

In Search of Consumer's Black Box: A Bibliometric Analysis of Neuromarketing Research



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Abstract

The use of neuromarketing (NM) has increased in recent years, mostly due to its potential to build more accurate insights about consumer behavior. Accordingly, as an alternative to the traditional market research, NM is widely attracting the attention of scholars in the different settings. Therefore, to achieve a better understanding of the conducted research and suggest guidelines for the future studies, this study aims to develop a big picture of available literature by using state-of-the-art bibliometric analysis tools. In order to investigate this trend, Journals, keywords, co-authorships, geographical distributions

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of scientific papers, and 351 indexed articles in “*Web of Science*” database were selected as samples. The results of this study indicated that NM is a growing trend, *Journal of Marketing Research* was the main source for NM studies and related studies were mostly collaborative research with more than one author. In addition, the USA was the most productive country and eye tracking was the most frequently applied keyword.

Keywords: Neuromarketing, Bibliometric analyses, Eye tracking, EEG, fMRI

Tüketicinin Kara Kutusunu Arayış: Nöropazarlama Araştırmalarının Bibliyometrik Bir Analizi

Öz

Son yıllarda nöropazarlamaya (NP) yönelim, çoğunlukla tüketici davranışı hakkında daha doğru bilgiler verme potansiyeli ve geleneksel pazarlama araştırma yöntemlerine bir alternatif olması dolayısıyla, artış göstermektedir. Yapılan araştırmaların daha iyi anlaşılabilmesi ve gelecekteki çalışmalar için yönergeler önermek için, bu çalışma, mevcut literatürlerin en güncel bibliyometrik analiz araçlarını kullanarak büyük bir resim geliştirmeyi amaçlamaktadır. Bu amacı gerçekleştirmek ve bu eğilimi araştırmak için dergiler, anahtar kelimeler, ortak yazarlar ve bilimsel makalelerin coğrafi dağılımları ve “*Web of Science*” veri tabanından 351 endeksli makale incelenmiştir. Çalışma sonucunda, NP’ ya artan bir eğilimin olduğu, *Journal of Marketing Research*’un NP çalışmalarının ana kaynağı olduğu ve bu çalışmalarda çoğunlukla birden fazla yazar ile ortak araştırmaların yapılmış olduğu sonuçlarına ulaşılmıştır. Bunlara ek olarak, en üretken ülke Amerika ve en çok kullanılan anahtar kelime de “eye tracking” olarak belirlenmiştir.

Anahtar Kelimeler: Nöropazarlama, Bibliyometrik analiz, Eye tracking, EEG, fMRI

Introduction

Because of increasing competition between firms and service providers, marketing research is being more and more important (Arora & Mahankale, 2013; Beri, 2008). In generally, it “involves the process of determining needs, setting goals to achieve these needs, prioritizing and planning tasks required to achieve these goals, although several other definitions exist” (M. Mostafa, 2014: 2176). While different kinds of traditional methods such as surveys, interviews and focus groups are the main preferences of marketers, are preferred because of their easy using, accessibility and cost effectiveness, emerging new technologies have risen doubt about their efficiency to provide accurate information (Yılmaz, et. al., 2014: 706). The rising critic toward the conventional market research is “mainly driven by the fact that people cannot (or do not want to) fully explain their preferences when explicitly asked” (Khushaba et al., 2013: 3804). As a result, application of neuroscience was suggested as an alternative to traditional market research methods (Agarwal, 2014; Fugate, 2007; Fulcher, Dean, & Trufil, 2016; Hsu & Yoon, 2015). The combination of neuroscience (or neurobiology) and marketing has developed a new marketing sub-discipline identified as “Neuromarketing” (Braeutigam, 2017; Burgos-Campero & Vargas-Hernandez, 2013; Javor et al., 2013; Lee, Broderick, & Chamberlain, 2007; Lee, Butler, & Senior, 2010; Lindell & Kidd, 2013; Mostafa, 2014; Morin, 2011; Nemorin, 2017). As an interdisciplinary area, psychology, neuroscience and marketing are the main foundations of neuromarketing (A. Booth & P.J. Freeman, 2014; Gbadamosi, 2016; Sebastian, 2014). Neuromarketing is defined as “the application of neuroscientific methods to analyze and understand human behavior in relation to markets and marketing exchanges” (Mostafa, 2014: 343). Such a definition has two results: firstly, it can shift the focus of neuromarketing activities further than commercial use. Secondly, it can broaden the scope of neuromarketing studies from merely consumer behavior to comprise many more interests (Lee et al., 2007).

While using neuroscience based techniques to examine customers is not new, according to methodological issues, they have not completely

met expectations until recent developments in technologies (Solnais, et. al., 2013: 70). Today's marketers who are in search of "buy button (Kühn, et. al., 2016: 122)" or "black box" (Singh & Sharma, 2010: 56) for customers, are mainly applying tools such as; "Functional magnetic resonance imaging (fMRI)" (Amit, et. al., 2017), "electroencephalography (EEG)" (Kenning, et. al., 2007), "magnetoencephalography (MEG)" (Vecchiato et al., 2011), eye tracking (Hae Won Ju & Johnson, 2010), and mouse tracking (Ha et al., 2016). While the prior studies in neuromarketing solely concentrated on brands (Khushaba et al., 2013) but with time, need for applying neuromarketing in a variety of settings like package design (Khushaba et al., 2013), advertising (Hae Won Ju & Johnson, 2010; Uva, Freitas, & Paiva, 2015), eating behavior (Khushaba et al., 2013), and online research (Tejkl, 2012) is rapidly growing. This extensive and diverse use of neuromarketing can bring some challenges for researchers. Accordingly, this study aims to develop a big picture of available literature and present some considerations and guidelines for future studies. Based on this, the following research questions (RQs) were designed.

RQ 1: How many NM papers have been published each year since 2005?

RQ 2: What are the highly-cited articles in NM?

RQ 3: What are the main journals for NM research?

RQ 4: How is the co-authorship between authors of NM in related papers?

RQ 5: How do different countries rank in terms of number of contributed papers?

RQ 6: What are the most researched keywords in NM studies?

Literature Review

The concept of neuromarketing was firstly put forward by Bright-house Institute in 2001 with the article of Lovel (2002) in Atlanta Busi-

ness Chronicle, which has drawn growing interest of marketers toward NM (Lovel, 2002; Wilson, et. al., 2008; Morin, 2011).

While marketing is trying to understand the psychology of human behavior, neuromarketing is trying to understand the biology of human behavior as Butler (2008) mentioned in his study. Morin (2011) suggested neuromarketing as a novel research area which is composed of “neuroscience” and “marketing”. In the field of advertising, NM has been defined as “applying the methods of the neurology lab to the questions of the advertising world” (Thompson, 2003: 53 as cited Wilson, et. al., 2008). The meaning of neuromarketing in marketing is the same as the meaning of neuropsychology in psychology. Actually, while neuropsychology examines cognitive and psychological interactions between brain and individual, neuromarketing investigates consumer behavior from the brain perspective (Morin, 2011: 132).

The most questioned issue about NM is whether it is based on a theory or not? The Previous studies have shown that “*neuromarketing is atheoretical*” as Garcia and Saad (2008) mentioned before. It is not based on a theory and it is composed of different empirical studies (Garcia and Saad, 2008: 408).

“Neurol Correlates of Behavioral Preference for Culturally Familiar Drinks” studied by Read Montague and his colleagues (Montague, et. al., 2004), can be identified as the first scientific research on NM (Morin, 2011: 132). In this study, participants were asked to drink Coca Cola and/or Pepsi while their brain was scanned by fMRI machine. Concentration has been observed in different areas of participants’ brains and these differences varied according to beverage brands. Results of this research showed that participants more liked Pepsi more even when they claimed that they prefer Coca-Cola (Montague, et. al., 2004).

More or less like the aboved mentioned study, Yucel and his colleagues conducted a research (Coffee tasting experiment from the neuromarketing perspective) on 30 university students by using EEG. Several participants were asked to drink 5 different kinds of coffee and try to find

their favorite one. The result of this study indicated that it was hard for the participants to find their favorite coffee brands (Yucel, et. al., 2015).

In an another study Walter, Abler, Ciaramidaro and Erk (2004) focused on the neural studies, in order to investigate the effect of reward and motivation factors on behavior. According to them the use of those reward-causing methods in neuromarketing studies cause of reward is an effective factor on decision making. They mentioned that those methods can help to understand which motives drive people to make decision (Walter, et. al., 2004: 377). Similar to this work, Grimes (2006) investigated studies evaluating brain activities for neuropsychological realization and applicability of those methods on neuromarketing (Grimes, 2006).

To Isabella and his colleagues (2015), the use of NM is rising, while the cost of analyses, is slowing down the development of NM related research. It is what that emphasising on it in their study. As another problem they stated slow adaptation of neuro scientific theories on marketing (Isabella, et. al, 2015).

Doing NM research needs some specific tools such as Eye Tracking, EKG (electrocardiogram), EDA (electrodermal activity), f EMG (electromyography), f MRI (magnetic resonance imaging) and EEG (electroencephalography) (Plassman et. al., 2012: 2; Isabella, et. al., 2015). The most frequently used tools (Giriskan, 2015) of them are the following three ones.

EEG:

“EEG is a non-invasive and silent technology directly sensitive to neural activity. The time resolution of the EEG is limited by the hardware, where, typically, a voltage is recorded every 1 to 3 milli-seconds” (Plassman et. al., 2007: 155). It makes use of numerous electrodes attached to the individual's head that recognizes electronic signals which represent current brain activity (Roth,2013: 6). Young's research (2002) showed that advertisements are the first factor to be noticed for brand development and attention. Researchers mostly use EEG for understanding individual's reactions toward TV advertisements (Lee et. al, 2007: 201).

FMRI:

This method makes various studies by scanning display areas of the brain with using high resolution techniques in the fMRI which gives researchers chance to find the relationship between behavior and changes in the brain (Giriskan, 2015: 18). By combining FMRI with the traditional data collection methods, it is possible to develop a new scale to assess personal mental abilities for salespeople and authors (Plassman et al., 2015). A number of fMRI experiments have shown that new insights in marketing activities can change properties such as brand awareness (Plassman et al., 2012).

Eye Tracking:

This method is frequently used in NM research to determine the consumer's eye focus on the target objects and their places (Giriskan, 2015: 16). By using graphs and colors, eye tracking can give some evidence about how long individual gazes at an object and which place the individual looks at. Therefore eye tracking is a frequently use method for designing WEB pages, product packages and shelves (Özdoğan,2008: 135).

Bibliometric Analysis

As Kline (2009, 28) claims, "Knowledge is cumulative", which means that previous scientific work constructs the foundation of new ones. Accordingly, a growing number of scientific researchers, and scholars, who "make sense of what has already been done, capture key lessons learned from the past, and identify directions for the future" (Kilubi, 2016: 3), have widely started to use bibliometric analysis (H. Chen, et. al., 2017; Claveau, 2016; Kirby, 2011; Kumar & Shehbaz Husain Naqvi, 2010; Liao, et. al., 2016; Madani & Weber, 2016; magyar, 1974; windsor, 1976; Zyoud, et. al., 2015). Bibliometric analysis is commonly known because Garfield (1972) (Benckendorff & Zehrer, 2013). He suggested a "Science Citation Index (SCI)", which enabled the systematic quantitative analysis of academic literature (Baykouche-

va & Baykoucheva, 2015). Bibliometric analyses offers a useful tool to represent the available literature in certain a research field. It involves quantitative and visual processes to identify patterns and dynamics in scientific publications (Y. Wang, et. al., 2016). In other words, bibliometric analysis is an effective tool to measure published studies with use of statistical methods to explore qualitative and quantitative changes in a certain scientific filed (D. Chen, Liu, Luo, Webber, & Chen, 2016) and offers helpful information for professionals who try to assess scientific activity (Heradio, Perez-Morago, Fernandez-Amoros, Javier Cabrerizo, & Herrera-Viedma, 2016), and help amateur researchers to find key studies and notable research (Benckendorff & Zehrer, 2013). Time and cost saving and generating more precise results (Bakri & Willett, 2011) are among the important reasons why bibliometric analysis has attracted the attention of scholars. Generally, bibliometric studies include collecting data about authors, journals, countries, institutes, research fields, keywords and citation analysis (Deng, et. al., 2009). More specifically, bibliometric studies can be divided into three groups: (1) review studies, (2) evaluative studies, and (3) relational studies (Koseoglu, et. al., 2016). Review studies are mainly based on “frequency” or “basic statistics” while evaluative studies are used for assessing the “scientific contributions” of published studies, applying the number of cited papers and the total number of citations (Benckendorff & Zehrer, 2013, 126). Relational studies, on the other hand, are seeking to explore the relationships among various constituent parts of published research (Stuart, 2014).

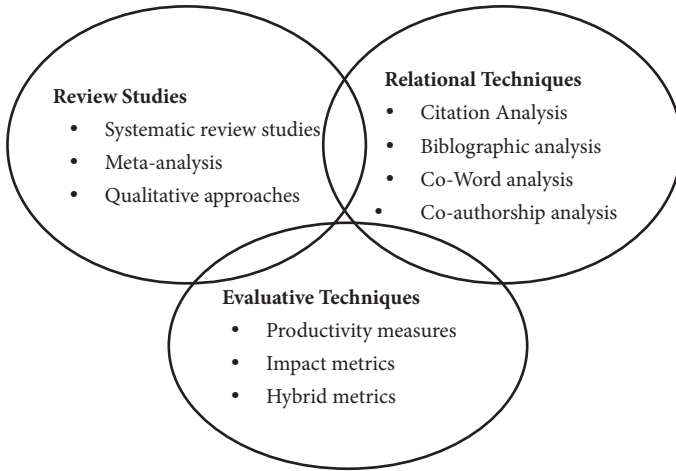


Figure 1: Three types of Bibliometric
(Koseoglu et al., 2016)

Co-authorship and Co-citation analysis are the two most common applied techniques in relational studies (Capone, 2015). In addition, recently co-word analysis also has attracted the attention of scholars (X. Chen, et. al., 2016; Hu & Zhang, 2015; Li, 2016; Topalli & Ivanaj, 2016; Wu & Leu, 2014)(see figure 1). Bibliometric analysis includes six steps(Albort-Morant & Ribeiro-Soriano, 2016):

- 1) Defining the field of study,
- 2) Choosing the database,
- 3) Adjusting the search criteria,
- 4) Compiling the categories of bibliographic information,
- 5) Codifying the material retrieved, and finally,
- 6) Analysing the information.

Methodology

“One of the most comprehensive bibliographic databases”(Keenan, 2016: 543) and “famous scientific citation index databases in the world” *Web of Science* (WOS) (formerly Web of Knowledge) which, was in-

roduced by Thomson (X. Wang, et. al., 2016: 918), was chosen as the database for this study. As a multi-disciplinary database index, scientific publications from 1898 to the present. Web of Science index includes 250 disciplines (Fong & Liu, 2014). In addition, WOS makes available “citations to over 10,000 high-impact journals” (Kimball, 2016: 93) and “over 160,000 international conference proceedings” (WOS, 2017). Web of Science contains a number of citation indexes. Its core collection indexes provides access to six databases, namely: “Science Citation Index Expanded (SCI-EXPANDED) --1980-present”, “Social Sciences Citation Index (SSCI) --1980-present”, “Arts & Humanities Citation Index (A&HCI) --1975-present”, “Conference Proceedings Citation Index-Science (CPCI-S) --1990-present”, “Conference Proceedings Citation Index- Social Science & Humanities (CPCI-SSH) --1990-present”, and “Emerging Sources Citation Index (ESCI) --2015-present”(WOS, 2017). Moreover, Web of Science offers various useful tools, including personalization results, citation report, easy results exportation to reference manager tools (e.g. EndNote& Mendeley), easily save results in different formats, and citation map. Consequently, despite of the emerging alternative databases (e.g. Google scholar and Scopus) Web of Science is still the main choice of scholars for doing bibliometric analysis (Bornmann & Leydesdorff, 2017; Cañas-Guerrero, et. al., 2013; Chang, Lin, Chen, et al., 2016; Chang, Lin, Hwang, et al., 2016; González Sala & Osca Lluch, 2016; J. Purnell & Quevedo-Blasco, 2013; Lin, et. al., 2014; Mohamad & Masrek, 2013; Okhovati, et. al., 2016; Zavadskas, et. al., 2014). After selecting database, by using the following filtering the search was conducted on 5 March 2017:

- Searching limited to: “Web of Science Core Collection”
- Searching keywords limited to “Neuromarketing” as title and topic and “neuroscience brand”, “neuroscience advertising”, “neuroscience packaging”, “neuroscience consumer”, “Eye tracking in marketing”, “Eye tracking consumer”, “EEG marketing”, “EEG advertising”, “EEG consumer”, “fMRI marketing”, “fMRI advertising”, “Eye tracking advertising”, “fMRI consumer” as title.

- 1975-2016 was selected as timespan.
- Citation indexes limited to: science citation index expanded (SCI-expanded) --1980-present, social sciences citation index (SSCI) --1980-present, arts & humanities citation index (A&H-CI) --1975-present, emerging sources citation index (ESCI) --2015-present.

All searches were conducted on 5 March 2017 to avoid bias due to the daily updating on WOS database. The retrieved documents resulted in 351 articles which have published in high indexed journals.

Results

RQ 1: How many neuromarketing articles have been published each year since 1987?

As table 1 shows, although the concept of NM firstly appear in 2001, it is obvious that collaboration between neuroscience and marketing traces back to 1987. The number of published articles in the peer-reviewed journals have grown notability; from 1 paper in 1987 to totally 351 articles in 2017.

Table 1. Number of Neuromarketing Article by Years

Years	Number	Years	Number
2016	83	2006	3
2015	74	2005	2
2014	50	2004	2
2013	32	2003	1
2012	34	2002	1
2011	17	2000	1
2010	22	1999	2
2009	8	1994	2
2008	9	1992	1
2007	6	1987	1
TOTAL			351

RQ 2: What are the highly-cited articles in neuromarketing?

Citation analysis, which can give some information about both how many times a given scientific study is cited and who cited that study (Bakkalbasi, Bauer, Glover, & Wang, 2006), is an important factor to position the study and to explore the influence, impact or quality of a given paper (Garousi & Mäntylä, 2016). Generally, there are both positive and negative opinions about using citation for analysing the impact of academic studies. Supporters believe that there is “the positive correlation between these counts and peer reviews and assessments of publication venues. Critics, on the other hand, claim that citation counting has serious problems or limitations that affect its validity” (Meho & Yang, 2007: 2105). In anyway, citation analysis is playing an important role. Until 2004, WOS was the only database for citation analysis. In 2004 two new citation databases, Scopus and Google Scholar (GS), emerged:

Table 2. Highly-Cited Articles in Neuromarketing

Title	Authors	Source title	Publication Year	Total Citations
Neuroscience, Molecular Biology, and the Childhood Roots of Health Disparities Building a New Framework for Health Promotion and Disease Prevention	Shonkoff, Jack P.; Boyce, W. Thomas; McEwen, Bruce S.	Jama-journal of the american medical association	2009	705
Attention capture and transfer in advertising: Brand, pictorial, and text-size effects	Pieters, R; Wedel, M	Journal of marketing	2004	156
Does In-Store Marketing Work? Effects of the Number and Position of Shelf Facings on Brand Attention and Evaluation at the Point of Purchase	Chandon, Pierre; Hutchinson, J. Wesley; Bradlow, Eric T.; Young, Scott H.	Journal of marketing	2009	127
Visual attention during brand choice: The impact of time pressure and task motivation	Pieters, R; Warlop, L	International journal of research in marketing	1999	118
Eye fixations on advertisements and memory for brands: A model and findings	Wedel, M; Pieters, R	Marketing science	2000	110

What is ‘neuromarketing’? A discussion and agenda for future research	Lee, Nick; Broderick, Amanda J.; Chamberlain, Laura	International journal of psychophysiology	2007	102
An eye-fixation analysis of choice processes for consumer nondurables	RUSSO, JE; LECLERC, F	Journal of consumer research	1994	96
Breaking through the clutter: Benefits of advertisement originality and familiarity for brand attention and memory	Pieters, R; Warlop, L; Wedel, M	Management science	2002	81
Search Dynamics in Consumer Choice under Time Pressure: An Eye-Tracking Study	Reutskaja, Elena; Nagel, Rosemarie; Camerer, Colin F.; Rangel, Antonio	American economic review	2011	77
Front-of-pack nutrition labels. Their effect on attention and choices when consumers have varying goals and time constraints	van Herpen, Erica; van Trijp, Hans C. M.	Appetite	2011	70

However, “the low data quality found in Google Scholar raises questions about its suitability for research evaluation” (Mongeon & Paul-Hus, 2016: 213). Accordingly, recently scholars have started to compare and evaluate these citation databases (Bar-Ilan, 2010; Harzing & Alakangas, 2017; Lateef, et. al., 2016; Martin-Martin, et. al., 2017; Prins, Costas, van Leeuwen, & Wouters, 2016; Walker et al., 2016). The findings of almost all of these attempt are that GS offers wider coverage and WOS and Scopus offer fairly similar outcomes (Harzing & Alakangas, 2016).

The study aimed to address the question of the most cited and thus impactful articles in the field of neuromarketing by using all citations in the core collection of the web of science. As Table 2 shows, the article by Shonkoff, et al, has received the most citations (705), followed by, “*Attention capture and transfer in advertising*” with 156 and “*Does In-Store Marketing Work?*” with 127 ones.

RQ 3: In which journals were the articles related to neuromarketing published most frequently?

Among the 351 articles analysed, there were 212 different journals which have published articles related to neuromarketing. This shows in the rising attention toward neuromarketing related research in different areas. Table 3 listed top 10 journals in terms of the number of publications related to neuromarketing. JOMR (15 articles), FQAP (15 articles), and PTAS (6 articles) took the first three places.

Table 3: Top ten journals in the field of neuromarketing-related publications

Source titles	Records	Source titles	Records
Journal of marketing research	15	Journal of business research	5
Food quality and preference	15	Plos one	5
Packaging technology and science	6	Judgment and decision making	5
Journal of economic psychology	6	Journal of neuroscience psychology and economics	5
Computers in human behavior	6	Journal of consumer psychology	5

RQ 4: How is co-authorship between authors of NM in related articles?

Collaboration is “a purposeful process of working together to plan, create, and solve problems and/or manage activities.” (Meyer, 2016: 3). Based on this, scientific collaboration can be described as “the interaction that takes place within a social context between two or more scientists, which facilitates the sharing of meaning and fulfillment of tasks in relation to a mutually shared goal” (Sonnenwald, 2007: 645). The rising question here is, what drives scholars to would collaborate with others? There are various reasons that drive scholars to collaborate. For example, the rising specialization in science, the complexity of academic subjects and the need to a combination of knowledge and skills to do scientific research (Fonseca, Sampaio, Fonseca, & Zicker, 2016), “costs sharing of conducting the research” (Meyer, 2016: 3), saving time and

accelerating conducting scientific activities and help to more innovative writing. Co-citation and co-authorship are two main tools to do scientific collaboration analysis (Racherla & Hu, 2010). Co-citation is used for “evaluating author’s scholarly activities”. It consists of three analyses, namely; documents, authors, and institutions (Kim, Jeong, & Song, 2016: 954–955). And happens when authors are cited together (Batistič, Černe, & Vogel, 2016). On the other side, co-authorship analysis means exploring the available relationship between scholars whereby important/ productive scholars are identified (Racherla & Hu, 2010).

Due to the multidisciplinary nature of neuromarketing (Lahmiri, 2017; Murphy, Illes, & Reiner, 2008; Oliveira, 2014), the collaboration plays an important role in conducting related studies. The results of co-authorship analysis can approve this. The majority of articles are collaborative research (82.35%). A total of 938 authors wrote or co-authored 351 articles related to neuromarketing. In other techinc design to identify the co-authorship network among authors is VOS viewer. WOS is used in order to extract bibliometric data analysis about authors. This extracted data is imported to Vosviewer and the connections between authors based on their collaboration in writing articles are visualized. As figure 2 shows, Ares and Babiloni are considered the most productive authors with 55 co-authorships, followed by Vecchiato with 45.

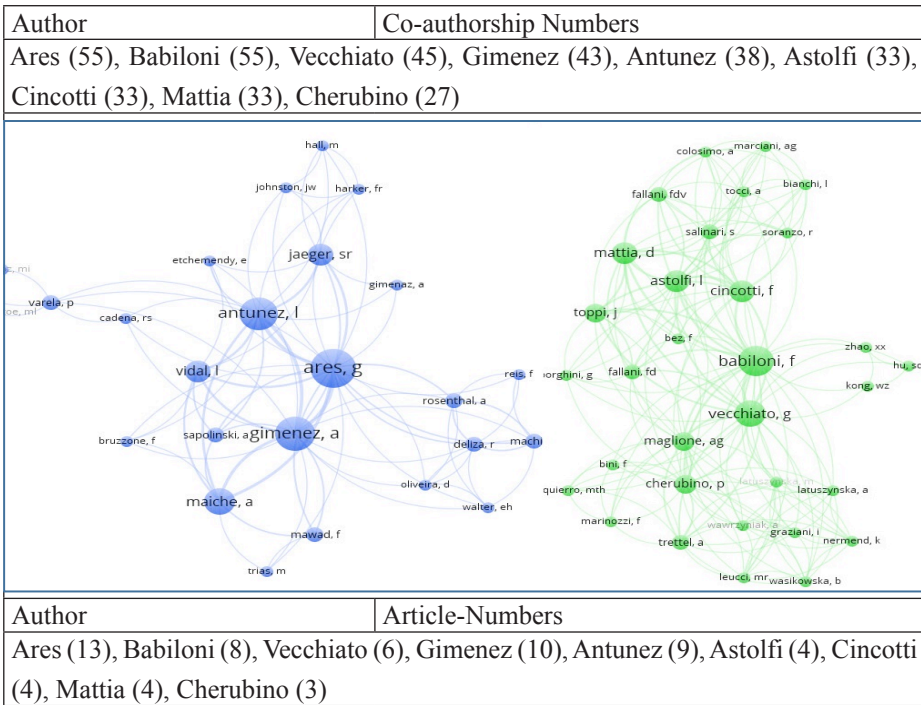


Figure 2. Co-authorship Network

RQ 5: How do different countries rank in terms of number of contributed articles and co-authorships?

From 2005 to 2016, 56 countries around the world have contributed to publish articles related to neuromarketing. As figure 5 shows, the USA is the most productive country with 126 articles, followed by Germany (27), Netherlands (26), and England (25). Moreover, of total 31 countries, 16 countries were from Europe. Based on this fact, it can be said that Europe is the most productive region. By identifying the most productive countries, it is conducted that collaborative analysis of countries are based on their participation with researchers from other countries to produce scientific studies about neuromarketing. As figure 3 indicates, most studies are national collaborative studies, which happen when institutions from one country conduct studies with institutions from in the same country (Shari, Haddow, & Genoni, 2012). In this relation, scholars from USA have been conducted more international collaborative studies.

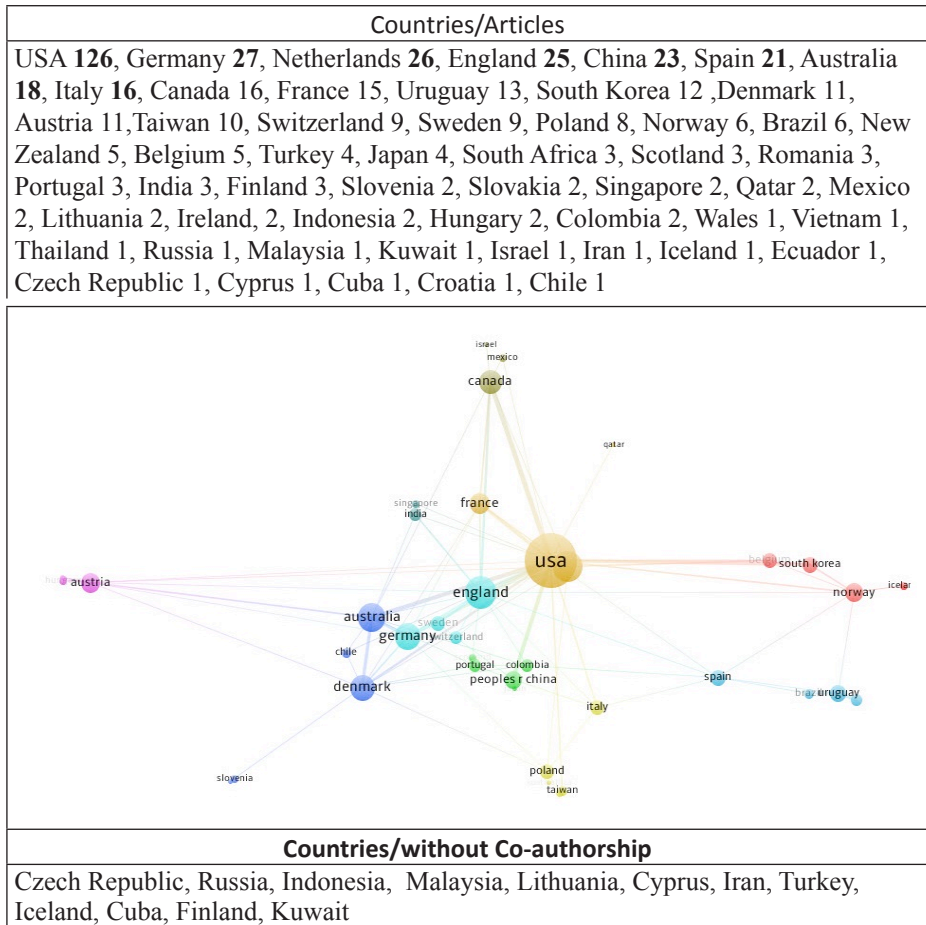


Figure 3. Countries/Co-authorship

RQ 6: What are the most researched keywords in NM studies?
(1527 keywords)

The keyword analysis emphasize on the frequency of keyword usage (Gurtu, Searcy, & Jaber, 2015). Keywords can provide an instant insight into the themes and main idea in a given study. Totally 1527 keywords were retrieved from the chosen 351 articles. Word frequency was counted by the online word frequency counter (www.textfixer.com & www.online-utility.org) and word visualization was conducted by an online word cloud tool called Wordle (www.wordle.net). Results demonstrate

keting (NM), by building a big picture of conducted research and developing guidelines for future studies. Actually, the current study applied bibliometric analyses to review 351 articles which were indexed in web of science in order to explore the number of published articles, high-cited articles, main journals for NM research, contributed countries, co-authorship, and used keywords.

Citation analyses results indicated that the most cited article was “Neuroscience, Molecular Biology, and the Childhood Roots of Health Disparities Building a New Framework for Health Promotion and Disease Prevention” which was published in 2009 and received 705 citations. The study also analyzed journals with the most frequently published articles about NM. The result of this analyses showed that *Journal of Marketing Research* (15), *Food quality and Preference* (15) and *Packaging Technology and Science* (6) were the first three journals in the field of NM. Designing co-authorship network, which was the fourth aim of this study, shows that a total of 938 authors were co-authored, which means 82.35% of articles are collaborative. This finding can be used as an evidence for the multidisciplinary nature of NM research.

Another finding of bibliometric analyses was about the most productive countries. According to the results, the most productive country was the USA (126) among 56 countries which contributed to NM related research, followed by Germany (27), the Netherlands (26), and England (25). It is possible to interpret this situation as a result of easy access to high-tech equipments and close partnership between government, academia and industry.

Keyword analysis was the last research question of this study. Keywords analyses helps to review the research topics, trends, and interests which can be identified as a guide for future research (Leung, Sun and Bai, 2017: 43). In total, 1527 keywords were retrieved from the chosen 351 articles. Eye tracking (129) was the most used keyword, followed by neuromarketing (62), attention (51), neuroscience (27), EEG (23), and fMRI (22). Some reasons that can be assumed for the high

usage of Eye tracking are low cost of devices, and technological development in eye tracking equipments (Wedel and Pieters, 2008: 123).

Future Directions and Limitations

Present study serves as a guide to an understanding of NM. As analyses showed NM has a growing interest by marketers and also NM is a growing research area. As support for the currently used methods, NM will shed light on marketing efforts in particular examining the causes of consumer behavior. For instance, with use of neuroscience features, things that are difficult to identify can become visual such as emotions.

The current study carried out by examining previous research. Researchers collect articles from a single database, web of science. As a natural consequence of this situation, research that is not included in this database is out of scope of current study. This creates a limitation for current study. Marketers can make broader bibliometric analysis. Moreover, researchers should make a meta analyses research of this field.

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