowledge from memory or perhaps genetic tendencies or it may be external, collecting information from friends, family and the marketplace. Sometimes consumers search passively by simply becoming more receptive to information around them, whereas at other time they engage in active search behavior, such as researching consumer publications, paying attention to ads or searching on the internet [Blackwell et al., 2001].

The next step of the consumer decision process is evaluating alternative options identified during the search process. In this stage, consumers seek answers to questions such as “What are my options?” and “Which one is the best?” when they compare, contrast and select from many products or services. Consumers compare what they know about different products and brands what they consider most important and begin to narrow the field of alternatives before they finally buy one of them [Blackwell et al., 2001].

Next stage of consumer decision process is called “purchase”. After deciding whether or not to purchase, consumers move through two phases. Consumer chooses one retailer over another retailer (or other ones such as catalogs, electronic sales with the aid of a TV or PC, or direct sales etc.). The second phase involves in store choices, influenced by salesperson, product display, electronic media and point of purchase advertising [Blackwell et al., 2001].

After the purchase is made and consumer takes possession of the product, consumption can occur – the point at which consumers use the product. Consumption can either occur immediately or be delayed. How consumers use products also affect how satisfied they are with the purchases and how likely they are to buy that particular product in the future [Blackwell et al., 2001].

The next stage of consumer decision making is post-consumption evaluation, in which consumers experience a sense of either satisfaction or dissatisfaction. Satisfaction occurs when consumers’ expectations are matched by perceived performance. When experiences and performance fall short of expectations, dissatisfaction occurs. The outcomes are significant because consumers store their evaluation in memory and refer to them in future decisions [Blackwell et al., 2001].

Divestment is the last stage in the consumer decision process model. Consumers have several options, including outright disposal, recycling or remarketing [Blackwell et al., 2001].

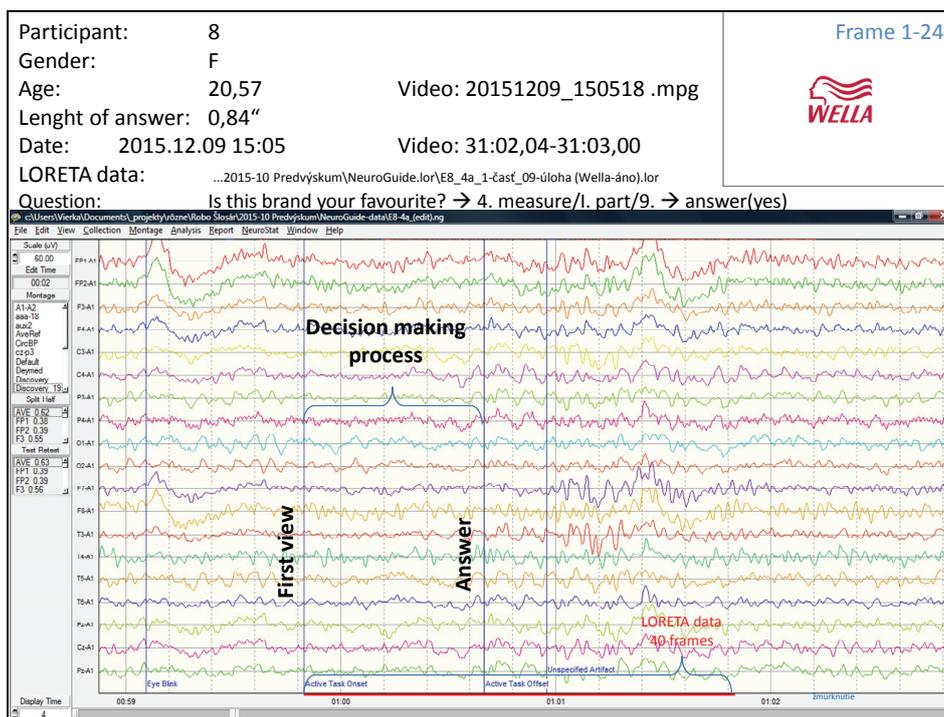
## 2. EEG

Electroencephalography (EEG) has for a long time been a very popular diagnostic tool for brain disorders. The same technique can show the brain activity in certain psychological states, such as alertness or drowsiness. Observation of the brainwaves whose different amplitudes correspond with different mental states, such as wakefulness (beta waves), relaxation (alpha waves), calmness (theta waves), light and deep sleep (delta waves) can tell a lot about the subjects' mental states. To assist in the task of measuring the brain activity, numerous electrodes (up to 256) are placed in various locations on the scalp. Each electrode, also referred to as "lead", makes a recording of its own. In order to draw the meaningful conclusions, the electrical potential measured needs to be compared to the baseline level. The dimensions of such a potential are: the particular voltage and a particular frequency which vary with a person's state [Ambler, 2006].

Portable EEG devices make it possible to collect data anytime and anywhere to allow studies of brain activity through a naturalistic observation (for example, following shoppers in the supermarket) [Novák et al., 1992]. The more so that modern sensors can be worn comfortably for an extended period of time. The disadvantage of EEG is that the electric conductivity, and therefore the measured electrical potentials can vary widely from person to person and at different time frames. This is because various tissues (brain matter, blood, bones, etc.) have different conductivities for electrical signals. In consequence, it is sometimes hard to ascertain where exactly the electrical signal comes from [Bear et al., 2006].

## 3. Example of EEG mapping process of decision making

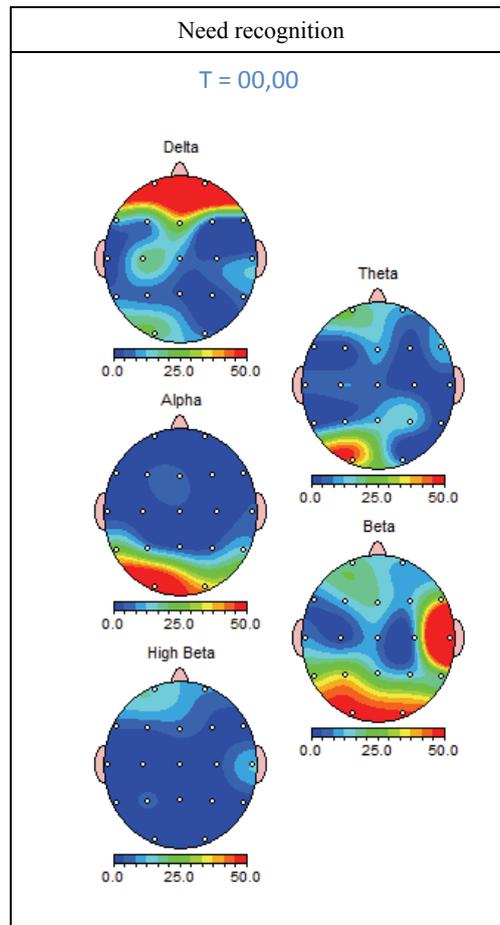
We expect that all of these seven stages except the last one are occurring in few seconds and the interval of decision making process is from first view of stimuli to formulate an answer. We presented a brand to participants and asked them, if the brand is their favorite. We showed participants brand Wella and asked them if this brand is their favorite. The aim of the question was the time of answer. EEG showed us brain activity during this decision making (Fig. 2).



**Fig. 2.** Example of decision making process

Source: Own processing.

Decision making model contains seven steps, we expect six of them except the last one. On each figures are pictures of brain and the important activity is represented by the darker areas.

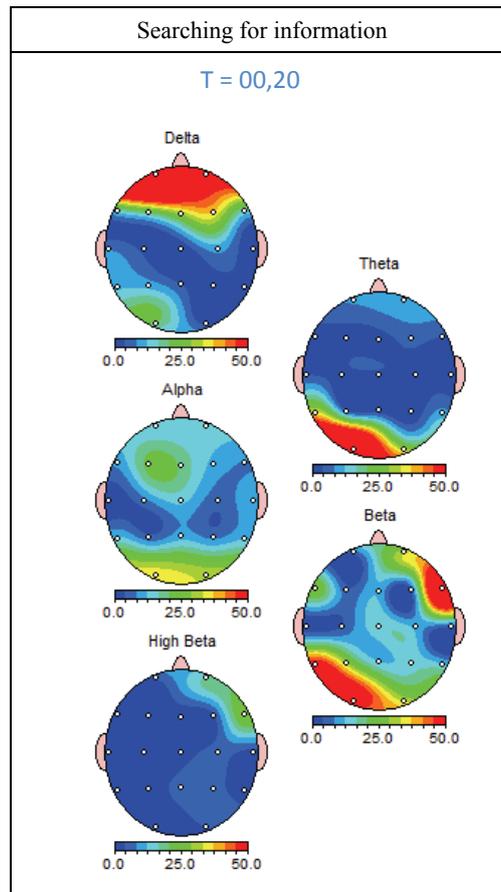


**Fig. 3.** Need recognition mapping

Source: Own processing.

In this moment participant saw the picture for first time in measurement. Brain of participants is interesting about the shapes and color during these first moments.

Primary visual cortex is most significant area in this part of measurement. Participant recognizes shapes and colors and use a bit of primary motor cortex for looking for information about this brand in memory.

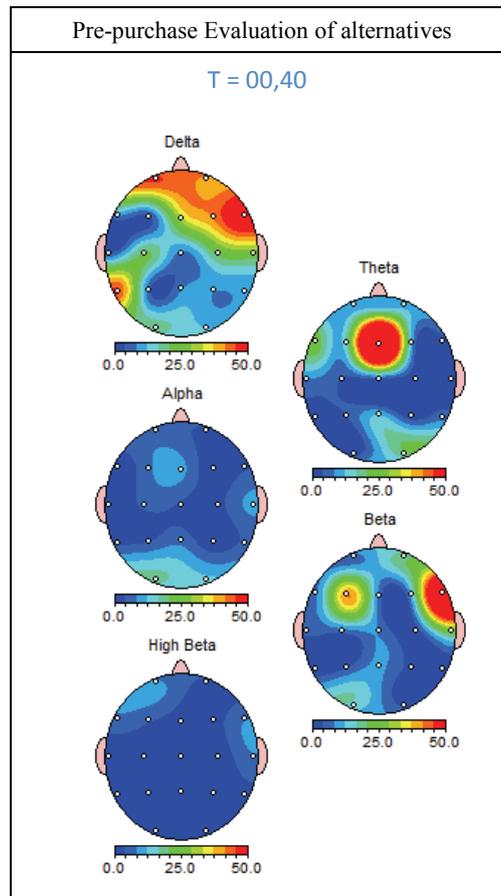


**Fig. 4.** Searching for information mapping

Source: Own processing.

Participant is looking for information in memory, because she knows the brand, but she is still looking on picture.

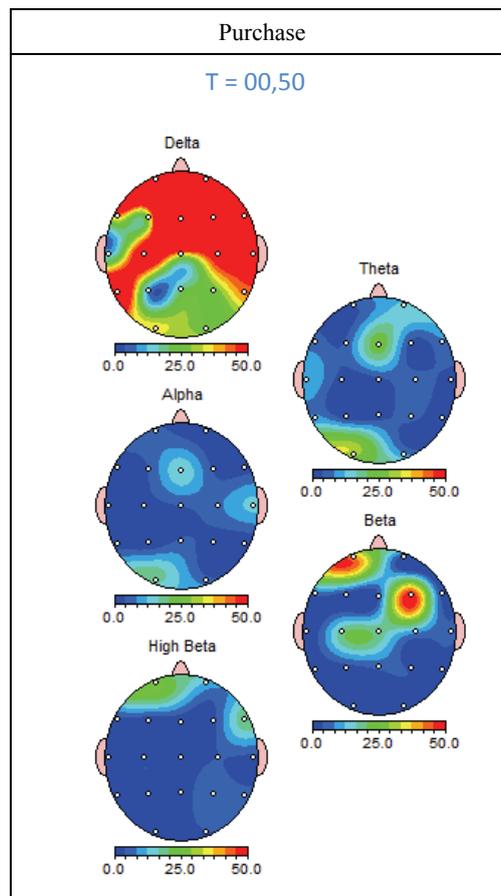
Includes frontal eye fields is using for searching some information in cooperation with primary motor cortex. Primary visual cortex is still active which means that participant is still looking on a brand. Higher activity is located in anterior prefrontal cortex which plays an important role in the integration of sensory and mnemonic information.



**Fig. 5.** Pre-purchase Evaluation of alternatives mapping

Source: Own processing.

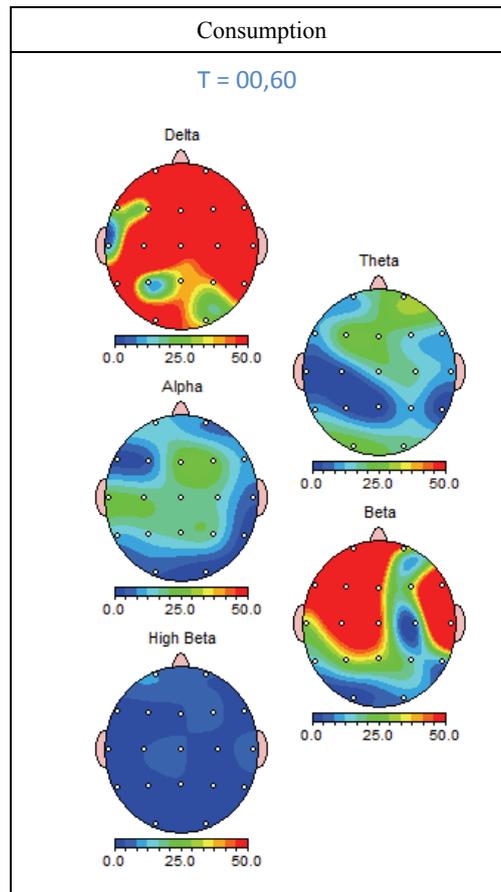
In  $T = 0,40$  is significant activity in premotor cortex which is responsible for planning. But major function is speech motor programming. We can assume that Brain of participant started with formulate an answer.



**Fig. 6.** Purchase mapping

Source: Own processing.

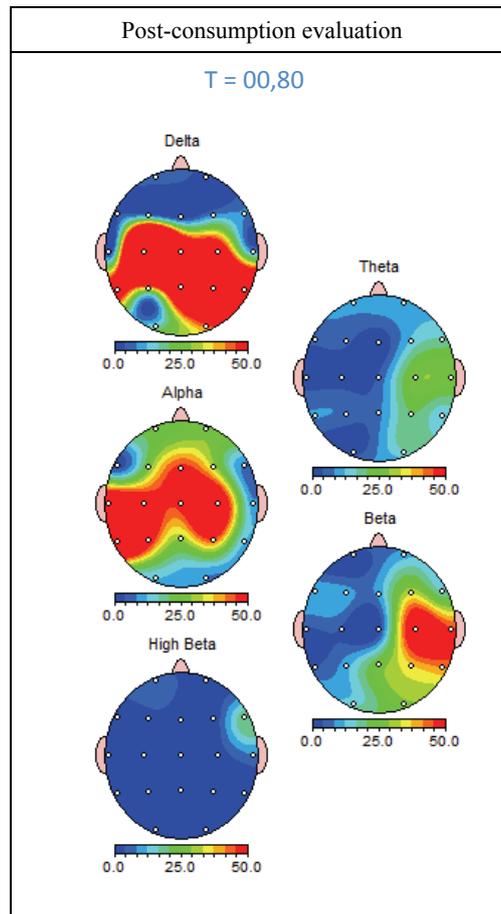
Anterior prefrontal cortex which plays an important role in the integration of sensory and mnemonic information is also active in areas responsible for organization, executive control of behavior and decision making. Orbitofrontal area, also active, is associating with decision making involving reward.



**Fig. 7.** Consumption mapping

Source: Own processing.

Anterior prefrontal cortex in this time uses part responsible for verbal fluency, verbal processing and decision making. We can observe activity in the middle frontal gyrus which is involved in processing emotions. This involvement may be related to making decisions about emotional stimuli.



**Fig. 8.** Post-consumption evaluation mapping

Source: Own processing.

In this step is the most important activity in Somatosensory association cortex. This part of Brain is processing emotions and self-reflections during decision makings.

## Conclusion

Consumer decision making process is influenced and shaped by many factors and determinants. These falls into three categories: individual differences, environmental influences and psychological processes. Consumer decisions move through the following stages: need recognition, search for information, pre-purchase evaluation of alternatives, purchase, consumption, post-purchase

alternative evaluation and divestment. As consumer move through these stages, marketers have an opportunity to react to influence behavior with effective communication and marketing strategies that address each of these stages and the variables that affect each stage [Felser, 2001]. EEG mapping can assist to marketers find the most important reactions during the process of consumer decision making. EEG represents the way of market research which is still in the beginning. Results from researches consumer behavior measures by EEG can help marketers more effective communicate with consumers and set the marketing strategies.

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## ANALIZA PROCESU PODEJMOWANIA DECYZJI Z WYKORZYSTANIEM EEG

**Streszczenie:** Podejmowanie decyzji jest jedną z największych tajemnic ludzkiego mózgu i zachowania. Każda decyzja to wybór, który w zasadzie może różnie przebiegać. Stojąc przed takim wyborem, można wybrać kierunek w jedną lub drugą stronę, ale po podjęciu tej decyzji nie można już zawrócić. Każdy człowiek dobrze wie, jakie to uczucie, gdy podejmuje się decyzje. Ale nie zdajemy sobie sprawy, dlaczego dokonujemy takich, a nie innych wyborów.

Nie możemy również zidentyfikować źródła naszych decyzji. Zwłaszcza gdy są to codzienne wybory, których dokonujemy jako konsumenci. W niniejszym opracowaniu ukazujemy sposób lepszego zrozumienia procesu podejmowania decyzji z wykorzystaniem EEG. W artykule staraliśmy się ustalić, co dzieje się w mózgu konsumenta podczas każdego etapu procesu decyzyjnego.

**Słowa kluczowe:** podejmowanie decyzji, EEG, konsument, decyzja.