



NEUROSCIENCE APPLICATIONS IN BUSINESS

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ABSTRACT

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Neuroscience is an emerging field in business life and most of the studies conducted on the topic are conceptual. In this study, how neuroscience applications take place in business is examined. In this context, the advantages and disadvantages of neuroscience applications and how neuroscience was defined were investigated within the framework of research questions.

The study was carried out in a qualitative pattern, and 14 interviews were conducted with academicians and company owners or managers working in the field. The interview texts were examined by content analysis and as a result, three main themes have emerged. The first theme is about the content of neuroscience. Regarding the content of neuroscience, the most mentioned themes are its interdisciplinary nature, its basis on brain science and its dependence on foreign sources. It is emphasized by the participants that although neuroscience applications are effective in Turkey, its external dependence is high. The second theme consists of advantages of neuroscience applications.

The advantages of neuroscience applications are mainly classified as marketing related advantages, efficiency related advantages and competition related topics. On the other hand, the final theme is about disadvantages of neuroscience applications.

Although the statements about the disadvantages of neuroscience research are limited, it has been observed that most of them are about the susceptibility of these applications to abuses. Moreover, growing ethical concerns about the applications are also expressed. In accordance, this study provides current situation of neuroscience applications in businesses based on expert opinions.

Keywords: Neuroscience, Neuromarketing, Neurofinance, Neuromanagement



ÖZET

İŞ DÜNYASINDA NÖROBİLİM UYGULAMALARI

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Nörobilim, iş dünyasında gelişmekte olan bir alan olup konuyla ilgili yapılan çalışmaların çoğu kavramsal niteliktedir. Bu çalışmada nörobilim uygulamalarının işletmelerde nasıl ele alındığı incelenmiştir. Bu kapsamda nörobilim uygulamalarının avantaj ve dezavantajları ile nörobilimin nasıl tanımlandığı, kurgulanan araştırma soruları çerçevesinde incelenmiştir.

Araştırma nitel bir desende gerçekleştirilmiş olup, akademisyenler ve alanda çalışan firma sahipleri veya yöneticileri ile yapılan on dört mülakat çerçevesinde yapılmıştır. Görüşme metinleri içerik analizi ile incelenmiş ve sonuç olarak üç ana tema ortaya çıkmıştır. İlk tema nörobilimin içeriği ile ilgilidir. Nörobilimin içeriği ile ilgili olarak, disiplinler arası doğası, beyin bilimine dayanması ve yabancı kaynaklara bağımlılığı en çok bahsedilen temalardır. Türkiye'de nörobilim uygulamalarının etkili olmasına rağmen dışa bağımlılığının yüksek olduğu katılımcılar tarafından vurgulanmıştır. İkinci tema, nörobilim uygulamalarının avantajlarından oluşmaktadır. Nörobilim uygulamalarının avantajları temel olarak pazarlama ile ilgili avantajlar, verimlilikle ilgili avantajlar ve rekabetle ilgili konular olarak sınıflandırılmıştır. Öte yandan, sonda yer alan tema, nörobilim uygulamalarının dezavantajları hakkındadır.

Nörobilim araştırmalarının dezavantajları ile ilgili ifadeler sınırlı olmakla birlikte, çoğunun bu uygulamaların suiistimallere yatkınlığı ile ilgili olduğu gözlemlenmiştir. Ayrıca, uygulamalarla ilgili artan etik kaygılar da dile getirilmektedir.

Buna uygun olarak mevcut çalışma, uzman görüşlerine dayalı olarak işletmelerde nörobilim uygulamalarının mevcut durumunu ortaya koymaktadır.

Anahtar Kelimeler: Nörobilim, Nöropazarlama, Nörofinans, Nöroyönetim



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This thesis is dedicated to my son Han...

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CHAPTER I

INTRODUCTION

Neuroscience has been developing extensively in recent years. The main reason for this development is the new technologies that made it possible to understand the structure of the human brain for scientists and learn more about how it works (Treutler 2010: 248). Related to Neuroscience, the concept of “Neuroeconomics” was used for the first time by Kevin McCabe in 1998 at George Mason University. In 1999, Paul Glimcher and Michael Pratt published their study about neuroeconomic analyzes on monkeys' behavior in Nature Magazine (Platt and Glimcher 1999: 237). Paul Zak, director of the Center for Neuroeconomics Studies at the Claremont Graduate University in California, states that this study revealed that the foundations of neuroeconomics are interdisciplinary integration due to its optimal allocation of scarce resources (Camerer et al. 2004: 560).

In recent years, neuroscience has emerged as a developing discipline that combines numerous sciences that study the functional organization and structure of the nerve system with specific attention on the brain. Neuroscience has developed some tools and applications in several areas of information, such as neuro leadership, neuro marketing, neuro finance, neuro management. All these applications and devices are adjusted for the decision-making process of financial agents, basically focusing on the emotions inside them: political electors, company CEOs, consumers, etc., all decisions based on feelings and emotions.

The science of experimental business received tremendous support from the science of neurology. This common discipline, in which neurologists use economic games to understand the brain's work, has been included in the literature and has been the subject of many scientific studies.

Colin Camerer works on game theory and related methodological approaches, while Ernst Fehr from Zürich University studies altruism, both of which are the field's pioneers.

Drazen Prelec and George Loewenstein have been working on the same subject for many years with many kinds of research (Camerer et al. 2005: 15).

The concept of neuro business focuses on measuring the conditions under which decision-making units display economic behavior by monitoring people's decision-making processes with economic decision-making, using much science, such as economics, biology, psychology, behavioral economics, and evolutionist economics. The rationality of the decision-makers, consumers, producers, and the economic decision authority and their behavior and path is the subject of the neuro-business (Hobikoğlu 2014: 23).

Linking the existing business models with the theories of neurology and psychology sciences enables to capture different approach points by associating the gap points of theories with other sciences. The association of the neuro system, which deals with consciousness, perception, memory, and the biological foundations of learning, with consumer behavior, also strengthened the economic experiment relationship. Business/financial decision-makers do not behave the same way and can be influenced by many dependent and independent variables such as personal and social factors. It is essential to establish a link between neuroscience and the economic consequences of the consumption decision that examines the conditions under which the brain works. Classical economics theories do not consider the situations caused by the neurochemical effects affecting the individual's behavior when looking at micro and macro scale behaviors; therefore, it makes explanations with more meaningful data in explaining the economic behaviors related to real individuals and situations. It is the most functional tool of the multi-scientific method that generates new solutions to complement the general fundamental economic doctrines that are non-linear and perceived so far in the sound financial track of the changing paradigm.

Neuro business works intensively on individual preferences and decisions. Personal Neuro business also focuses on emotional changes while studying economic choices and decisions. While psychology examines language, cognition, memory, neuro business primarily examines cognition and preferences, the effect of emotions on behavior, and the perception of risk and gain of economic phenomena.

NeuroLeadership, neuromarketing, neuro finance, and neuro management are branches of neuroscience studying the role of neuro-physiological processes in human decision-making. These branches of neuroscience work on how the nervous system interprets the stimuli that a person gets each day and the possible ways of using its results and applications (Taş 2014: 37). This study will elaborate on the scientific studies, methods, strategies, applications, and suggestions related to neuroscience. The objective is to understand new improvements within the field.

In this thesis, it is aimed to provide pertinent studies and the most recent empirical findings all around the world but particularly in Turkey. The objective is to focus on the studies about economy, finance, and business in the area. It is aimed to put forward the most recent real-world applications: studies and tests with important administrative suggestions. The most recent applications of neuromarketing, neuro financing, neuro management/neuro leadership, and innovative neuroscientific methods, from MRI (Magnetic Resonance Imaging) to EEG (Electro Encephalography) machines, will be provided in the study. This study will try to be as comprehensive as possible and a reference source for analysts and supervisors curious about neuroscience. Additionally, implementations from different social sciences, with an extensive framework of strategies and techniques, will be examined. Beside implementations, results, innovations, methodologies, technologies, and study areas connected to neuroscience, financial matters, and business will be analyzed and presented in the study to serve as a reference.

The contents of the study will be presented in five main chapters; following the first chapter, the introduction, the second chapter of the study is a presentation of literature review about neuroscience (neuromarketing, neuro finance, neuro leadership etc.). This chapter will summarize different resources and methodologies studied to understand the human response through neurophysiological techniques. The chapter will contain a brief depiction of each method and their application to consumer-focused study. Subsequently, specific applications derived from neuroscience for marketing will be given based on an audit of some reflections on the subject.

Neuro-finance aims to evaluate the responses of decision-making processes in the brain to accounting phenomena by adapting neuroscientific methods to accounting. Neuro-finance studies, which have made interdisciplinary research mandatory, have already come a long way, although it is a very new field. Neuro-finance, which can be seen primarily as a continuation of behavioral accounting representatives redefining

the functions of accounting, allows increasing information about the physiology and anatomy of the human brain in the field of accounting with the development of science and technology. In the second chapter it is aimed to present a comprehensive overview of the history and future of neuro financing with its development, methods, advantages, and handicaps, and to discuss the permanence of this new phenomenon as a sub-discipline of accounting.

Leadership and management concepts will be examined within the scope of the neuro-leadership and neuro-management discipline. In the second chapter, emotional intelligence, IQ and other intelligence-related concepts such as social intelligence will be mentioned. The topic of neuroscience will be discussed together with the neuroscience contributing to this field. Finally, in this chapter, emotional and social intelligence characteristics will be explained with the ideas that have appeared in this area recently.

In chapter three, the research method part of the study, within the framework of a qualitative research pattern, an analysis of the questions asked to the participants was carried out using the phenomenology technique. The results were interpreted by conducting a descriptive and content analysis of the interview texts within the framework of a qualitative research design. Finally, research findings are discussed in chapter four, conclusion section.

CHAPTER II

LITERATURE REVIEW

This section contains a review of the literature about neuroscience. In this context, firstly, a review of the literature on the concepts of neuromarketing, then neuro-finance, and finally, neuro-management will be included.

It is useful to examine the underlying definitions in the beginning. The first one is neuroscience; The science of anatomy, physiology, biochemistry, or molecular biology of the nervous system, which deals with the behavior and learning of nervous and nervous tissues, etc. Psychophysiological criteria determine autonomous responses that occur involuntarily. For this reason, psychophysiological criteria are thought to provide a very basic, impartial, and sensitive evaluation of the person's response to a stimulus (Utkutuğ and Alkibay 2013: 172).

Neuroscience consists of neuromarketing, neuro-finance, and neuro-management, which will be further explained below.

2.1. NEUROMARKETING

Before neuromarketing, the interdisciplinary field where neuroscience and economic sciences first met was neuroeconomics. Later, marketing, a sub-science of economics, started to benefit from the findings that neuroscience has on the human brain. Thus, neuromarketing entered the literature as one of the marketing research methods (Giray and Girişken 2013: 613). The concept of neuroeconomics, for the first time, was used by Kevin McCabe in 1998 at George Mason University. In 1999, Paul Glimcher and Michael Pratt published their neuroeconomic analysis studies on monkeys' behavior.

Neuromarketing came to the fore for the first time in 1990 when Professor Jerry Zaltman from Harvard University announced that he used the functional Magnetic Resonance Imaging (fMRI) device in marketing research (Fisher et al 2010: 235).

Prof. Ale Smidts, the winner of the Nobel Prize from Erasmus University, has been the first to use these studies with the concept of neuromarketing and to bring them to the academic literature in 2002 (Lewis and Bridger 2008: 37). Neuromarketing is the inclusion of data from the combination of neuroscience and psychophysiology in marketing processes (Hubert and Kenning 2008: 275). Neuromarketing is an attempt to understand the response of the human brain to marketing stimuli using neuroscience techniques (Senior et al 2007: 154). In parallel with the developments in brain imaging technologies, Neuromarketing is expressed as the measurement of the responses of the human brain, which resembles a black box, consisting of about 100 billion neurons, to the marketing stimulants with complex thinking capacity by using brain imaging methods. Neuroscience, which operates in the anatomy, physiology, biochemistry, or molecular biology of the brain and nervous system, especially examining the relationship of the nervous system with behavior and learning; has evolved to a marketing branch that consists of cognitive psychology and marketing disciplines that examine mental processes such as thinking, feeling, learning, recall, decision making, language, problem-solving and judgment (Senior et al 2007: 155).

Neuromarketing evaluates neurons at the consumer decision stage and therefore signals from the brain. Consumer decisions are mixed. Although a consumer thinks that he prefers any brand due to quality, price, and appearance, those reflected from the brain do not show exactly this. Neuromarketing attempts to reveal the unconscious causes of choices and decisions. Marketing and advertising strategies are mostly based on touching and waking up the deeply hidden aspects that even the person himself does not know. Marketers use tactics and techniques individually for each individual. These can be of logical and emotional nature. However, emotional strategies are often used that activate different parts of the human brain (Ariely and Berns 2010: 290).

In short; Neuromarketing evaluates the consumer brain's response to advertising and marketing stimuli. Every individual has a choice, but the reason why he prefers something over another is a difficult question to answer. Although it is tried to be explained with logical explanations most of the time, the reality appears much more complex than it is supposed. The response of a consumer to a marketing stimulus

can actually depend on a very different reason. Neuromarketing examines the brain's response and unconscious reactions to these stimuli. Studies in this field reveals that individuals are completely different from what they actually feel and what they feel. This situation originates from brain activations at the unconscious level. Unlike traditional marketing research, neuromarketing aims to develop different marketing strategies by using consumers' brain activities. Using neuromarketing and brain imaging techniques, emotional impact levels such as simultaneous interest, attention, and motivation of the consumer mind against the marketing stimulus can be analyzed based on measuring the digitized responses of the unconscious within a certain algorithm (Eser et al 2011: 857; Yücel and Çubuk 2014: 137).

Renvoise and Morin (2013: 181) state that the brain is divided into three groups with different cellular and functional features; the old brain, midbrain, and new brain. They state that neuromarketing is based on the interaction of the old brain with the new brain, and this interaction sheds light on the concept of neuromarketing. The new brain thinks the midbrain feels, and the old brain decides. Neuromarketing, which is shaped by the fact that the decision process is affected by emotions, emphasizes that consumers do not always make rational decisions and that they make irrational decisions under the influence of emotions. In research using brain imaging techniques, the human brain was observed while making decisions, and it was proved that apparently rational decisions were directed by the emotional brain (Carter et al 2013: 74). In his book, *Descartes' Error*, Prof. Antonio Damasio indicates that “Emotion, feeling and biological arrangements all play a role in human logic” (Damasio 1994: 27); therefore, functions related to human survival have an effect on decision making (Renvoise and Morin 2013: 196).

Neuromarketing, through the collaboration of many different disciplines, examines the consumer purchasing decision process within the senses and obtains data by analyzing the regional impulse response of marketing stimuli in the brain and measuring emotional responses. With the data obtained, it is aimed to reveal the unconscious reactions of consumers that direct the purchase decision and thus clarify how the consumer actually makes the purchase decision (Yücel and Çubuk 2014: 135). The responses of consumers to marketing communication stimulators such as fragrance, packaging, products, advertisements, logos, and music are measured in seconds by using brain imaging tools, and the real reasons underlying consumer

purchasing decisions and preferences are tried to be understood within the framework of data obtained as a result of statistical analysis.

The real feelings and thoughts of the consumers that are results of commercials can be revealed; thus, it is aimed to deliver the right message to the right target audience at the right time in line with consumers' wishes, needs, and expectations (Lee et al 2007: 200).

In this context, to find out the real causes of consumers' purchasing decisions and preferences, studies are conducted in this field by using various methods. Considering that today's consumers are more knowledgeable and conscious, competition is intense, and businesses have to develop different marketing strategies; neuromarketing is becoming more and more important.

It is generally accepted that neuromarketing can be a concept that can answer Lindstrom's (2014: 192) questions;

- What do businesses need to do to impress the customers in a unique way, rather than simply trying to attract attention?
- What is the impulse that drives humans, consumers, to the choices consumers make?
- What are the real thoughts crossing the minds of shoppers?

It is possible to detail the application areas of neuromarketing with the following questions (Özdoğan et al 2008: 4);

- Which presentations of TV create a more memorable or positive emotion for the brand?
- To what extent does the viewer receive the information in the ad emotionally or analytically?
- Among the advertising tools, which ones attract the least and most attention? What does music add to the message, and what does it negate?
- What happens in the mind of the consumer when examining the different features of a new product?
- Are visual or audio messages suitable for a target audience?
- Which color will be most successful for a new product?
- What are the subconscious reactions to a new scent?
- How can the findings of other market tool types be verified?

2.1.1 The Difference of Neuromarketing from Traditional Marketing Concept

The use of neuromarketing techniques has changed the direction of traditional marketing studies and has moved marketing to a different dimension from the traditional marketing approach. Neuromarketing combines traditional marketing and multidisciplinary neuroscience and helps the business communicate its message to its consumers more clearly (Treutler 2010: 245). The reason why businesses use brain imaging methods instead of simply asking their preferences about their consumers is that they cannot clearly explain their preferences and show their true behavior. According to Zaltman (2000: 427), 95% of individuals' feelings and thoughts are influenced by unconscious processes, and then individuals attempt to rationalize their decisions. For this reason, it is necessary to go deep into the consciousness in order to reveal the true feelings and thoughts of the consumer.

Neuromarketing evaluates the outputs of consumer consciousness and sub-consciousness together, which reveals the real feelings that shape the basic behaviors of the consumer and enables marketing professionals to shape their decisions to make marketing processes more effective. Instead of the answers given by the consumers according to social acceptance, the real feelings and thoughts hidden in the depths of the consumer mind can be brought to light with neuromarketing techniques that focus on the real reasons underlying their behavior (Ural 2008: 455). It seems possible that the neuromarketing research methods, which reveal the real feelings, thoughts, and unconscious reactions of the consumers that they do not express, by supporting them with other qualitative research, will lead to healthier results in the way of understanding the consumer. Neuromarketing research methods are complementary, not substitutes, of traditional marketing research methods (Morin 2011: 134).

Although the budget that businesses devote to market research continues to increase every year, 8 out of 10 new products coming to the market in the United States fail in 3 months after their launch date, and this figure may even reach 9.7 in Japan (Lindstrom 2014: 29). Professor of Harvard University Gerald Zaltman indicated that “the consumer's behavior by using well-known but useless research techniques are constantly misinterpreted. The products and communications that are developed with this information are no longer appealing to the consumer” (Zaltman 2000: 15; Özkaya 2015: 34). Famous advertiser David Ogilvy states that “People cannot think what they feel, cannot express what they think and do not do what they say”. In parallel with this finding, researchers think that they can access some data by examining the consumer's

brain during an advertisement or product choice. Nonetheless, UC Irvine Neuroscience Director Professor Antonio Damasio, investigating the effect of emotions on the consumer's purchasing decision mechanism, opposing the traditional marketing approach shaped by the assumption that the consumer is rational in his preferences, expressed that "they are not thinking machines with feelings, but feeling machines with thoughts." It suggests that consumers make irrational decisions under the great influence of their emotions (Damasio 1994: 29; Eser et al 2011: 867). In other words, Damasio stated that the consumers tend to express the answers he thinks they can choose with his prejudices, and which he thinks he is expected to be expressed instead of expressing the real feelings and reasons underlying his preferences. The issue of how real the data and results obtained in this way reflect the reality opens the discussion.

2.1.2. Techniques Used in Neuromarketing

Until recently, scientists have not been able to find the necessary information about how the human brain works. The research was limited to predictions about what was happening to the brain by studying behavioral changes after brain damage. In order for scientists to find out which control areas in the brain are related to functions such as thinking, perception, moving, decision making, emotion, memory, speech, or vision, and to determine the extent of brain damage and where it occurs in the brain; they had to wait for a person with a sensory impairment to be found and die due to injury (Carter et al 2013: 185).

However, neuroscientists today have the opportunity to observe the electrical activity in the living brain and how the different functions of the brain work together while performing mental processes or sensory functions, thanks to modern functional brain imaging techniques that add a new and complementary dimension to the brain research. These techniques are also useful in detecting damages to the brain, determining which control area in the brain provides which function, thus enabling the association of emotion and behavior types and similar functions with specific types of activities in the brain. Neuroscientists have uncovered a detailed map showing brain functions based on information obtained by using functional brain imaging techniques in brain research (Carter et al 2013: 199). However, since what we know about sensory perception and abilities is very limited (Krishna 2012: 342), it will take some more time to use these developments in the field of marketing.

In neuromarketing research, besides functional brain imaging techniques, biometric measurement techniques, including computer-aided systems developed to measure the physiological and biological responses of the consumer outside the brain, are used (Ustaahmetoğlu 2015: 154). Functional brain imaging techniques used in neuromarketing research are; Functional Magnetic Resonance Imaging (fMRI), which records metabolic activities in the brain; Positron Emission Tomography (PET) and Electron Brain Graph (Electroencephalography- EEG) that records electrical activities in the brain, Magnetic Brain Graph (Magnetoencephalography- MEG), Steady State Typography (SST) and Transcranial Magnetic Stimulation (TMS) techniques. Measurement techniques performed without recording biometric or brain activity includes; Skin Conductance Response (SCR), Facial Electromyography (Facial EMG), Measuring Physiological Responses, Eye Tracking, Implicit Association Test, and Facial Coding Techniques (Zaltman 1997: 428; Akın 2014: 84; Çubuk 2012: 55; Ural 2008: 425; Lindstrom 2014: 26; Bercea 2013: 125; Özkaya 2015: 42; Ustaahmetoğlu 2015: 154; Kahraman and Aytakin 2014: 52).

Neuromarketing is the inclusion of data from the combination of neuroscience and psychophysiology in marketing processes (Hubert and Kenning 2008: 280). Neuromarketing research is based on the measurement of the digitized responses of the unconscious within a certain algorithm using neuroscience's functional brain imaging techniques to understand the response of the human brain to marketing stimuli (Senior et al 2007: 162). The data obtained are evaluated simultaneously with cognitive psychological processes regarding the consumer purchasing decision mechanism; thus, the real reason behind the consumer preferences is tried to be understood. In this respect, it would be appropriate to explain neuromarketing research techniques.

2.1.2.1. Functional Magnetic Resonance Imaging- fMRI

Functional Magnetic Resonance Imaging (fMRI) has become popular in neuromarketing research in recent years and provides detailed visualization of brain functions. fMRI measures neural activity based on blood volume, oxygenation, and blood flow variability. fMRI is based on the difference in the magnetic properties of oxyhemoglobin (oxygen-bound hemoglobin) and deoxyhemoglobin (oxygen-depleted hemoglobin), and therefore the fMRI signal is called the Blood Oxygenation Level

Dependent (BOLD) signal. This signal provides a mapping of active neural areas (Özkaya 2015: 45).

Increased neuronal activity causes an increase in oxygen consumption and energy metabolism in the activated region, thereby causing an increase in deoxyhemoglobin and a decrease in magnetic signal. At the same time, an increase in oxygen consumption occurs within seconds with an increase in local blood flow. Since the increase in the blood flow of the brain exceeds the increase in oxygen consumption, oxyhemoglobin increases, and the signal size increases, thus, from which regions or regions of the brain the desired physical or mental activity can be displayed (Ariely and Berns, 2010: 290; Bercea 2013: 132; Carter et al 2013: 221 Fortunato et al 2014: 213). The increase in neuronal activity in the areas related to purchasing in the brain, the blood flow to the region related to the fMRI technique can be monitored (which can be seen in Figure 1), and the current activity status can be monitored in short intervals of a millionth of a second (Kahraman and Aytakin 2014: 55). For example, the first stage of the 2004 Coke - Pepsi tasting comparison, in which brand names were not given, was made with fMRI. Although consumers liked Pepsi at a high rate, it was observed that they preferred Coke when the brands were announced. This has been associated with Coke's increased activation in the emotional loyalty and trust area of consumers, according to fMRI results¹.

¹ <http://barisgurkas.com/noropazarlama-nedir/>

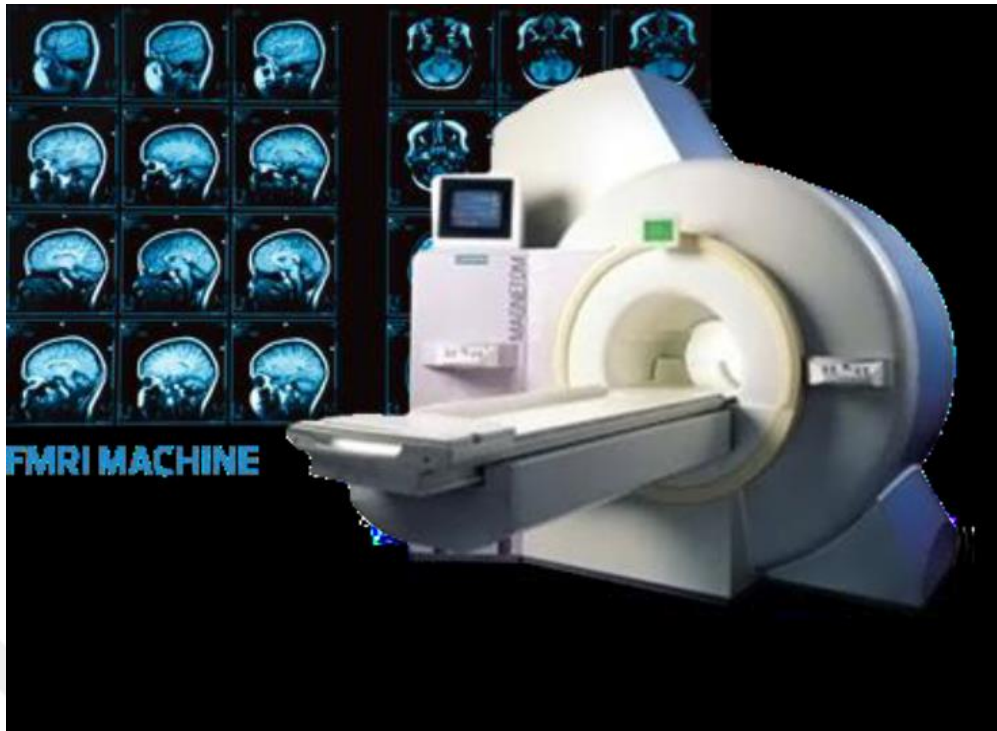


Figure 1 - Functional magnetic resonance imaging -fMRI
(www.neuro.mediasauce.com)

2.1.2.2. Electro Brain Graph (Electroencephalography- EEG)

With the help of electrodes placed around the skull, brain waves of different frequencies in the brain are measured. It is one of the most used techniques in neuromarketing research after the fMRI technique.

In EEG recording, 8-16 electrode pairs are placed at standard points around the skull, called the international 10- 20 system. Naming these points; F, T, P, C, O (frontal, temporal, parietal, central, occipital) respectively, 1-2-3-4 numbers (double numbers represent the right hemisphere, single numbers represent the left-brain hemisphere)². Amplitude represents the strength of the electrical activity that the brain generates. The volume or intensity of brain wave activity is measured with microvolts, and the wave frequency is indicated with Hertz (Hz). Brain waves are defined as low-frequency electrical activity created by neurochemical activity in a living brain. With EEG, the electrical activity is recorded, and these recorded neuronal electric wave patterns show brain waves. A flat EEG indicates that there is no electrical activity; this is clinical evidence of brain death. Brain waves are divided into four basic groups: Delta, Theta, Alpha, and Beta. Raw EEG is mostly defined by these frequency bands;

² (www.efizder.org/sayfa.asp?sayfaid=1571)

Delta (less than 4 Hz), Theta (4-8 Hz), Alpha (8-12 Hz), and Beta (13-30 Hz) (Carter et al 2013: 225).

The most important parameter in the evaluation of EEG waves is frequency, and another important parameter is amplitude. As the activity level of the brain increases, the frequency of EEG waves increases, and their amplitude decreases. Frequency is the number of times a wave repeats in a second. In cases where these frequencies are insufficient, too much, or difficult to find, mental performance can be negatively affected (Sürmeli 2010: 18).

It is a technique that is very common all over the world because of its ease of use, portability, relatively low cost, and high temporal resolution. Being able to move to the markets where the products are exhibited and to the stores where the products are sold due to being wireless and lightweight; provides great advantages to brands by measuring the effectiveness of stimulants in many different places (Alyar 2018: 82).

Delta waves take place in the frequency range of 0.1-3 Hz and are usually seen when sleep, deep meditation, and empathy are felt. It is the dominant rhythm in babies up to 1-year-old and is in the 3rd and 4th stages of adult sleep. Delta waves reflect subconscious thought; in other words, subconscious thoughts are reached through delta waves. The delta wave is the highest and slowest wave in amplitude. While delta waves should be increased in order to decrease awareness in the physical world, to improve performance, delta waves are reduced to achieve high focus and high performance. Delta waves are recorded when the brain shows very low activity (Sürmeli 2010: 19). It belongs to the period when the brain is least functioning, and growth hormone secretion increases during this period. It provides physical growth in children, beauty, and vigor in adults (Fannin 2018: 120).

Theta waves take place in the frequencies of 5- 8 Hz and are expressed as slow activity. It is associated with intuition, learning, creativity, calmness, peace, relaxation, dreaming, emotions, memories, exciting events, and unconscious theta wave. It is also strong during inward focus and meditation and reflects the state between wakefulness and sleep. Theta wave shows the activity in the hippocampus and limbic system region.

While the beta is active in conscious behavior; Theta waves are active in frequent, habitual, automated behavior. Theta activity has been found to be associated with memory processes (Fell et al 2003: 1085).

Alpha waves are located at frequencies of 7.5-12 Hz and are concentrated in the occipital region and frontal cortex. Alpha wave is important in learning and using

information. At the same time, it acts as a bridge between consciousness and the subconscious; extraversion is associated with creativity and mental activity. In normal alpha rhythm, good mood, calmness, attention, and fast comprehension are observed (Fannin 2018: 121). When the eyes are closed, and the deep breaths are taken, and the mental effects from the outside world decrease, the alpha dimension is passed. While on Alpha waves, success in works increases. In the case of deep sleep or anxiety and fear, this wave is never seen. During studies such as meditation, yoga, and reiki, the brain is in alpha size (Cvijetic 2020: 25).

The beta wave has an active role in active thinking, interest, concentration, problem-solving, decision making, judgment, and processing of sensory information. The beta wave is recorded when the brain shows a very high level of activity (Sürmeli 2010: 23). Beta waves have relatively low amplitude and are the fastest of four different brain waves. The frequency of beta waves ranges from 15 to 40 cycles per second. Brain waves are effective in awake, conscious thinking, concentrating, chatting, making decisions, solving a problem, focusing on a task, learning a new concept (Cvijetic 2020 :28).

Studies on EEG are frequently used to examine the neurological responses of individuals during purchasing behavior (Vecchiato 2011).

2.1.2.3. Magnetic Brain X-ray (Magnetoencephalography- MEG)

MEG technique uses magnetic potential to record brain activity at the level of the scalp with a helmet with a sensitive detector placed on the subject's head. The device and its replacement are shown in Figure 2. In this way, it provides to obtain the functional image or activity map of the brain. MEG is able to measure brain activities in milliseconds by monitoring magnetic field changes and showing neuronal activities with millimeter precision so that it is possible to reach detailed data by detecting

possible activation areas of the brain (Crease, 1991; Bercea 2013: 133). MEG is shown in Figure 2.



Figure2 :Magnetic brain x-ray (MEG) (www.neuromarketingresearch.co)

2.1.2.4. Positron Emission Tomography (Positron Emission Tomography- PET)

Positron Emission Tomography (PET) involves intravenous injection of a radioactive marker, which is bound to glucose in the brain and dissipates by positron heat, and emits special signals. The PET is shown in Figure 3; red areas with high activity use glucose as fuel. Marker dye shows which areas of the brain have fired. PET provides metabolic and functional imaging based on metabolic measurement of changes in glucose absorption (Lin, Tuan and Chiu 2010; Bercea 2013: 135; Fortunato et al 2014: 212).



Figure 3 - Positron Emission Tomography.

2.1.2.5. Transcranial Magnetic Stimulation- TMS

The transcranial Magnetic Stimulation (TMS) technique is used with EEG and MEG for better detection of electrical activity changes occurring in brain areas during sensing and thinking. The magnetic charge is directed to a certain area in the brain in a short time by means of a rod, which can be seen in Figure 4, placed close to the subject's head, and this load can be examined as MEG and EEG outputs (Bercea 2013: 133).



Figure 4 - Transcranial magnetic stimulation (TMS)

2.1.2.6. Steady State Topography- SST

The Steady-State Topography (SST) technique is used in cognitive neuroscience and neuromarketing research to measure brain activity and rapid changes in brain activity. SST device is shown in Figure 5 SST, thanks to its sinusoidal visual feature, measures the pulsating electrical responses of the brain to the stimuli of a completely vibration-free visual environment and records brain electrical activity simultaneously with a method also known as the Steady-State Visual Evoked Potential (SSVEP) (Bercea 2013: 135).



Figure 5 - Steady-State Topography – SST (www.wallblog.co.uk)

2.1.2.7. Eye Tracking Technique

Eye Tracking Technique is frequently used in neuromarketing research and involves tracking eye movements against visual stimuli without measuring brain activity, and it is shown in Figure 6. Accordingly, data based on physiological measurement of where a participant is looking at what time and how eye movements are followed at any time are obtained in the experiment (Nenad 2011; Baş and Tüzün 2014).

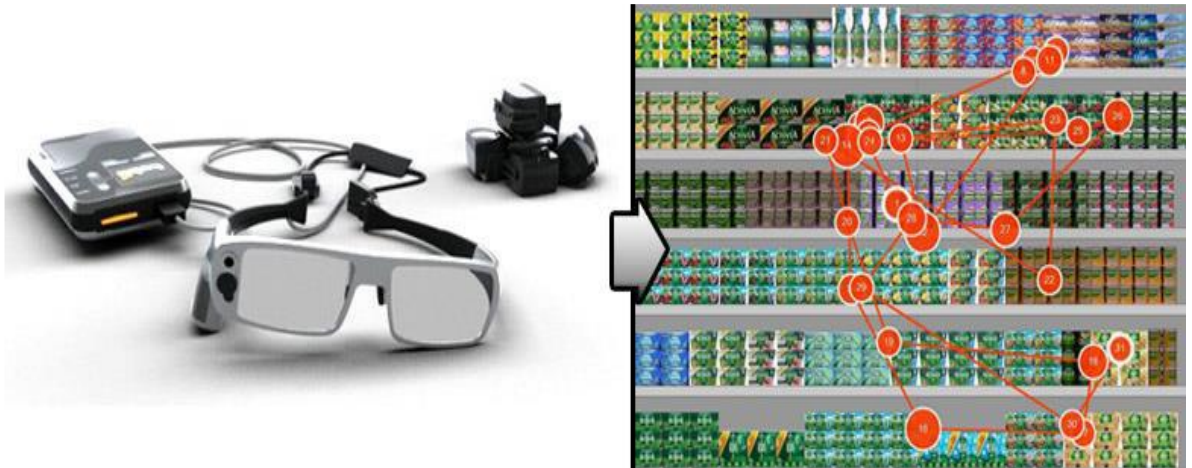


Figure 6 - Eye tracking (www.marketingactual.es)

2.1.2.8. Measuring Physiological Responses

Biological reactions to stimuli provide information about the emotional effects of the subject, such as lie detectors. Researchers can reveal momentary emotional states of subjects based on measuring physiological responses such as heart rate, blood pressure, skin conductivity, the salivary stress hormone, and contraction of facial muscles (Bercea 2013: 137).

2.1.2.9. Implicit Association Test (Implicit Association Test)

The implicit association test helps to identify hierarchies by comparing the products used in individual behavior and experience measurement. It is used to measure the implicit attitudes of individuals towards any concept. According to the implicit association test, the concepts in the same category in mind automatically evoke each other (Atakay 2014).

2.1.2.10. Skin Conductance Response (SCR)

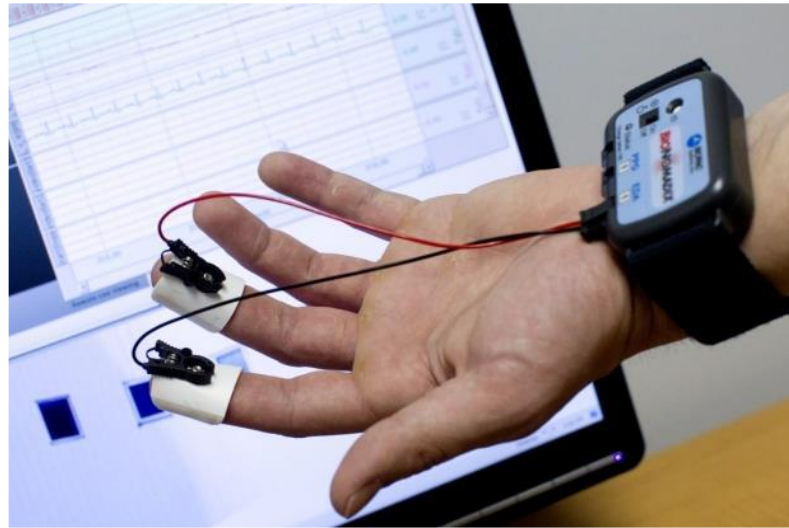


Figure 7 - Skin Conductance Response –SCR

Skin conductivity is based on the analysis of galvanic skin changes caused by activation of the autonomic nervous system and measures the stimulation that occurs (Banks et al. 2012). The device of SCR is shown in Figure 7. LaBarbea and Tucciarone (1995) found that skin conductivity can predict market performance better than individual reports (Bercea 2013 138).

2.1.2.11. Facial Coding

Facial Coding is a method that measures micro-expressions that encode unconscious reactions based on the activity of the facial muscles through a video camera. A facial coding device is shown in Figure 8. Facial expressions are spontaneous provide real-time information but are subjective (Bercea 2013: 139).

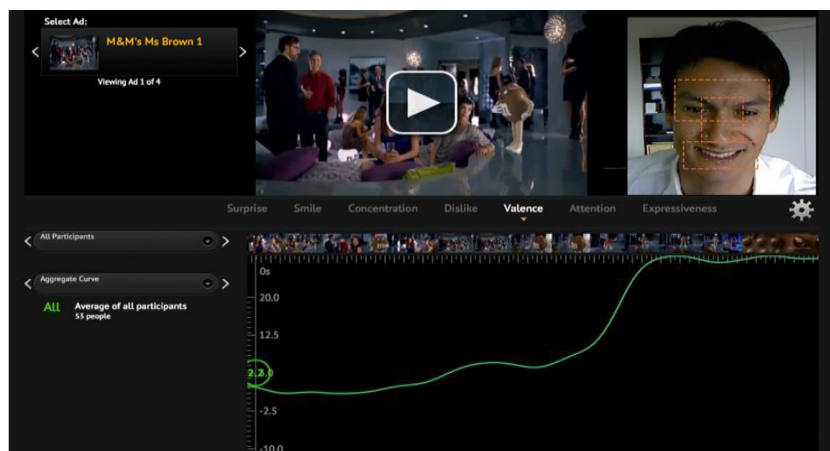


Figure 8 - Face coding (www.millwardbrowniberia.co)

2.1.2.12. Facial Electromyography (Facial EMG)

Facial EMG is a method that measures and evaluates the physiological features of voluntary and involuntary facial muscle movements, each reflecting the conscious and unconscious expressions of emotions, each characterized by a specific facial movement. Facial Electromyography (Facial EMG) is performed using small surface electrodes, which are usually bipolar, placed on both sides of the face, each recording activity in specific muscles that play a prominent role in basic emotional expressions, and it is shown in Figure 9. Facial Electromyography (Facial EMG) is a more sensitive and effective method to detect changes in facial expressions. Even when subjects hide their emotional facial expressions, muscle activity is recorded (Bercea 2013: 139).

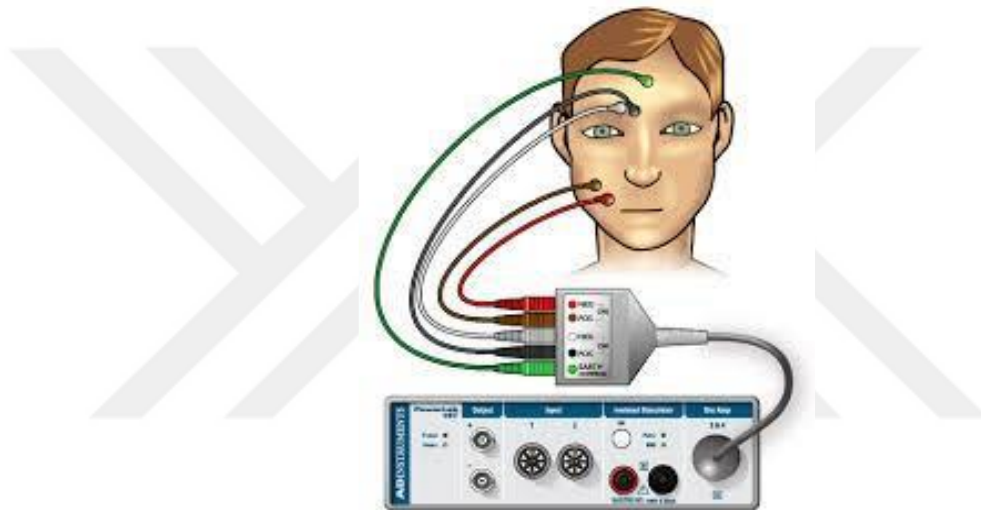


Figure 9 - Face Electromyography (EMG) ([www. Indiana.edu](http://www.Indiana.edu))

2.2. NEUROFINANCE

2.2.1. History and Definition of Neurofinance

One of the important signals of the interdisciplinary neuro-studies being accepted was the book "Introduction: A Brief History of Neuroeconomics," which was published by the editors of Glimcher and Fehr (2014) and prepared by behavioral economics, psychology, and neuroscience specialists. This book studied integrating neuroscience, researching the anatomy and physiology of the brain and psychology sciences, researching the human mind and behavior. It has led to the birth of many subdisciplines such as neuromarketing, neuroma accounting, neuroethics, neuro-leadership (Ahmad 2010). The concept of neuro-financing is a new topic with respect to other neurosciences, and few studies have been done on this concept yet. Because a financing researcher aiming to work on neuro-financing has to finance a high amount of research costs and get support from researchers specialized in neurology (Birnberg and Ganguly 2012: 7).

As long as the decision-making process is human-oriented, behavioral differences will always be effective in decision-making. Financing, which is a social science, will reflect the results of human behavior as well as numerical data at every stage. As a matter of fact, International Financial Reporting Standards (IFRS), given in "Financial reports based on Conceptual Framework on Financial Report," are largely based on predictions, judgments, and methods rather than definitive explanations. "The Conceptual Framework sets the basis for these predictions, judgments, and methods."³ and "Using reasonable estimates is an important basis in the preparation of financial statements and does not weaken the reliability of financial statements"⁴ expresses how effective the human element is in accounting.

Considering that the human element is an important factor in decision-making processes in businesses and the effect of financing/auditing units, these techniques and the concept of neuro-financing are important (Cesar et al 2010: 62). In fact, these techniques used by neurology are also used in different fields such as neuroeconomics neuromarketing and help to understand the underlying causes of the human brain in decision making, emotional response, and many more mental functions. For this

³ Conceptual Framework for Financial Reporting, A11

⁴ Conceptual Framework for Financial Reporting, 4.41

reason, we need to look at what psychophysiology is and its status in neuromarketing, one of the areas where it is used the most except neurology.

While behavioral economists and cognitive psychologists try to use functional brain imaging methods as a tool to develop an alternative to neoclassical theories; some cognitive neuroscientists have also tried to use economic theories as a tool to develop algorithmic models to explain the function of the nervous system in decision making (Glimcher and Fehr 2014). From the beginning of the 21st century, leading behavioral economists have also begun to advocate the use of neuroscience tools to understand the decision-making process of the human brain (Birnberg and Ganguly 2011: 6).

The studies of Dickhaut et al. (2010: 225), which are the continuation of Waymire and Basu (2007: 12), have become an important milestone in the field of neuro-accounting with their research on the origin of the basic principles of accounting. Waymire and Basu (2007: 18) have argued that accounting is a discovered discipline that is, based on existing principles. When concepts are divided into two as designed and discovered, it is argued that accounting principles are among the concepts that are discovered, not designed. This distinction is likewise the one by Dickhaut et al. (2010: 230), and the assumption that accounting principles have evolved with the influence of more than one factor, especially judicial decisions and academic studies that will provide professional development.

Dickhaut et al. (2010: 231) studied the hypothesis that “The emergence and permanence of accounting principles arise from the structure of the brain in parallel with the biological evolution in terms of utilization of exchange opportunities”. This pioneering study investigating the neuroscientific linkages of accounting principles found remarkable parallels between accounting, which showed a cultural evolution when it comes to economic decisions and the behavior of the human brain.

Another important hypothesis of Dickhaut et al. (2010: 232) is that accounting applications support the brain and decision-making processes with their recording and balancing functions. Within the scope of the study, in an experiment between the Sender and the Receiver, a scenario was designed by giving some money to the senders and allowing them to give some of it (the amount is entirely at their own discretion) to the receiver and the receiver will take it three times and can return some of it back to the sender if the receiver wants (again the amount he wants). In the experiment, more than one transaction was allowed between the two parties so that the “reputation”

factor was aimed to be included in the economic decisions. In the next step, a complex economy model has been created by allowing each Sender to send to more than one Receiver. Finally, while some of the subjects were allowed to keep records, others had to be content with their memories. Findings from this multi-layered experiment proved the contribution of accounting to decision-making processes in the human brain.

Neuro-financing is, in its simplest definition, a financing sub-discipline that envisages the use of neuroscientific methods in the field of accounting. In order to define the relationship between neuroscience and accounting, it is beneficial to define the field of neuroeconomics, which can be considered as the forerunner of neuroscience.

Neuroeconomic discipline is a gradually increasing discipline that combines neuroscience, economics, and psychology sciences using cognitive neuroscience and experimental economics methods (Ahmad 2010: 1-5). Connecting economics and neuroscience disciplines, neuroeconomics is defined as the use of neuroscientific methods to understand economic behavior (Kenning and Plassmann 2005: 345).

Kenning and Plassmann (2005: 345) argue that neuroeconomic studies disassemble the concept of "homo economicus" and replace it with the concept of "homo neurobiological". While Homo economicus is used to describe a human species that tries to maximize its economic interests in every decision; the basis of all behaviors and social, economic nature of homo neurobiological is based on neurobiology.

Neuro financing aims to explain neuroscience methods in terms of neurology and in terms of accounting phenomena by bringing neuroscience methods to its field. It is the accounting sub-science that deals with the role of the brain and accounting in a scientific perspective in the formation of neuro-accounting, economic practice, and traditions (Ahmad 2010: 1-3).

Neuro financing is a new accounting discipline combining neurobiology, economics, and finance. Neurobiology is a scientific branch that deals with nervous systems. When people make a decision by using photos of certain parts of the brain, information about what is going on in the human brain is obtained during the decision process. In the light of this information obtained, it is tried to define the behavioral dimensions of decision-makers that can be changed with medication during the decision-making phase (Shariff et al 2012: 4501).

Neuro financing is a discipline that has emerged as a bridge that provides a better understanding of how people make decisions. This discipline; examines the neurological basis of mental states during the decision-making process. While doing this review, at the same time, it is studied on the effect of different hormones secreted by individuals while taking risks in decision making.

2.2.2. Neuroaccounting Methods

It can be said that neuro accounting was born from two main starting points. The first of these is the developments in behavioral accounting that have taken accounting out of its traditional operations; the other is the advances in sub-disciplines that bring neuroscience techniques, especially neuroeconomics, into their own fields. On the other hand, experimental studies in the field of neuroeconomics have encouraged accounting researchers to engage in interdisciplinary studies in interaction with neuroscience.

Behavioral accounting studies have started to examine the effects of emotions that people have while making financial decisions, while at the same time, they have started to examine the effects of various parts of the human brain, neural pathways, and different drugs on people's decision-making methods. These investigations have brought the concept of neuro-accounting with them.

Neuroaccounting is a discipline that emerged as a bridge to a better understanding of how people make decisions. This discipline; examines the neurological bases of mental states in decision making. While doing this examination, at the same time, the effects of different hormones secreted by individuals while taking risks on decision making are studied, as well.

The concept of neuroeconomics was first used by Kevin McCabe at George Mason University in 1998 (Hobikoğlu 2014: 27). With the addition of neuro-finance to the studies of behavioral economics, which is already in interaction with many disciplines, the activities and working principles of the human brain have been added to the decision-making process, and neuroscientific techniques have been used as a method in accounting, marketing, and finance.

The main goal of accounting, in its simplest definition, is to make a meaningful contribution to the decision-making process. Therefore, revealing the factors affecting the decision-making process will shed light on the issues that accounting science should emphasize. Since the last quarter of the last century, it has been demonstrated

by the pioneers of behavioral accounting that many factors are closely associated with accounting, such as psychological, social, cultural, etc. Neuroaccounting takes these studies one step further and envisages the collaboration of accounting with neuroscience.

To see how the cognitive process used in decision-making in the brain changes in the face of an accounting phenomenon is one of the main goals of neuro-accounting studies. As our knowledge of the anatomical and physiological structure of the brain increases, questions such as what factors can be manipulated by decision-makers or what information decision-makers may need to reach the best decision will open an important door for the development of accounting science.

The evolutionary process of the basic principles of accounting emerges as another research area of neuro-accounting. It is among the discussed issues today that the foundations of international standards, which were put forward with the development of the modern economy and that we consider accounting as a big step in terms of globalization, emerged as a result of a natural process.

Neuroaccounting, in its simplest definition, is an accounting sub-discipline that envisages the use of neuroscientific methods in the field of accounting. In order to define the relationship between neuroscience and accounting, it is beneficial to first define the field of neuroeconomics, which can be regarded as the pioneer of neuroscience accounting.

The discipline of neuroeconomics is a rising discipline that combines cognitive neuroscience and experimental economics, combining neuroscience, economics, and psychology (Ahmad 2010: 1-5). Neuroeconomics, which connects the disciplines of economics and neuroscience, is defined as the use of neuroscientific methods to understand economic behavior (Kenning and Plassmann 2005: 350). Neuro-accounting aims to explain human behaviors from a neurological perspective by bringing neuroscience methods into its field. Neuroaccounting is a sub-science of accounting that deals with the role of the brain and accounting in the formation of economic practices and traditions (Ahmad 2010: 1-3). Neuroaccounting emerges as a new accounting discipline consisting of the combination of neurobiology, economics, and finance. Neurobiology is a scientific branch that deals with nervous systems. When people make a decision, information about what is happening in the human brain is obtained by using photographs of certain regions of the brain. In the light of this information obtained, the behavioral dimensions are tried to be defined that decision-

makers will show during the decision-making process can be changed with drugs. (Shariff et al 2012: 4503).

Neuroaccounting is a discipline that emerged as a bridge to a better understanding of how people make decisions. This discipline; examines the neurological bases of mental states in decision making. While doing this thinning, at the same time, the effects of different hormones secreted by individuals while taking risks on decision making are studied.

In the past decade, criticism has been growing rapidly that accounting research is now uniform, innovative, and far from contributing to science. It is stated in these criticisms that academic studies in the field of accounting do not contribute to other fields (Demski 2007: 153). It is far from answering practical problems of accounting (Kaplan 2011,367) and is boring (Basu 2012: 432).

Moser (2012) argues that cooperating with fields such as law, economics, mathematics, philosophy, sociology, neuroscience, and anthropology can contribute to accounting researchers in terms of knowledge, although it is a time-consuming process.

While researching the factors affecting human behavior, it is necessary to expand the scope of the studies in order to find more modern instruments that can explain the elements that cannot be noticed by using traditional methods more strongly (Rocha and Rocha 2017,133-138). Neuro-financing and, more broadly, studies in the field of neuroeconomics aim to improve accounting and economic research in terms of scope and methodology. A wide variety of methods can be used in neuro accounting studies, and as technology advances, it is possible to obtain more reliable results as well as diversifying methods. Therefore, innovative studies in the field of neuro-accounting will undoubtedly bring a breath of fresh air to accounting work that has become stagnant.

The methods that can be used in neuro-financing can be grouped into two groups methods that require and do not require intervention. Among the methods that do not require intervention, we can count the psychological measurements that can be observed from the outside, such as growth in the eye pupil, tone of voice, skin conductivity, and pulse (Birnberg and Ganguly 2011: 5). These methods aim to observe and measure the “response” of participants when an external stimulus comes.

Another method that does not require intervention is the eye-tracking method that aims to observe the attention points and attention levels of the participants. This

method is among the methods that can be applied both in humans and primates (Birnberg and Ganguly 2011: 8).

Methods that require intervention include stimulating a certain part of the brain and damaging a certain part, measuring the activity of certain neurons, measuring the number of chemicals in the blood. Experiments to see the origin of human reactions in the brain can be done by stimulating certain parts of the brain or damaging certain parts of the brain.

In addition, studies to obtain findings based on neuron activity or chemical amount, such as measuring high-frequency dopamine secretions or measuring oxytocin levels, are also observed (Birnberg and Ganguly 2011: 7).

It is preferred to work with primates in these experiments since the methods that require intervention are not accepted in humans in terms of ethics. However, even in the name of science, the use of animals in experiments, where they can be harmed, is undoubtedly subject to serious ethical criticism.

In addition to the methods listed above, imaging and mapping methods are also frequently used in neuroeconomics and neuro-accounting studies. The leading ones include electroencephalography (EEG-brain mapping), positron emission tomography (PET), diffusion tensor imaging (DTI), and functional magnetic resonance imaging (fMRI). These methods take pictures that show which parts of the brain are active at certain moments (Birnberg and Ganguly 2011: 6).

Neuroscientific functional imaging techniques allow the measurement of local mobility in the brain against cognitive tasks as long as screening is performed (Poldrak 2006: 59-63). While imaging techniques such as EEG, PET, and fMRI reveal neuron connections that are not seen in living humans, it is also possible to analyze brain waves with techniques such as quantitative EEG (Ahmad 2010: 3).

Kenning and Plassmann (2005: 351) group the methods used in neuroeconomics studies into two groups according to the mechanism they use: 1. Electromagnetic records, 2. Methods for measuring metabolic or hemodynamic responses to neural activities. Electroencephalography (EEG) and Magnetoencephalography (MEG) are the electromagnetic scanning methods that fall into the first group. EEG, used for the first time in the late 1920s, is one of the oldest intervention-free electrophysiological recording techniques (Braeutigam 2012). While measuring the voltage fluctuations on the EEG skull, the MEG method can observe the magnetic field changes caused by the triggering of electrical movements in the

brain and provide information on the deeper structures of the brain compared to EEG. The second group that measures metabolic and hemodynamic responses against neural activities includes positron emission tomography (PET) and functional magnetic resonance tomography (fMRI) techniques. PET is based on the observation of the dispersion of modified molecules with chemically the same properties to replace some radionuclides that absorb positrons but which can be exposed to non-radioactive isotopes by scanning them.

The use of radioactive tracers restricts the use of this method on healthy people. The fMRI technique, which is one of the most used functional imaging methods in neuroeconomic studies, is based on the imaging of magnetic fields formed by hemodynamic responses resulting from increased neuronal activities in certain parts of the brain; it has the ability to present a high-resolution brain morphology.

Applications to support these methods, which are listed in neuroscience research, can also be found. For example, when applying any of these methods, a specific chemical injection, noninvasive (non-interfering) transcranial magnetic stimulation (TMS), and direct current stimulations (tcDCS) can be counted as supportive methods that can be applied in experiments (Birnberg and Ganguly 2011: 7).

The methods used in neuroscientific and neuro-financing research will be supported by different disciplines. The effects of sociological, cultural, and psychological factors in the decision-making processes should not be ignored in the interpretation of the results of neuro-accounting research, and even studies involving different disciplines should be designed. Looking at the decision-making process in the human brain, Neuro-accounting shows that there is a difference even between men and women. Brain traces show that men tend to use the right hemisphere of their brains and women tend to use both hemispheres, which brings together the interpretation that men's attention cannot easily be drawn with unnecessary data (Altunöz and Altunöz 2017).

Other disciplines should not be ignored in the design of neuro-accounting research in order to prevent the results of different factors from directing the researcher to false conclusions.

2.2.3. Methods of Financial Decision Making in Neurofinance

Neurofinance has an advantageous potential to separate between competing hypothetical methods for financial options. First, researchers tried to identify the neural relations between distinctive behavioral models. For example, by using fMRI, it has been showing that the anticipated utility of an alternative is represented basically in the mPFC⁵ and the NAcc⁶, a result duplicated numerous since (Knutson et al 2003: 267) proved that most subjects show nonlinear likelihood capacities by underweighting mid to high probabilities and, overweighting low probabilities which are in contrast with anticipated utility hypothesis and consistent with prospect hypothesis.

This function of nonlinear probability was reflected within the BOLD⁷ reaction in the striatum, the frontal operculum, and also in the cingulate gyrus (Rushworth et al 2011: 1058). This outcome recommends that probability is nonlinearly encoded within the brain, which supports the prospect theory: concavity reflecting risk aversion in the domain of gains and convexity reflecting risk-seeking in the losses domain, which together outline the reflection impact. In any case, Boorman and Sallet (2009) stated that, while these outcomes are encouraging, anticipated prospect and utility models are not the only hypotheses supported by imaging research.

Another compelling method of decision making (Markowitz 1952) under uncertainty, including a mean-variance analysis, is supported equally (Christopoulos et al 2009: 12579). This means that the value processing in the brain was proved to be dependent, to some degree, on the level of risk (Christopoulos et al 2009: 12579).

Moreover, neural information has been utilized in investor behavior test models, like the “realization utility” hypothesis of exchanging (Camerer et al. 2004: 563). Participants exchanged three sorts of stocks in a test market, whereas fMRI information was procured.

Frydman and Camerer (2016: 667) utilized a fictional stock exchanging paradigm and fMRI to appear that when a stock isn't possessed, the news from a cost increment produces a compensate prediction error flag within the ventral striatum reflecting the lament from offering as well early. During the introduction of a cost upgrade screen, after the subject has made his or her decision about the investment, a

⁵ mPFC: medial prefrontal cortex

⁶ NAcc: nucleus accumbens

⁷ BOLD: The blood-oxygen-level-dependent

reduction within the neural flag in the ventral striatum was watched when a subject saw a cost increment for a recently sold stock. Particularly, the fMRI flag within the vmPFC⁸ when a member could repurchase a stock was adversely connected with the predestined capital pick up. In conjunction with past investigate that illustrated brain movement related to counterfactual data approximately unselected remunerate (Lohrenz et al 2007: 9495), these discoveries back up the hypothesis that lament contributes to realization utility, too.

Besides assessing financial methods and models, neuro-finance studies aim to create modern models of financial decision-making which are biologically motivated, too. One of the leading models nowadays is the anticipatory affect model, which suggests that expectation of financial results, including large questionable gains, are likely to elicit positive excitement and actuate the NAcc, whereas expectation of financial results including huge dubious losses are likely to elicit negative arousal and activate the front insula (Knutson and Greer 2008: 3775). The activation of those emotional states and neural circuits leads to avoidance and approach behaviors, respectively, which proves that emotional arousal in anticipation of results can form behavior. Hence, compared to conventional financial models, the expectant anticipatory model takes into consideration the various test outcomes proving that emotions (Baker and Wurgler 2007: 133) play an important role in financial decisions like anticipation (Kuhnen and Knutson 2011: 613).

2.2.4. Criticism Made to The Neuro Financing

Although Neurofinance has so far provided valuable insights into how humans make financial decisions and how to make use of this information, it is still in its infancy. But it is also accepted that the most exciting and important steps are still to come (Miendlarzewska et al 2017: 27).

Birnberg and Ganguly (2011: 10) gathered criticisms facing neuro accounting in two main groups. While the first criticism is arising from the design of neuroscientific research, the other consists of doubts about the size of the potential contribution neuroscience can give to the science of accounting.

Criticisms of the design of the research focus on sample size and data quality. Because finding enough samples to obtain meaningful results is both difficult and

⁸ vmPFC: ventromedial prefrontal cortex

costly (Birnberg and Ganguly 2011: 10), research is often limited to small sample numbers.

Another important problem in neuro-accounting studies is the reliability of the results. Inferences from the findings obtained in neuroscientific experiments are often subject to criticism. By questioning the results obtained from neuroscientific imaging techniques, Poldrak (2006) warned that results should be approached with caution, especially when doing 'reversal inference,' i.e. when mobility in a particular area of the brain is linked to a particular cognitive process. Since a large number of different configurations can lead to similar reactions in the brain (Kenning and Plassmann 2005: 347), it will not be possible to fully reveal the cause of the observed movements in neurons. Birnberg and Ganguly (2011: 11) suggested that comments on brain scans may be subjective. Since many disciplines work together in neuroeconomics, neuro-accounting, and derivative fields, caution should be exercised in the interpretation of experimental results (Kenning and Plassmann 2005: 350).

The contribution of the neuroscience discipline to the economics and accounting sciences is also doubtful. It is suspected that seeing the locations of local activities in the brain will make a meaningful contribution to explaining economic decisions. It has been suggested that neuroeconomic studies performed to date have not contributed more than to see which region of the brain is activated in the face of certain mental processes, decisions, and choices, and this makes it difficult to interpret causality (Birnberg and Ganguly 2011: 11).

Another obstacle to the development of neuro accounting is the very low number of accounting professionals with scientific infrastructure and equipment that can be used in scientific research (Cahan 2011: 85). Accounting specialists interested in neuroscientific research will need to use neuroscience centers or medical centers with sufficient resources and equipment when examining accounting behavior (Birnberg and Ganguly 2011: 12). Since techniques such as EEG and fMRI are only available to neurologists in medical schools in many countries, neuro-accounting researchers have limited access to such methods. For this reason, research teams composed of experts from different disciplines can be a suitable solution for neuro-accounting studies (Ahmad 2010: 1-3).

Another obstacle to neuro-accounting studies is ethical problems. Although high ethical standards are accepted in research in the field of economics and business

in general; Neuroscientific techniques using humans as subjects cause serious ethical concerns (Ahmad 2010: 1-3).

Another criticism is about the research environment since much of the information and results are obtained in isolated and generally static laboratory locations. But on the other side, financial decisions regarding real-life problems are made in a social and dynamic economic context which influences the individuals' decisions and might cause herding behavior and conformism. For example, immediately after a crash in the stock market, investors turn to be more risk-averse (Cohn et al 2015: 865). Since it is difficult to collect real-life data on daily business, it is also difficult to make studies including physiological measures. Lo and Repin (2002: 325) supplied traders with biofeedback equipment to analyze how their blood volume pulse, skin conductance, heart rate, body temperature change, respiration, and electromyographical signals. Herbert and Coates (2008: 6168) demonstrated that cortisol levels increment over advertise members during periods of increased advertising instability, conceivably driving to collective modifications of budgetary choice making that increase the advertising patterns.

However, collecting fMRI information is still limited with the research facilities where members can be in any case uncovered to more practical scenarios such as test showcase bubbles. Following this way, found that the cost changes amid the bubble were emphatically related to the amassed neuronal action within the NAcc. Subjects that tended to purchase as a work of NAcc movement earned lower returns, whereas subjects with big returns obtained stock less regularly as a work of NAcc movement but also showed expanded insular movement going before the burst of the bubble (Smith et al 2014: 192). Additionally, another study showed that increments in vmPFC action were related to the readiness to purchase at costs over the basic values (Smith et al 2014: 193).

Another problem associated with neuro financing is that market behavior is the result of the financial and social interaction of numerous factors. The initial presumption that operators are sound and normally deviations from rationality are disseminated has been adequately challenged to reexamine existing models of cost arrangement in aggregate markets. To precisely model and foresee monetary markets, modern models ought to moreover join context-dependent behavioral inclinations and may indeed exploit the predictive power of physiological signals (Knutson and Kuhnen 2011: 615).

Most of the current investigation is constrained to Western industrialized countries, which is also criticized. It is clear that distinctive societies see and prepare data in a different way (Hedden et al 2008: 13). This may likely result in totally different behavioral inclinations driving to diverse behavior.

Additionally, the investigation is exceptionally insufficient within the space of budgetary education, which neuro-finance may address by examining, for example, how we learn from economic or financial data, knowing that there are natural inclinations in how the brain processes typical numbers and quantities (Schiebener and Brand 2015: 177; Thoma et al 2015: 29). This might provide a basis for planning better training mediations for different populaces.

Lastly, there are many other regions in finance that need to be re-studied in the light of the over critics, from administrative arrangements to behavioral interventions for speculators. The administrative arrangements currently underestimate or disregard the effect of human biases and feelings on investment behavior and distribution of overall wealth.

2.2.5. The Future of Neuroaccounting

The assumptions that economic units act rationally in making decisions and in their expectations and that they try to maximize their interests have lost their validity today, and it has been revealed over and over by behavioral economics and behavioral accounting researchers that decision-making processes are affected by many factors such as social, cultural, psychological, etc. While including the physiological and anatomical features of the brain in the decision-making process have provided that the neuroeconomics and neuro-accounting fields were born, on the other hand, developments in neuroscience have also played a role in encouraging research in these sub-disciplines. The number of studies that adapt neuroscientific methods to the fields of economics, finance, marketing, and accounting is increasing.

Although the field of neuro-accounting is still in its infancy (Birnberg and Ganguly 2011: 12), it has already made significant contributions to economics (Kenning and Plassmann 2005: 351). The establishment of neuroeconomics studies as a part of behavioral accounting research will depend on the applicability of the studies of neuro-economists on processes in the brain and the applicability of the findings to accounting functions and the usability of accounting information (Birnberg and Ganguly 2011: 12).

Although neuroscientific studies in accounting are seen as a temporary trend by some researchers, the increase in our knowledge about decision-making processes in the human brain undoubtedly has a great potential to make significant changes in both theoretical and practical accounting as in many other fields.

Neuroscientific research will lay the groundwork for proving the findings of behavioral accountants' social experiments with neurological experiments and even improving the hypotheses put forward. For example, behavioral accountants argue that people have different attitudes to losses and gains. Against the expected utility theory, Kahneman and Tversky (1979: 58) stated that individuals in the decision-making process are often faced with great uncertainty about the results; therefore the assumptions of the expected utility theory are not correct, and they proposed the "prospect theory" against this. One of the main findings of this theory is the avoidance of loss. People are more susceptible to losses than gains. Neuroscientific research also shows that the human brain reacts differently to gains and losses (Cahan 2011: 88).

It is thought that neuro-accounting research will also contribute to accounting information systems studies. It is hoped that neurocognitive methods will also contribute to the development of information systems in order to better understand the cognitive processes related to the use of accounting information systems, and to provide accounting information systems researchers with a more comprehensive and deeper view on the cognitive processes and behaviors of decision-makers (Moffitt et al 2016: 165).

Neuroscientific studies may open new paths for the accounting profession. Waymire (2014: 25) states that the effects of accounting education on neuronal connections can be a research area that can make significant contributions to the accounting profession. In addition, the idea that the genetic characteristics of their brains may also be effective among the reasons for accountants to choose this profession, which is also put forward by Waymire, is that we will not need to choose accounting or any profession in the future, as our genetic codes can give us the most suitable profession from a younger age, perhaps from birth. The moment may signal a dream that seems utopian but not impossible.

2.3. NEUROMANAGEMENT APPLICATIONS AND NEUROLEADERSHIP

Neuroscience findings show how organizations can be better structured and managed by helping to link human interaction and effective leadership practices

(Gibaldi and Gibaldi 2015: 291). With the understanding that neuroscience will be useful for understanding the social interactions of people, neuroimaging tools have been used in social sciences (Bozkurt et al 2015: 335). Neuromanagement is a discipline that examines the emotions, thoughts, attitudes, and behaviors of employees in an organizational environment from a neuroscientific perspective. Neuromanagement, which helps to understand, explain and develop the behavior and attitudes of individuals and groups within the organization from a neuroscientific perspective, will be a guide for managers in creating a brain-based structure by increasing the contribution of the organization to the employees.

There are many approaches in which the findings of neuroscience are used in the organizational field. Neuro-leadership, which is still under development, is a very young discipline. In order to develop a systematic approach to neuroscience, numerous findings related to the brain need to be integrated into scientific findings related to leadership (Schweizer 2014: 48). In order to become a neuroleader, the leader needs to control the neuropsychological level of all relevant interactors, that is, to be aware of the feelings of himself, his employees, and colleagues because the success of an individual in his/her occupation depends largely on the ability to read others' signals and react accordingly (Rostomyan and Sukiasyan 2015).

Generally speaking, it would not be wrong to say that there is a concentration in the field of organizational behavior since neuroscience studies examine human behavior and its mental functioning processes by nature. From this point of view, studies on leadership take the first place with 21 articles. The reason for this can be considered as the effect of the studies conducted, especially in the field of "political marketing" and the support given to the leadership studies of large companies; however, this claim is nothing more than an assumption for now. For this, it is necessary to examine in detail the articles, the neuroscientific experimental setup, and which institutions and organizations it is financially supported by. However, it is an important finding for us at this point to reveal that neuroscience studies in the field of management and organization are mostly focused on leadership studies (Erkal et al 2017: 405).

It is necessary to know the human brain very well for the understanding of leadership knowledge. When the physical functioning of the brain is supported by positive and correct methods, new skills and behaviors can be developed. Therefore, the concept of leadership seems to be closely related to understanding the functioning

of the brain and supporting it appropriately (Kocabaş 2012). Neuro-leadership offers management scientists a new way in order to change, grow and learn (Lafferty and Alford 2010). Creating trust-inspiring work environments where employees can become creators of how to manage their workflows, based on the work systematics of the brain, will distinguish the best organizations from the average ones in the coming years (McLennan 2016). Therefore, although management scientists do not have as much knowledge as a neuroscientist about human brain, it is important that they have a level of neurological knowledge so that they can analyze and make inferences well in organizational neuroscience research.

Other than the leadership theme, the field of organizational behavior has been the subject of neuroscience studies with 13 articles. There are only five articles that discuss the relationship between organizational behavior and neuroscience itself. Apart from this, the theoretical position of neuroscience studies in the field of organizational behavior has been discussed extensively in the literature. Under the theme of organizational behavior, there are four articles that overlap with the theme of theory and method discussions, while 3 of these articles overlap with the theme of organizational studies. We can draw the following conclusion here that neuroscience articles on organizational behavior mostly discuss the future of the field and the theoretical basis of these studies.

Apart from the topics of “Organizational Behavior,” another area in which neuroscience studies are concentrated are “Organizational Theory” and “Organizational Level” research topics. These studies, which will be gathered under organizational neuroscience, have an important place in the literature, both including general discussions on organizational theory and neuroscientific examination of many issues at the organizational level. Under the theme, the main subjects of the articles are in organizational level discussions such as “organizational justice” (Cropanzano et al 2016; BEUGRÉ 2009: 131) and “corporate culture” (Becker et al 2011: 935) together with the theoretical discussions under the name of “organizational neuroscience” (Lindebaum and Raftopoulou 2017: 817; Cropanzano and Becker 2013: 301; Becker and Cropanzano 2010: 1056).

Apart from organizational studies, another area where articles are concentrated is “theory and method discussions.” This theme, which can be considered together with the theme of ethics, was examined in detail, and important information was obtained in the study. Accordingly, the most important finding in the article, in general,

is that neuroscience studies in the literature have been discussed under questions such as "what will be management and organization theories in the future, how will theorization be different" (Lindebaum 2016: 542). In this direction, there are two extreme thoughts in the literature (Healey and Hodgkinson 2014: 768). The first of these is the opinions that view neuroscience studies positively and argue that these studies will shape the future of literature (Waldman et al 2011a: 72; Becker et al 2011: 937; Senior 2011; Lee et al. 2012). The other point of view approaches neuroscientific studies cautiously, even negatively, and questions the reliability of the data obtained from these studies (Mc Lagan 2013; Lindebaum 2013).

The most important thought defended by those who look positively on neuroscience studies in the field of management and organization is that these studies have the potential to provide empirical data to future theories. Especially in areas related to human behavior, the preparation of mind maps of the individual and the analysis of the cognitive mechanisms behind the behaviors with the help of these maps stand as an important source in terms of being an empirical basis for theories (Senior 2011; Waldman 2011b; Becker et al 2011: 938; Lee et al. 2012).

Those who do not support the use of neuroscience studies in the field of management and organization especially focused on the power of empirical data and ethical problems. Lindebaum's article published on this subject in 2016 collects the criticisms made over the years by those who hesitate to use neuroscience studies in the field of management and organization. He has collected these reservations in three points. The first is that the reliability of the data obtained should be questioned. From this point of view, he claims that the statistical power of the data obtained from the fMRI device is weak in order to establish a theory in management studies. Apart from this, it is argued that the experimental setups and the data obtained as a result of this setup will be insufficient and simple to answer the basic hypothesis questions that need to be examined (Lindebaum 2016).

Another point defended by the negative view of neuroscience studies is ethical problems. This subject, which is handled under both theory and method discussions and under the heading of ethical studies, argues that the experimental setups established in neuroscience studies and the results obtained from the data should be taken into account with its ethical dimension. First of all, how ethical it is to involve people in these experimental setups has an important place in the discussions. The second is the ethical problems that may be experienced while evaluating and applying

the results of these studies. Especially in areas such as human resources, people of these data and mind maps are smart, potential, leader, etc. It is argued that it can be used as a means of marginalizing others. In this respect, these studies should be questioned from an ethical point of view, and when considering their empirical value, ethical debates should not be ignored (Waldman 2011b; Robertson et al. 2016: 5).

2.3.1. The Concept of Neuro-leadership and Its Scope

From the 1900s, when the first foundations were laid on organizational and management sciences, many have been conducted studies inspired by approaches at the individual, group, and organization levels (Bozkurt et al 2015: 338). Most leadership theories have evolved through this behavioral observation or social psychology research. Although there are over 60,000 books on leadership, there is no full agreement on exactly what leaders do or what they need to do in order to successfully do their job (Rock 2010). When these studies are analyzed, it is seen that attention is not mostly paid to the interactions in the human brain, and this is a deficiency in the field in organizational and managerial sense (Sezgin and Uçar 2015). Indeed, Waldman et al. (2011a: 70) state that neuroscience is more successful in defining and developing leadership, whereas psychometric evaluation of personality is both practically and theoretically ineffective in describing the forms of leadership. It is stated that neuroscience imaging techniques that will be used in addition to psychometric-based evaluations will further expand their managerial and scientific perspectives (Sezgin and Uçar 2015), and will make management practices and employee behaviors much more understandable (BEUGRÉ 2010: 133).

In recent years, unique developments in the field of neuroscience have led to the emergence of Neuroleadership as a new field of study (Rock 2010). The first article on Neuroleadership, "The Neuroscience of Leadership", was published in 2006, and in this article, Rock and Schwartz (2006) suggested that neuroscientific findings could be useful in introducing new perspectives and ways of thinking to managers, thus increasing their leadership effectiveness. The term neuro-leadership is a discipline that explores how leaders and followers think, with emphasis on four main areas of leadership, such as the ability to solve problems and make decisions, control emotions, the ability to collaborate with others, and facilitate changes (Rock 2010).

The management profession has the feature of being a guide in the choices that individuals in the organization will make. It can be said that the effect level of this

guidance is an important determinant of the adaptation time to organizational changes. As organizations become more complex recently, the profession of management has changed, as well. As shown in Table 4.2., each age shows improvement in line with the knowledge, technology competence, and needs.

Table 1 - Change of Management with the time (McLennan, 2016)

EXECUTIVE Industrial Age	LEADER Information Age	NEUROLEADER Age of Imagination
Control = Power	Information= Power	Ideas = Power
Systematic	Visionary	Creator
Duty-oriented	People-oriented	Brain-Driven
Balanced	Brave	Responsive
I know...	We Know...	Who knows?
No feedback	One-way Feedback	Bidirectional feedback

In the age of industrialization, which was between 1800 and 1960, people created the tools and machines that manipulated nature. The leadership model of the industrial age was based on top-down and directive autocracy. Strict rules were in place and the top leader had to know more about the organization and the market than anyone else in the company (McLennan 2016). With the widespread use of the internet in the 1980s and its complete release in 1995, the information age began (Castells 1999). In line with the technological developments, information and communication infrastructures became widespread all over the world and access to information through mobile communication technologies became independent from time and space, enabling individuals and institutions to perform some of their communication needs by computer networks (Webster 2001). In this age, concepts such as delegation of authority, project management, resource allocation, capital management and efficient team meetings management have started to enter the leadership literature. Leadership has changed from directionality to visionary, but one-way feedback has become an important tool (McLennan 2016). The most important power for the leaders in the information age is knowledge. Unlike the industrial age, the leaders of this age have a human-oriented management approach.

The age of imagination is an age beyond the information age, where imagination and creativity will become the primary creator of economic value. This age is shaped by technological trends such as YouTube-like digital platforms and virtual reality, where its content is created by users. Ideas can be tested by creating prototypes to change the system and lives rather than expressing utopian views

(Bidshahri 2017). Technologies that were only ideas in the minds of their designers in the past have now become useful tools that make life easier.

As it can be seen in Table 4.2, the most important power for the neuro leaders in the age of imagination is ideas. A brain-oriented approach prevails in the relationships they establish with employees. They are sensitive to their emotions and the underlying causes of their behavior. They have no assertive belief that they know everything themselves. They are modest according to their place. They have a culture of bidirectional feedback on employees and their behavior and work. And they see this as an opportunity for organizational development.

The potential benefits of neuro leadership for working life can be listed as follows (Reinhardt 2014):

- **Negative Prejudices:** Individuals immediately perceive situations that pose a threat to themselves and spend more time on negative prejudices than non-threatening situations. They have a special sensor for danger, risk, and any other harmful or threatening situation. Warning of the threat system takes place automatically. Managers must actively stimulate employee reward systems (LeDoux 1996).

- **Individualization of managerial behavior:** Neurogeriological research in the context of emotion and motivation has highlighted this requirement since the connection between productivity and flexible managerial behaviors started in the 1960s within the framework of "situational management approaches" (Neuberger, 2002). Individuals differ from each other in terms of their emotional styles and motivational schemes. So they perceive tasks and interactions to be differently threatening or motivating. Therefore, there is a need for privatization of the communication of the managers with their employees.

- It should also be known that neuronal processes, which are responsible for empathy and, accordingly, social competence, are sensitive to an elevation of status and use of authority. Establishing a culture of trust and thus avoiding micropolitical behaviors are essential prerequisites for the implementation of practices in the field of neuroscience.

The aim of neuro-leadership is to raise awareness of what is important to the human brain and how it reacts in critical situations and to help the leader see their own thoughts, actions and employees with a different light in order to develop a more brain-focused leadership style (Nagl, 2013). Neuroleadership can give managers the ability

to re-question what is known about leadership and to look from a new perspective, as well as gain the ability to better understand the intellectual mechanisms underlying individuals' thinking processes and behaviors.

2.3.2. Neuro-leadership theories

Throughout the history of humanity, Scientific method helped to materialize the obtained data as a holistic and reliable source of information by drawing cognitive boundaries that can be grasped with the human mind (Ergen and Ülman 2012). At the beginning of each new branch study, there are many important discussions on how to organize the ideas within this branch and the overall value the field can have (Rock and Ringleb 2009).

In order to develop a systematic approach to neuroscience, numerous research findings related to the brain must be integrated into scientific findings related to leadership (Schweizer 2014: 50). Herrmann's "Brain Dominance Model", Hüther's "Brain-Friendly Leadership Theory", Elger's neuro-leadership approach, Ghadiri / Habermacher / Peters's "ACTIVE Model", Reinhard's neuro-leadership approach and David Rock's "Neuro-Leadership: SCARF Model" is briefly mentioned.

Herrmann's Brain Dominance Model focuses on limbic and cerebral layers of the brain. Her research led her to the search for a tool to measure the dominant side of the brain, that is, to identify ways of preferred thinking styles. As a result of this search, Herrmann developed the Brain Dominance Tool (Herrmann Brain Dominance Instrument-HBDI). Herrmann based his initial efforts to measure the dominance of the brain based on EEG measurements, in which brain waves are measured by individuals during certain tasks. Since this method is a very slow and expensive method, Herrmann has focused his attention on developing an easier and successful method that can be done with pencil and paper (Mert 2003: 13). This tool, which consists of 120 topics, profiles of intellectual preferences, defines the profile results seen in the four quarters as four principles of thought structure in the brain (Herrmann 2003: 144). Each quarter of the brain, which establishes hundreds of thousands of connections at the neuronal level, performs synchronously as a whole, even if it performs different tasks.

As a result of his work on thousands of people, Herrmann has carried the dominance tool to digital environments in parallel with the developments in technology. Herrmann Brain Dominance Tool (HBDI) has become a tool that is easy

to use, highly reliable and valid at the individual, team and organizational level based on the working principles of the brain (Mert 2003: 14).

The Herrmann Brain Raid Tool can be used in organizations to help individuals understand each other and increase their productivity and creativity. The model is a brain-based thinking model that shows cognitive preferences. (Ghadiri, Habermacher and Peters 2012: 6). The use of Herrmann's Brain Dominance Tool in organizations is considered important in terms of having more knowledge of the individual's thinking modes at the personal and organizational level. Findings can be a good source of data for leaders in increasing the success of organizations and creating much better solutions.

With the term “Supportive Leadership”, Gerald Hüther defined a management style in which the potentials of the employees are developed by the manager and where authoritarian and dominant management behaviors are not desired. Hüther also proposes four rules to assist managers in considering brain-friendly management and the neurobiological needs of the brain. These are; creating new tasks, establishing an information network within the organization, creating a positive culture of error and creating positive experiences (Ghadiri, Habermacher and Peters 2012: 7).

According to Hüther, neurobiological findings are the basis of the characteristics that a supportive leader should have. According to this management theory, as a manager, while the potentials of the employees are being developed, the hierarchy is waived from orders. The fact that managers have the ability and courage to give employees enthusiasm is reported as a prerequisite of the theory. The characteristics of the supportive leader are (Ghadiri, Habermacher and Peters 2012: 8);

- Managers treat ineffective and inefficient employees with respect and motivate them emotionally.
- Employees are encouraged to find solutions on their own. Managers support employees in the face of difficult and new tasks and problems.
- Managers have the ability to give inspiration and enthusiasm to their employees.

The four basic needs of people (the need for education, orientation and control, the need to raise and maintain self-esteem, the need to enjoy and avoid indigestion) and their distinction and interaction are the core and starting point of Christian Elgers' approach. Each need is based on another neuronal circuit, and its activation takes place in different parts of the brain. If these needs are met, the reward center is activated and

“consistency” can be achieved (Ghadiri, Habermacher and Peters 2012: 8). In this regard, high achievements are expected at the organizational level as the basic needs of the employees are met and employee behaviors will be more consistent in brain-friendly workplaces.

The ACTIVE Model was developed to enable leaders to build a healthy and brain-focused workplace built on a solid neuroscience foundation. It is a model designed to be based on four basic requirements, combining some organizational and personnel development tools and leadership concepts. The five steps of this approach allow leaders to implement a scientifically sound, structured approach to leadership (Ghadiri, Habermacher and Peters 2012: 9).

The SCARF Model is named after the first letters of the English words of the dimensions that make up it. These;

- **Status:** It is the perception of the employee about his location. Low-status perception activates the threat mechanism, while high-status perception activates the reward mechanism. The status here is a perception of the situation hierarchically based on the relationship of the employee with other employees and the manager, rather than the level.

- **Certainty:** It is the perception of clarity about the current situation and future of the employee.

- **Autonomy:** It is the perception of autonomy provided to the employee in his decisions.

- **Relatedness:** Relationships between managers and employees and perception of this in terms of employees.

- **Fairness:** It is the perception of justice.

2.3.3. Studies regarding Neuromanagement

One finding obtained from the literature review is the focus of neuroscience studies regarding management and organizational issues. The results of our qualitative analysis are shown in detail in Table 2. This table is based on the study of Erkal et al (2017: 410) but updates and additions are included.

Generally speaking, it would not be wrong to say that there is a concentration in the field of *organizational behavior* since neuroscience studies examine human behavior and its mental functioning processes by nature.

Table 2 - Neuromanagement Studies

Topics	Number of Studies	Author(s)
Leadership	24	Goleman, 2006; Campell, Whiteheart and Finkelstein, 2009; Antonakis et al., 2009; Waldman et al., 2011a; Waldman et al., 2011b; Boyatzis et al., 2012; Balthazard et al., 2012; Lee et al., 2012a; Cropanzano and Becker, 2013; Bagozzi et al., 2013; Becker and Menges, 2013; Lindebaum (2013a and 2013b); Lindebaum and Zundel, 2013, McLagan, 2013, Ashkanasy, 2013, Hodgkinson, 2013; Jamieson, 2013; Tee, 2015; McDonald and Tang, 2014; Lindebaum and Raftopoulou, 2017; Lawrence and Pirson, 2015; Rochford, 2016; Trichas et al., 2017
Organization Studies	22	BEUGRÉ, 2009; Becker and Cropanzano, 2010; Becker and Cropanzano, 2010; Senior et al., 2011; Becker et al., 2011; Volk and Köhler, 2012; Lee et al. (2012a and 2012b); Uhlmann et al., 2012; Cropanzano and Becker, 2013; Hodgkinson, 2013; Kathleen, 2013; Lindebaum and Zundel, 2013; Schoeneborn et al., 2013; Healey and Hodgkinson, 2014; McDonald and Tang, 2014; Spector, 2014; Lindebaum and Raftopoulou, 2017; Weaver et al., 2014; Becker et al., 2015; Cropanzano v.d., 2016; Houdek, 2017
Theory and Method Discussions	21	Butler and Senior (2007); BEUGRÉ, 2009; Becker and Cropanzano, 2010; Becker et al., 2011; Powell, 2011; Hodgkinson and Healey, 2011; Senior et al., 2011; Waldman et al., 2011a; Uhlmann et al., 2012; Volk and Köhler, 2012; Lee et al., 2012b; Lindebaum, 2013b; Lindebaum and Zundel, 2013; Schoeneborn et al., 2013; Hodgkinson, 2013; Lindebaum and Jordan, 2014; Healey and Hodgkinson, 2014; Weaver et al., 2014; Robertson et al., 2016; Lindebaum, 2016; Houdek, 2017
Organizational Behavior	13	Antonakis et al., 2009; Mason et al., 2009; Becker and Cropanzano, 2010; Senior et al., 2011; Pavlovich and Krahnke, 2012; Richard et al., 2013; Hodgkinson, 2013; Schoeneborn et al., 2013; Becker and Jochen, 2013; Ashkanasy et al., 2014; Lindebaum and Jordan, 2014; Becker et al., 2015; Niven and Boorman, 2016
Decision Making	10	Robertson et al., 2016; Christopoulos et al., 2016; Stanton, 2016; Becker and Cropanzano, 2010; Weaver et al., 2014; Dane et al., 2012; Salas et al., 2010; BEUGRÉ, 2009; Price and Norman, 2008; Woiceshyn, 2011
Ethics	8	Waldman et al., 2011; Woiceshyn, 2011; Lindebaum et al., 2013a; Cropanzano and Becker, 2013; Weaver et al., 2014; Robertson et al., 2016; Stanton, 2016; Rochford, 2016
Human Resources	6	Waldman et al., 2011; Lebbon and Austin, 2013; Becker and Jochen, 2013; McDonald and Tang, 2014; Scherbaum and Goldstein, 2015; Cropanzano et al., 2016
Entrepreneurship and Strategic Management	5	Hodgkinson and Healey, 2011; Powell, 2011; Volk and Köhler, 2012; Nicolaou and Shane, 2014; Holan, 2014

Source: Compiled by the author based on Erkal et al (2017: 410)

Apart from this, the theoretical position of neuroscience studies in the field of organizational behavior has been discussed extensively in the literature. Under the theme of organizational behavior, there are four articles that overlap with the theme of theory and method discussions, while 3 of these articles overlap with the theme of organization studies. From this, we can draw the following conclusion that

neuroscience articles on organizational behavior discuss the future of the field and the theoretical basis of these studies.

Studies about neuro-management in the literature are given in Table 3 in general. Some of those studies are summarized as follows;

In the research about neuro-finance, conducted by Peterson (2005), functional magnetic resonance imaging (fMRI) results of investors were observed in order to relate basic neural activations with behavior, emotion and cognition of individuals in the organization during financial activities.

Some of the research about neuro-management is related to organizational behavior. Butler and Senior (2007) defined the use of neuroscience techniques in analyzing the behavior of individuals in the organization as organizational cognitive neuroscience and a conceptualization study was conducted. In addition, Becker and Cropanzano (2010: 1057) conducted a conceptualization study in which they discussed and reviewed recent findings in the Organizational Neuroscience and offered suggestions on how the field of organizational behavior can benefit from neuroscience. They stated in their conclusion that this paradigm offers powerful tools and insights which complement traditional organizational research.

In their study "Biological Implicit Measures in HRM⁹ and OB¹⁰: A Question of How Not if", Becker and Menges (2013: 222) have explained neuroscience techniques that can be used in human resources and organizational neuroscience research and how they can be used in research. Although no empirical studies have been conducted, the biological consequences of the underlying facts that underlie the behavior of individuals and the predictive techniques used in neuroscience are explained. These techniques are cortisol measurement, skin conductivity, event-related potential (ERP), and fMRI.

In the study of BEUGRÉ (2009: 138), a neuro-organizational justice model was proposed by making use of the studies in the fields of organizational justice and social cognitive neuroscience. On the other hand, Bagozziet al (2013: 1769) have studied the empathic bases and mind theory of the makievelist behaviors of individuals through functional magnetic resonance imaging in their study of "Theory of Mind and Empathic Explanations of Machiavellianism A Neuroscience Perspective". Which

⁹ HRM: Human Resource Management

¹⁰ OB: Organizational Behavior

brain regions affect the machiavellist behaviors of individuals, and the relation between the machiavellist behavior and some organizational citizenship, performance, etc., are questioned and made suggestions.

Some researchers focus on leadership in relation to neuro-management. Campbell Whitehead and Finkelstein (2009: 62) investigated why high-skilled leaders sometimes made erroneous decisions and the underlying reasons for this in their study, and came to the conclusion that this was due to emotional labels and familiar patterns related to situations in which leaders made decisions in the past. In another study, Waldman et al. (2011: 72) provided an overview of how the emerging social cognitive neuroscience field can be linked to leadership theory and practice, in addition to new leadership research involving neuroscience practices, as well as emotional regulation and ethics. They reviewed areas that are closely related to leadership, such as reasoning and decision-making. Besides, in the study of Balthazard et al. (2012: 247), it was aimed to reveal and classify the differences between transformational and non-transformational leaders with neuroimaging methods. In the study, data from 19 sensors deployed on the brain with current psychometric measurement techniques and electroencephalography (EEG) method were recorded to measure the perceptions of the leader's followers. It was explained by using EEG in the study by associating the signals that are concentrated on the prefrontal and frontal-temporal, central, and lateral and occipital areas of the brain with and without transformational leadership characteristics. Boyatzis et al (2012: 62) monitored which neuronal region and networks are activated in the brains with the fMRI imaging technique when individuals remembered the interaction moments with the compatible and incompatible leaders they worked with. In the research, neural areas such as the bilateral insula, right inferior parietal lobe and left superior temporal gyrus are activated when they remember interactions with compatible leaders, and they concluded that when individuals remember interactions with incompatible leaders, the bilateral posterior region of the right anterior cingulate cortex and bilateral inferior frontal gyrus and bilateral inferior frontal and gyrus/insula were activated.

In their study with fMRI imaging technique, Aziz-Zadeh, Kaplan and Iacoboni (2009: 42) sought answers to the question of what the neural relationships or correlations of the insight solutions have. As a result of the research, it has been stated that insight verbal solutions activate a neural distributed network which includes bilateral activation in the anterior cingulate, the right prefrontal cortex, and the insula.

These areas are discussed with their possible role in metacognition and of evaluation insight solutions, as well as monitoring and attention.

Table 3 - Neuromanagement Studies in General

Author(s)	Year	Topic	Empirical Study	Neuroimaging Technique
Peterson	2005	Neuroscience	+	It measured the behavior of investors at high levels of uncertainty and at risk using the fMRI technique. (Brain reward system)
Butler and Senior	2007	Organizational Cognitive Neuroscience	-	Conceptualization (no neuroimaging technique is used)
BEUGRÉ	2009	Neuroeconomics, Social Cognitive Neuroscience, and Organizational Neuroscience	-	Neuro-organizational justice model (no neuroimaging technique was used)
Aziz-Zadeh, Kaplan and Iacoboni	2009	Neuroscience	+	She tried to analyze the efforts to find solutions and comprehension by using fMRI neuroimaging technique.
Campell, Whiteheart and Finkelstein	2009	Neuroscience	-	Entrepreneurship skills (no neuroimaging technique was used)
Becker and Cropanzano	2010	Organizational Neuroscience	-	Conceptualization (no neuroimaging technique is used)
Waldman, Balthazard and Peterson	2011	Social Cognitive Neuroscience	-	To reveal the relationship between leadership and social cognitive neuroscience. A model proposal (no technique used)
Boyatzis, Pasarelli, Koenig, Lowe, Stoller, Mathew, and Phillips	2012	Neurological Impact (Organizational Neuroscience)	+	The neurological effect that participants felt about compatible and incompatible leaders was measured with fMRI.
Balthazard, Thatcher, Waldman, Verbeke, and Hannah	2012	Neurological Pattern	+	EEG was used to measure Transformational Leadership.
Bagozzi, Belschak, Dietvorst, and Berg	2013	Organizational Cognitive Neuroscience	+	FMRI technique was used in measuring the makeevlist behavior of individuals.
Becker and Menges	2013	Biological Covert Measurement, Organizational Neuroscience	-	Emphasis on neuroscience that can be used for Human Resources (no technique used)

Source: Compiled by the author

CHAPTER III

RESEARCH METHODOLOGY AND FINDINGS

3.1. RESEARCH QUESTIONS AND RESEARCH PURPOSE

In this thesis it is aimed to provide pertinent theoretical studies and the most recent empirical findings all around the world but particularly in Turkey. The objective is to focus on the studies about economy, finance and business in the area. It is aimed to put forward the most recent real-world applications: studies and tests with important administrative suggestions. This study will try to be as comprehensive as it can be, and a reference source for analysts and supervisors curious about neuroscience.

Due to the fact that neuroscience is a multidisciplinary field of research, the field of its study is quite wide. In this study the implementation of this phenomenon in the field of business and economics was studied. Within this framework, research questions are formed as follows.

Research Question 1: How are neuroscience studies defined?

Research Question 2: What are the main advantages and disadvantages of neuroscience applications?

3.2. RESEARCH METHOD AND RESEARCH DESIGN

In this study, within the framework of a qualitative research pattern, an analysis of the questions asked to the participants was carried out using the phenomenology technique. For this purpose, various descriptive results obtained primarily from the texts are shown with a word cloud, word frequencies and word trees. Then, the content analysis of the texts was carried out and contextual analyses of the statements put forward by the participants were carried out.

The data summarized and interpreted at the descriptive examination stage in qualitative analyses can be subjected to a deeper process in content analysis and concepts and themes that cannot be discovered because of descriptive analysis can be revealed (Sığrı 2018: 275). It is known that the use of auxiliary analysis software has become widespread in recent years in this type of analysis. In fact, generic office software can also be used in research that does not contain a lot of qualitative data. However, qualitative research software offers a lot of convenience and certainty that allows researchers to conduct more reliable research. In this study, Nvivo 12 Plus software was used at the stage of analyzing qualitative data.

Content analysis is a commonly used qualitative research technique (Hsieh and Shannon 2005: 1279), while researchers can usually analyze sections in a journal or textbook using such techniques (Krippendorff 2004: 422). Key steps in the content analysis include; i) encoding data, ii) finding themes, iii) organizing codes and themes, iv) examining data, codes, and themes in the light, v) revealing and interpreting findings (Sığrı 2018: 280). There are different methods of content analysis. Generally, accepted approaches are traditional, guided and summarizer (Sığrı 2018: 294). In traditional content analysis, encoding categories are derived directly from the text data. Summarizer content analysis usually involves counting, comparing the keywords or content, and then interpreting the underlying content. And the guided approach begins with a theory or related research findings as the guidance of the initial codes. In this study, the summarizer content analysis method was used.

3.3. DATA COLLECTION

In qualitative research patterns, participant observation, natural observation, document review and in-depth interview are used as the main data collection techniques (Creswell 2007: 301). In this study, the scripts of the interviews were collected within the framework of the in-depth interview technique. In-depth interviews with experts related to the research topic of the participants in the round for a certain purpose, though the phenomenological interview is speaking event or how you perceive events related to the research topic and is intended to uncover statements (Sığrı 2018: 282).

Participants were reached by the snowball method. Interviews were conducted in the form of remote interviews due to the pandemic. Within the scope of the research, we tried to reach participants from the academic and business world in a balanced way.

However, due to ethical concerns, we had trouble reaching enough companies. The interviews lasted between half an hour and an hour on average. Before starting the interviews, the participants were informed about the confidentiality and permission was obtained from the participants to record the interviews. Transcriptions were obtained from the recorded interviews and then translated to English prior to analysis.

Table 4 contains some information about the participants. Names are omitted for privacy reasons. The sample of the study consists of 14 participants of whom 60% are women. While some of them are either company owner or managers of businesses in the field of neuroscience, most of them (n=8) are academics working on this subject. One of the participants do this both academically and commercially. Since neuroscience applications are a new field in Turkey, the number of experts in this field is limited. For this reason, academics working on the subject in a laboratory environment were reached. In Turkey, there are five enterprises practicing Neuroscience, of these, the owners of 4 enterprises were interviewed.

Table 4 - Interviewee List

Group	File	Participant No	Occupation	Gender
1	Interview-02	P02	Academics	Female
	Interview-05	P05	Academics	Male
	Interview-07	P07	Academics	Male
	Interview-08	P08	Academics	Female
	Interview-09	P09	Academics	Female
	Interview-11	P11	Academics	Female
	Interview-12	P12	Academics	Female
	Interview-14	P14	Academics	Female
2	Interview-01	P01	Academician and Company Owner	Male
	Interview-03	P03	CSO ¹¹	Male
	Interview-04	P04	Marketing Manager	Female
	Interview-06	P06	Company Owner	Male
	Interview-10	P10	Company Owner	Female
	Interview-13	P13	Company Owner	Male

3.4. DESCRIPTIVE ANALYSIS OF INTERVIEWS

In qualitative research, there are less quantitative data. But this does not mean that such data is insignificant or worthless for research. However, in many studies, preliminary information about the data can be obtained by methods such as word frequencies or word cloud or word tree. Storey (2007: 61) states that studies in the qualitative pattern are aimed at revealing people's perspectives on phenomena, while Dey (1993: 125) notes that qualitative research, in contrast to quantitative research based on the analysis of statistical data, seeks answers to the question of how people characterize events. In this section, analyses were made with different descriptive notations in order to examine the data in a summary manner before proceeding to content analysis. The word cloud obtained from the answers given to the questions by the participants is included in Figure 10, which is one of the basic descriptive representations.

¹¹ Chief Strategy Officer



Figure 10 - Word Cloud of Interviews

In qualitative research, some quantitative results can be shown in order to increase reliability (Sıgır 2018: 289). The word frequency for the texts obtained from the responses is given in Table 5. Word search is done in the form of stem words (i.e. study/studying) and the results are grouped. It is observed that the concepts of neuroscience, study, applications, and neuromarketing come to the fore in word frequencies (F).

Table 5 - Word Frequency of Interviews

TERM	F	%	TERM	F	%	TERM	F	%
neuroscience	315	3,49	Turkey	67	0,74	work	46	0,51
studying	158	1,75	university	61	0,67	product	45	0,5
applications	140	1,55	consumer	57	0,63	customers	44	0,49
neuromarketing	122	1,35	developments	53	0,59	science	44	0,49
using	118	1,31	field	50	0,55	focus	43	0,48
brain	100	1,11	business	49	0,54	world	43	0,48
marketing	97	1,07	methods	49	0,54	terms	42	0,46
companies	90	1,00	conducted	48	0,53	important	38	0,42
research	88	0,97	people	48	0,53	measure	37	0,41
devices	80	0,89	advertising	46	0,51	addition	35	0,39

Word trees show the semantic structure formed in the form of sentences around one or more words searched for in text content. Especially when working with voluminous qualitative data, meanings can be quickly reached in a summary way with

word trees. Figure 11 shows the word tree belonging to the concept of "neuroscience applications" which is a combination of the most frequent terms. In accordance, there are some expressions extracted from the interviews below is given in two topics.

Neuroscience applications:

Neuroscience applications enable us to reach objective answers relating to the reactions of the customers. (P06)

Neuroscience applications enable product development. (P06)

Neuroscience applications are utilized by companies. In addition, neuroscience applications are beneficial in medicine for diagnosis and treatment of diseases. (P04)

Firstly, neuroscience applications are expensive. There are still problems regarding generalizability and external validity. (P05)

On the downside, neuroscience applications are complicated. For instance, when you provide the raw form of the survey, the marketing manager can analyze it. (P05)

Neuroscience applications are data-driven. (P06)

Neuroscience applications are generally used in advertising, packaging, logo design, determination of slogans, and in studies related to smell. (P07)

Neuroscience applications are used in neuroeconomics, neuropolitics, neuromarketing and even in neuroaesthetics. (P12)

Neuroscience applications in Turkey:

Neuroscience applications are becoming increasingly widespread in the world; however, I think, in Turkey, we do not capitalize on neuroscience applications in an adequate and acceptable level. (P01)

In my opinion, neuroscience applications are in a more rapid and effective progress in Turkey in comparison to many countries in the world. (P03)

Whereas devices used for neuroscience applications are mostly developed in Canada, in the First World, in the USA, and Germany; in Turkey, we have limited production. (P04)

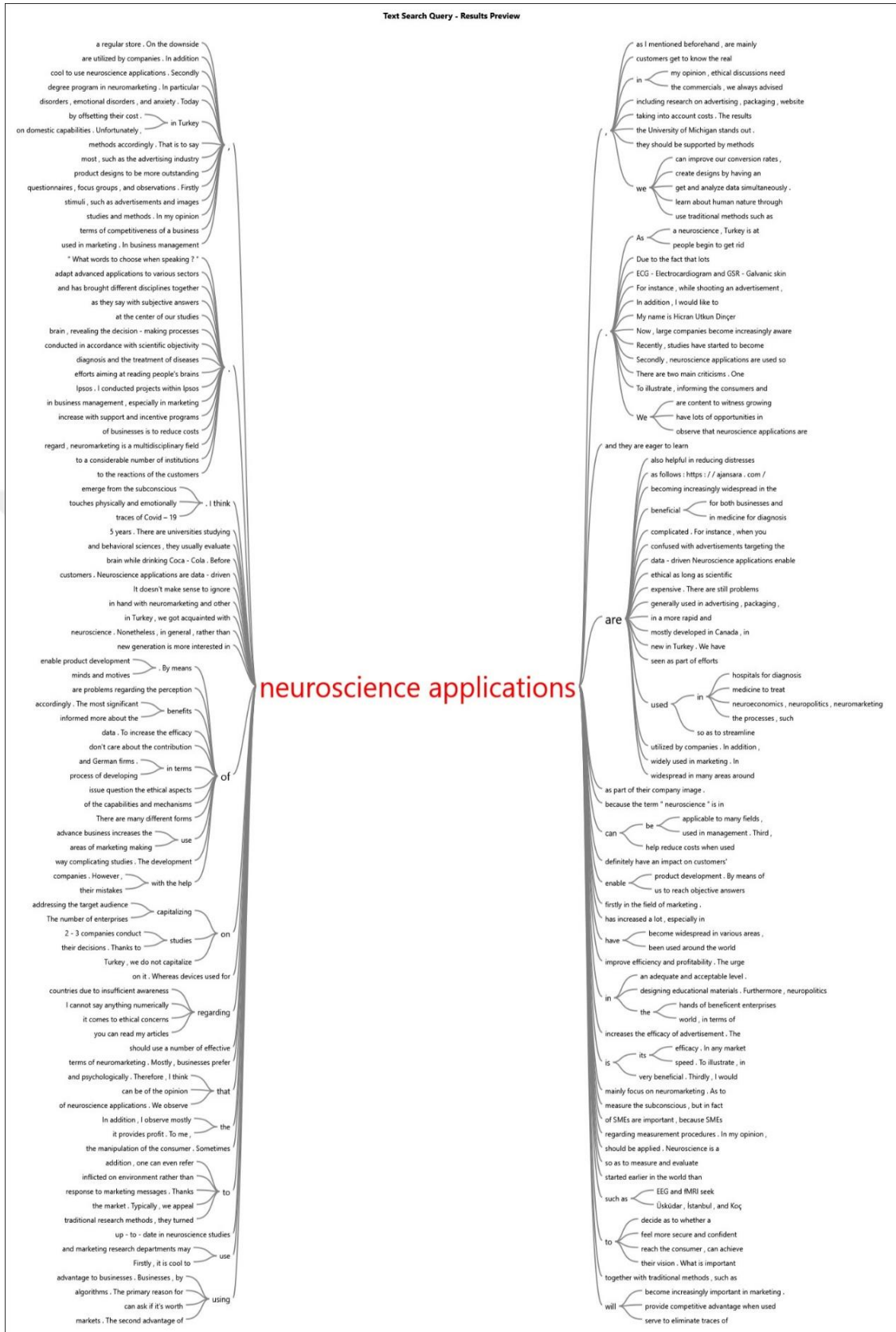


Figure 11 - Word Tree of "Neuroscience Applications"

The word tree belonging to the concept of "neuromarketing", which is often repeated, is shown in Figure 12. In addition, some statements from the interviews related to this concept are given below. Statements of group one (academicians):

In my opinion, enterprises should take part in the neuromarketing process. We should not waste our efforts in the marketing processes. (P05)

I have no information regarding the studies aiming at producing devices for neuromarketing or neuromanagement. Perhaps, there may be some studies in RandD departments. (P08)

Neuromarketing is an area that is applied in big companies. Although the cost is high, the return is higher, and it provides profit. (P12)

We take advantage of neuromarketing techniques in all areas of marketing in order to get answers directly from within the brain, by measuring emotional responses of the different areas of the brain such as frontal cortex, because the results are very rewarding in terms of data wealth, validity and reliability compared to other traditional methods. That is why; we are committed to applying these applications to all areas. (P14)

Statements of group two (company owners):

Although neuromarketing methods are not effectively used in Turkey, in the areas where it is applied, such as banking applications, it helps optimize the products before being released to the market and presented to the user by means of neuroscientific data. (P01)

Neuromarketing has been advancing very fast. Accordingly, neuromarketing research is also in a very rapid progress in the world, especially in Turkey owing to the fact that people enjoy the benefits of digitizing a social science such as marketing using methods of neuroscience. (P03)

Neuromarketing provides competitive advantage. Companies taking advantage of neuromarketing outperforms the companies using traditional methods. (P04)



Figure 12 - Word Tree of "Neuromarketing"

3.5. CONTENT ANALYSIS

In Nvivo, which is used as research software, concept coding is done through nodes. “Nodes provide the storage areas in NVivo for references to the coded text. Each node serves as a container for everything that is known about one particular concept or category. Nodes can also be used as a tool to organize qualitative data in particular ways (Bazeley and Jackson 2013:17). In the content analysis section of the research, the interviews were examined with contextual concepts determined within the framework of the literature. Nodes were encoded in three main themes shown in Table 6. In these encodings, three main themes have emerged, the definition of neuroscience, its disadvantages, and the advantages of neuroscience applications.

Table 6 - Main Themes of Content Analysis

Theme	Files	References
Neuroscience	14	183
Advantages of neuroscience applications	14	103
Disadvantages	8	13

In the content analysis, the codes obtained for the definition of neuroscience are given in Table 7.

The following are the statements regarding the definition and general statement for neuroscience. Statements of group one (academicians):

Neuroscience is used in the field of management and business, by guiding human behavior, thus transforming us into non-mechanical robots. (P09)

We explore how buying behavior is effective in making decisions, how brain takes decisions, what kind of influences brain goes through when we come across a logo, a slogan when we examine a product of a brand, and the mental processes during various decision-making stages. (P11)

Recent research shows that the most striking topic in neuroscience is the brain, including animal brains. In short, what matters the most is the brain. (P02)

Therefore, in Turkey, neuroscience has developed far better than many 3rd World countries and even than many European countries. Turkey is home to very qualified neuroscientists. (P02)

We are developing in the field of neuromarketing with the contribution of many proficient and accomplished scientists in neuromarketing and neuroscience. (P05)

As far as I know, marketing was the first area to develop in Turkey regarding neuroscience, thus providing unprecedented methods of attracting more customers to products. (P08)

The software used with these devices is generally imported from abroad. The required equipment is also procured from abroad by foreign currency. (P11)

There are two main criticisms. One is the moral dimension of it, and the second is that both devices and techniques are very expensive. One can ask if it's worth using neuroscience applications, taking into account costs. (P14)

Statements of group two (company owners and private sector):

Whereas neurology refers to the discipline of medicine, neuroscience is a discipline giving us clues about consumer behavior and marketing. (P10)

As every study we execute as regards neuroscience requires understanding and analyzing human behavior, "human" is at the center of our studies. (P01)

Neuroscience is an academic branch which seeks to explain human behavior by means of brain sciences, analyzing the system of the brain. (P01)

Since, as Turkey, we are foreign-dependent, research on neuroscience costs way too much. For instance, buying only a behavioral analyzer amounts to around \$150,000 today. (P01)

Since we do not develop new technology, we buy technology and related products from countries that develop them. (P13)

Whereas neurology refers to the discipline of medicine, neuroscience is a discipline giving us clues about consumer behavior and marketing. We deal with neuroscience in terms of understanding and evaluating consumer behavior. In this regard, neuromarketing is a multidisciplinary field. (P10)

In a general sense, neuroscience is a scientific study of the nervous system. Neuroscience is an interdisciplinary science, capitalizing on the interactions of various disciplines (P03).

With the commencement of production of these devices in Turkey, I hope that advancements will accelerate. No need to say that only the devices designed and manufactured by ourselves pave way for effective and efficient scientific inventions and original studies. (P01)

Table 7 - Sub-Themes of "Neuroscience"

Theme / Sub-Themes	Files	References
neuroscience	14	183
interdisciplinary	12	22
neglected in Turkey	9	21
brain science	12	19
dependence on foreign resources	11	18
behavioral science	9	17
effective in Turkey	10	15
importance of ethics	8	13
high randd costs	6	10
increasingly widespread	8	10
scientific oriented	6	9
Demanding	4	7
effective in the world	5	7
medical education and purposes	2	5
need local manufacturers	2	3
Rewarding	2	2
paradigm absence	1	1
cultural barriers	1	1

In their interviews, the participants stated with various expressions for neuroscience. In these statements, it can be seen that neuroscience is a behavioral science (P01, P09, P10, P11), it includes brain research (P02), it is an academic branch (P01), it is developing in Turkey (P02, P08), there is a dependence on foreign resources (P01, P11), the research process is expensive (P14), and it is a multidisciplinary field (P03, P10). When all expressions on Table 7 were observed, it was seen that some participants stated that neuroscience was rewarding, scientific oriented and interdisciplinary. These statements generally came from academic participants. In addition, while the company owners or employees among the participants did not find these applications expensive, the academic participants found them costly.

In the content analysis, the codes obtained for the advantages of neuroscience applications' are given in Table 8.

Table 8 - Sub-Themes of "Advantages of neuroscience Applications"

Theme / Sub-Themes	Files	References
neuroscience applications advantages	14	103
marketing strategies	12	34
provides competitive advantage	11	16
helps understanding customer needs	6	12
positive multidisciplinary outcomes	5	7
helps on customer awareness	5	6
helps on optimization	3	5
reaching target audience	4	5
reduces production costs	2	4
medicine development	2	3
positive impact on user experience	2	3
design materials for education	2	2
helps closing economic gaps	2	2
avoiding confusion	1	1
improves communication	1	1
informing consumers	1	1
security purposes	1	1

The following are the statements regarding neuroscience applications' advantages. Statements are grouped according to sub-themes.

- Marketing related advantages such as setting marketing strategies (P01, P03, P06, P07, P10), helping on understanding customer needs (P03, P07, P08, P11), helping on customer awareness (P02, P03, P14), reaching the target audience, informing consumers, positive impact on user experience:

With the current developments in science and the level it has reached, it has become obvious that everyone, including patients and their circle is inquisitive about the brain, bringing about further studies. As a consequence, people have started to ask their doctors questions like "Is there anything wrong in my brain regarding my problem? (P02)

In a sense, with the help of neuromarketing, we can easily make decisions relating to marketing strategies. (P03)

We are, mainly interested in applications as regards marketing. (P10)

Customers often have no idea as to what they do, as to when they do it, as to why they do it, as to why they prefer certain brands, and as to how they make their decisions. Thanks to studies on neuroscience applications, customers get to know the

real reasons for their choices and for impulsive decisions that emerge from the subconscious. (P14)

In any market research, we aim at understanding and measuring the preferences of the target audience, for instance, enabling us to decide on the right packaging, in the right place, at the right price, with the right advertisement. (P03)

There are many different forms of neuroscience applications. To illustrate, informing the consumers and making advertisements and promotions using your neuroscience knowledge and neuroscience-based methods help consumers a lot in getting messages much clearer, in exploring the products better, and in avoiding confusion among alternatives. (P01)

By means of neuroscience applications, we can improve our conversion rates, we can create advertising campaigns that attract the attention of our customers, and we can form our designs and messages accordingly. (P06)

As neuromarketing is more up-to-date and more prevalent in market conditions, we would tie the term “neuroscience” especially to marketing. (P07)

Therefore, neuroscience makes a significant difference. In this regard, our customers also show great interest in our studies and methods. (P03)

For this reason, neuromarketing and neuroscience studies outperform traditional methods with their capabilities in eliminating the difference between what people say and what they really think. (P07)

The most significant benefits of neuroscience applications in the hands of beneficent enterprises are generally about finding out the customer needs and about guiding customers by analyzing brain activities accordingly. (P08)

In fact, people disguise their real emotions to be accepted by the society, by refraining from expressing real attitude towards a service or product without revealing the facts in their brains. We seek to uncover this discrepancy with neuroscience. (P11)

- *Efficiency related advantages such as helps on optimization (P01), reduce production costs (P07, P03, P01):*

With the help of the studies carried out on focus groups; products and services can be optimized and presented accordingly. (P01)

Advertising companies have increased investments in neuroscience with the thought that these applications would be profitable by offsetting their cost. (P07)

Neuromarketing studies facilitates the appreciation process in an effective and efficient fashion by eliminating unnecessary processes, by taking into account the preferences of customers and socio-cultural acceptances and beliefs. (P03)

In addition, using neuroscientific techniques reduces production costs. Since neuroscience help to define the preferences of the consumers and the extent of the preferences beforehand, by neuromarketing, companies, for example, get rid of the cost of production by putting unnecessary prototypes on the market and by the process of trial and error. (P01)

- Competition related topics such as medicine development (P04, P08), provides a competitive advantage (P10), improve efficiency (P04):

In addition, neuroscience applications are beneficial in medicine for diagnosis and treatment of diseases. Neuroscience is also helpful in prosthetics. A host of neuroscientists study in the field of biomedicine. (P04)

Neuroscience is mostly used in medicine, paving way to applications in different realms. However, compared to Turkey, it started to be applied in the world before and predominantly. (P08)

Other than motivation and attention, we measure many phenomena. But our main focus is on these two important features. Naturally, they provide competitive advantage. For instance, when you are browsing the supermarket aisles, you come across with many brands that produce milk. It is of importance for brands to stand out among others, to be noticed and to attract attention. (P10)

I think it is important to be up-to-date in today's rapidly changing world. It is inevitable for the companies to compete in a global market. ... Neuroscience applications improve efficiency and profitability. (P04)

- Miscellaneous topics such as design materials for education (P05, P07), improve communication with customers (P13):

Moreover, neuroscience is used in the design of a website. In education, we can develop materials, making use of neuroscience. (P05)

There are studies on finance as well as on architecture. In addition, I observe mostly the neuroscience applications in designing educational materials. (P07)

Studies are generally carried out on improving communicate on, mostly reaching consumers one-on-one. Customers enjoy one-on-one communication very much. (P13)

The sub-themes in the main theme of disadvantages are listed in Table 9. As can be seen from the table, the most repeated sub-theme was that applications are “susceptible to abuses.”

Table 9 - Sub-Themes of "Disadvantages"

Theme / Sub-Themes	Files	References
Disadvantages	8	13
susceptible to abuses	8	11
high costs for customers	1	1
violation of privacy	1	1

Some of the participants stated that neuroscience applications are open to abuse. Some of them are given below.

Neuroscience, brain and behavioral sciences are like a double-edged sword. These realms are susceptible to abuses. In the market, there are many training systems that issue certificates with doubtful success levels, and people with insufficient training can work and make various promises with their so-called certificates. In the communities where awareness about scientific issues is not high, neuroscience is always prone to be a subject of fraud. (P01)

Doubts regarding ethical value of methods of neuromarketing should be eliminated. Data obtained through neuromarketing should not be used for malicious purposes. (P04)

Neuroscience research is also conducted regarding politics, unhealthy food and drink, and gambling sectors, with the potential inclination to serve to malicious purposes. (P06)

It is also likely that companies abuse capabilities of neuroscience. (P07)

Businesses can launch such a competitive strategy by using neuroentrepreneurship or neuroscience, causing great harm to their customers, indeed to society. They can manipulate customers by forcing unfair competition. (P08)

As people begin to get rid of their preconceptions about neuroscience, they will begin to understand neuroscience more. In addition, some view neuroscience as a violation of human rights. (P11)

In the interviews, the participants stated with various expressions that neuroscience applications are an area open to abuse. Some have stated that neuroscience is a double-edged sword (P01), while others have expressed growing

ethical concerns about it (P04). Some have expressed concern that customer data may be manipulated by creating an unfair competitive environment (P08). In addition, one participant (P01) stated that *“personal privacy may be violated”* and *“the cost of accessing the product or service for customers may increase”*.

When the statements obtained from the participants about the abuse of neuroscience were examined, it was noticed that the issue of ethics in such practices came to the fore. Accordingly, the statements of the participants were analyzed. P1 stated that *“In the market, there are many training systems that issue certificates with doubtful success levels, and people with insufficient training can work and make various promises with their so-called certificates.”* This indicates a statement made with a serious ethical concern. Participants P1, P4, P6, P7, P8, P9, P11, and P14 made statements about abuse and violation of privacy regarding Neuroscience practices. It is noteworthy that 6 out of 8 participants who made such statements are academics.

CHAPTER IV

DISCUSSION AND CONCLUSION

Neuro business tries to present concrete data by experimenting with scientific tools as the main factor that guides the decision processes of psychological or external factors. Neuro business is the economic behavior of the decision-making process of consumers, who are the economic decision unit, and in which direction economic behaviors occur in which conditions and environments measure and investigate the results of these behaviors. The studies on the applications of neuroscience to the economic world and business have improved a long way since there have been huge efforts to understand how our feelings and decisions affect each other. This relationship can be used to improve the business and economy. It's time to elaborate on the leading neuroscience applications in each business department (Hobikoğlu, 2014: 29). The fact that the economic decisions taken are not independent of emotions increases the efficiency of the studies. By using advanced technologies such as Magnetic Resonance Imaging (MRI), more extensive studies can be done about the effects of people making economic decisions. Neuro-business practices will be effective in creating processes that will stimulate the competitive environment in the market in macroeconomic terms, require manufacturers to increase their innovative abilities, accelerate and stimulate the development process economically and structurally (Bandettini 2007: 142).

In this study, interviews with the experts were examined within the framework of a qualitative research pattern for the concept and applications of neuroscience. In recent years, neuroscience has emerged as a developing discipline that combines numerous sciences that study the functional organization and structure of the nerve system with specific attention on the brain.

Due to its multidisciplinary nature, neuroscience applications have many effects in different fields. The studies on the applications of neuroscience to the economic world and business have improved a long way, and this can be used at improving the business and economy. In the scope of this study, the meaning of neuroscience and its applications in the fields of business and economics and the advantages and disadvantages of these applications were examined. The study was conducted within the framework of a qualitative research pattern. In this context, questions were asked to experts in their field within the framework of the studied literature, and these interviews were examined in the form of descriptive and content analysis.

Neuroscience: the science of anatomy, physiology, biochemistry, or molecular biology of the nervous system, deals with the behavior and learning of nervous and nervous tissues. In this context, it can be stated that neuroscience is a multidisciplinary research field as well as a brain research field because it includes nervous system research with intensity. Already in the descriptive study conducted before the content analysis of the texts, it was seen that the concept of the brain is in the top ten most repeated words. Twelve of the fourteen participants made statements related to this. Since the brain and behavior are two complementary concepts, the statements of nine of the participants that it is a field of behavioral research have been seen. However, it is noteworthy that the participants emphasized that neuroscience applications are effective in Turkey, but that external dependence is high. Although this is actually a common situation in Turkey for emerging technologies, the emphasis on high RandD expenses as a result of this situation was made by six participants. In this direction, two participants emphasized that there should be local manufacturers for software and hardware.

When the general evaluations made by the experts participating in the study regarding the concept of neuroscience were continued, it was seen that almost all (85%) of them stated that it is a multidisciplinary practice. In addition, it was observed that nine participants stated that the desired research level was not provided and ignored, which is considered to be due to the multidisciplinary nature of the field or because of other reasons. Another prominent issue is related to ethics. Eight of the participants made statements about the importance of ethics. It is noteworthy that 6 out of 8 participants who made such statements are academics. In addition, two

participants stated that such research was rewarding, and six participants stated that these studies were conducted on a scientific basis.

Although there were not many statements about the disadvantages of neuroscience research, it has been seen that most of them are that these studies are open to abuse. In the statements made against this, it has been stated that the data obtained from the customers may fall into the hands of undesirable people or be used in an undesirable way, which may harm the customer and society. Similarly, one participant stated that cases of violation of customer privacy might be encountered. Finally, one participant stated that it might be a case of the customer incurring more costs.

As an emerging research field, there are also advantages of neuroscience applications in different fields. In interviews with participants, statements about these benefits were found frequently. One participant stated that informing the consumers and making advertisements and promotions using neuroscience knowledge and neuroscience-based methods help consumers a lot in getting messages much clearer, in exploring the products better, and in avoiding confusion among alternatives. This situation will be able to avoid the confusion experienced in product development. Neuroscience applications are used in the development of many different products. These include educational materials as stated by two of the participants. In addition, as stated by two other participants, the development of new products, as well as the fact that these are products with high added value, may mean closing the gap with developed countries in terms of economic development.

In many cases, the awareness of the customer is to facilitate the work of the manufacturer and the employees of the marketing and sales departments. In this way, product/service promotions and sales can be made easier. Five of the respondents stated that neuroscience and neuromarketing practices increase customer awareness. It is parallel with Yücel and Çubuk's (2014: 139) statement that unconscious reactions of consumers direct the purchase decision and thus clarify how the consumer actually makes the purchase decision. Similarly, it is important to understand the customer's needs in product development. As people cannot think what they feel, cannot express what they think and do not do what they say, when this is achieved, products and services that meet the customer's needs will be able to be developed at less cost. Six of the participants explained this. Since marketing of the product is as important as product development, determining the right marketing strategies, especially in today's

rapidly changing market environments, will provide benefits to businesses compared to their competitors. Twelve of the participants mentioned the benefits and importance of these practices for their marketing strategies.

The experience that the customer has gained from the product or service, which emerges after the product is marketed and sold, will be beneficial for resale or increasing brand awareness. Two of the participants mentioned the benefits of neuroscience applications about this. It has been mentioned that these practices are multi-disciplinary. Five of the participants stated that there would be such multidisciplinary outcomes. For example, one of the participants stated that businesses are taking advantage of neuromarketing applications that can be more effective in management, marketing, and competition, thus procuring far more qualified human resources and developing more effective working styles. Many of these positive results were expressed in terms of profit or benefit for businesses. One of them is to gain a competitive advantage, as stated by eleven of the participants. Moreover, many sectors can benefit from this. For example, one of the participants stated that among the sectors, automotive, telecommunication, banking, house cleaning, personal care, fuel, e-commerce, beverage, electronics, white goods, financial institutions other than banks, chain stores, and real estate, as the ones capitalizing on the opportunities of the methods of neuroscience. However, this situation is parallel to Bandettini's (2007: 144) study that neuroscience will stimulate the competitive environment in the market in macroeconomic terms, require manufacturers to increase their innovative abilities, accelerate and stimulate the development process economically and structurally. One of the other participants stated that neuroscience applications improve efficiency and profitability. Finally, some of the participants stated that neuroscience applications made it easier to reach the target audience and reduced production costs.

As a result, neuroscience applications can cause different positive results in different fields with the diversity brought by the existence of multiple disciplines. However, considering that the field is developing and that brain-related studies have not yet come a long way, there are many more questions that need to be answered. Nevertheless, it seems that the information obtained so far provides benefits to companies and researchers in the field of neuroscience, especially in neuromarketing. With this research, it has been determined that neuroscience applications and research provide benefits to companies, especially in understanding competitive advantage and customer needs. However, the need for these studies to require high RandD

expenditures and the shortcomings caused by external dependence on software and hardware slow down research institutions and companies to reach the desired level. In addition, while the company owners or employees among the participants did not find these applications expensive, the academic participants found them costly. It has also been stated by the participants that neuroscience is widely used in the field of neuromarketing in business life and that there may be developments in areas such as neuro-management and neuro-finance in the future.

Implications for Future Research:

More and more research is being done on the applications of neuroscience. Since this field contains many innovations and is a multi-disciplinary subject of study, there will be many areas that it will affect. We will see their more tangible effects as time goes on. Of course, different research designs such as case studies are needed to measure tangible effects. However, in this research, it has been tried to observe how neuroscience practices progress and are perceived in academia and the business world in an exploratory context and in a qualitative research design. Thus, it was possible to evaluate the views of the participants, who have two different working styles and perspectives, in the same context. This is thought to be valuable for researchers and interested parties working in the field.

The results of the research show that the subject is important in Turkey, but it is dependent on foreign sources in terms of technology. However, some researchers complained that due to the multidisciplinary nature of the subject, it did not find the desired level of interest. Another notable issue was ethics. Some participants emphasized that the subject is open to abuse. In fact, we think that the issue that bothers them about ethics is the results rather than the methods used. Since the awareness of neuromarketing has not increased in society yet, people may confuse this issue with subjects such as subliminal. For this reason, they may not find it ethical.

Neuroscience is still developing in business life in Turkey, and there are companies providing services in the neuromarketing field. However, we would like to point out that there are no companies providing services in areas such as neuro-financing and neuro-management. Despite all this, neuroscience is promising and will bring many benefits in the business world with developments. In other fields (such as management, leadership, finance), there are studies conducted by academicians using neuroscience, but no companies providing services related to this have been found.

Within the scope of the information obtained from the implementing companies, we can say that many companies have increased their brand positioning, marketing strategies, competitiveness levels, and most importantly, their sales in the market with their neuroscience and neuromarketing applications.

There are some limitations of the research. The research is carried out with a qualitative research pattern and is limited to the opinions of the 14 participating experts. Therefore, in future studies, in addition to participant interviews, more in-depth research can be conducted on some of the areas mentioned with a case study. It is hoped that the research results will benefit those who work in this field and the relevant public and private sector managers and relevant staff. Another limitation is that company representatives using these applications are not among the participants because they did not accept the interview due to confidentiality.

In future studies, case studies can be done by determining topics in specific areas. It is thought that more in-depth information will be obtained in case studies to be made on neuromarketing, which is more commonly included in the literature. It is hoped that the results of the study will benefit researchers, managers, and other interested people working in the field.

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