Journal of Theoretical and Applied Information Technology
15th August 2020. Vol.98. No 15

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

RESEARCH TRENDS OF NEUROMARKETING: A BIBLIOMETRIC ANALYSIS

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ABSTRACT

The rising demand for exploring what is inside consumers' brains and the growth of neuroscience stimulated research efforts to explore the subtle centers in the consumer's brain that responsible for making-decisions. Therefore, understanding the essential subjects relevant to neuromarketing is important for expanding collaboration and to push the progression of research towards the desired goals perfectly. In this paper, our goals were to assess the global research trend in neuromarketing field upon on outputs of publication, co-authorships, countries, and co-occurrences. This paper has used the Scopus database to analysis related articles between 2007 and 2018, the result was 137 journal articles. In 2012, the publications' number has increased by about 12 articles each two-year, which led to a steady rise in the sum of the total publications. Approximately 52% of the universal publications were published in the USA, Spain, UK, Italy and Germany leading the other 32 countries/territories.

Keywords: *Neuromarketing, Bibliometric Analysis, Author Keyword Co-Occurrences, Vosviewer, Scopus Database, Web Of Science, Citation Index.*

1. INTRODUCTION

The neuroscience field is too broad a terms, thereby, consumer neuroscience is divided into two categories cognitive and affective neuroscience [1]. Therefore, with the application of neuroimaging technology such as fMRI and EEG in the marketing field, understanding salient emotional reactions on a neurological level has been the focus of neuroscience for close to a decade. But it is only in recent years that consumer behaviour and marketing research has started looking towards neuroscience for answers to salient consumer decision [2], which led to emerging neuromarketing (NM) as a result of the high competition among huge companies in 2002 [3]. Ale Smidt's was the first one who coined 'neuromarketing' in 2002 who defined it as the study of the brain's mechanisms for strategies and practices [4]. As neuromarketing is an interdisciplinary field, situated at the borderline between neuroscience, psychology and economics [4-9], thereby, scholars and practitioners are encouraged to develop various techniques to improve marketing strategies [7, 10-13].

Humans' brain activity is irrational because %80 of buying decisions are made either subconsciously or unconsciously [14]. Unlike traditional marketing, the advantage of neuromarketing is innovation and the ability to obtain new information. Since the brain is not visible to the naked eye, neuromarketing allows to explore subconscious responses and watch brain activity in humans and their reaction to marketing tools that consumers are not aware of by Neuroscientific tools such as fMRI [15].

Although neuromarketing is in its embryonic stage, researchers and companies cannot ignore this upcoming field due to neuromarketing provides more precise information than conventional methods that can shed light on consumers' behaviour in terms of decision making [4, 7, 14, 16-18]. Unlike traditional methods, neuromarketing uses advanced medical equipment, such as fMRI, to explore consumers' thoughts, and the gathered information is meaningful to improve marketing strategies and practices [19, 20]. This paper is considered as a merit paper in neuromarketing bibliometric analysis based on Scopus database.

Although Scopus and WoS databases are associating with each other, for example, index various journals, and sometimes interfere in journals indexing [21, 22]. Scopus is considered as the largest database of abstract and citation which covers a broad range of topics. Therefore, the Scopus database is covering more subjects which perhaps not available in WoS.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

To this end, this study tries to incorporate as many directions as possible. Popular research topics are investigated deeply based on their respective sub-domains to achieve a precise, concrete and concise conclusion. The objectives of this study are summarised as follows: (i) to analyse temporal distribution patterns of NM journal articles; (ii) to display contributions of countries/territories, authors, and the most productive academic institutions; (iii) to shed light on research subjects and popular terms; (iv) to identify the dominant countries in this field based on the Scopus database; and (v) to provide profound insight into future directions. Therefore, This study will be fruitful for individuals, marketing manager, policymakers, and researchers to understand the research trends in NM and to explore the potential and opportunities for future research.

2. METHODS

Bibliometric analysis is a type of research approach to understand the global research trends in a particular field upon on the outputs of the academic publications whether the Scopus or WoS database. Therefore, this type of approach is differentiating between two types of academic research (i.e., review paper and a bibliometric analysis) which primarily discuss the final results of a specific topic.

2.1 Data Source and Search Strategy

Data mining was conducted within October 20 and 28, 2019 using Scopus database. The main topic of this study was research articles which include in the abstract and title "neuro* marketing". Where the oldest publication was in 2007 and the latest publication in 2018 "Figure 2". The code of search was: (TITLE-ABS ("neuro*marketing")) AND (LIMIT-TO (SRCTYPE,"j")) AND (LIMIT-TO (DOCTYPE,"ar")) AND (EXCLUDE (PUBYEAR,2020) OR EXCLUDE (PUBYEAR,2019)). The result of the search led to 137 journal articles. Therefore, to ensure that there was no review article we add some words such as review, recent, highlight and so forth. The finding was 21 articles and after reading abstract and full texts, we identified 16 review articles. EID looks like a footprint in the Scopus database.

It is worth noting that it is considered as the most appropriate method to collect the most precise information about authors' outputs, it uses the own ID of the author. An author profile is considered as the wallet of his/her publications. Data for single-country publication (SCP) was recovered through searching to a specific country by using code as AFFILCOUNTRY. It was analyzed the central topic upon on an author, source, subject area, year, document type, country, and affiliation. This study has used total citation (TC), the total publication (TP), h-index, and CiteScore for ranking goals.

Besides, we also created a sub-theme to explore the output trends in NM study were i) emotion; ii) attention; iii) memory; and iv) campaigns/ advertisement/ advertising. The search chain for each application was run separately. By using prior search chain, specific terminologies were added to it relying on the sort of applications, e.g. ("emotion*") or ("attention*") or ("memory") or (campaign* OR advertis*). The search findings have been analyzed reliant on outputs of publication per year. There are potential changes that two application or more perhaps overlap with each other, thereby, we excluding irrelevant applications, the search concentrate on NM. The process of collecting data for the main theme and sub-theme is summarized in "Figure 1".

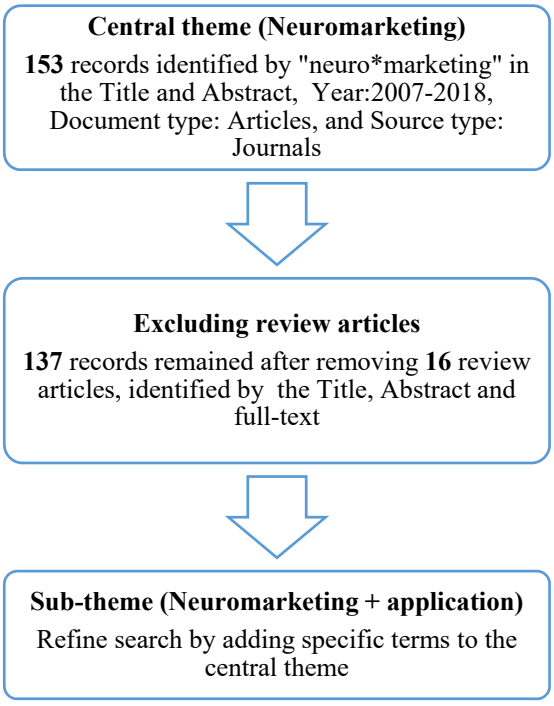

Figure 1: The Number of Publications of the Subject.

It has been summarized the process of collecting data for the main theme and sub-theme in "Figure 1".

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2.2 Bibliometric Maps

Author keywords, citation, and bibliographical data of 137 journal articles exported to VOSviewer programme, it's considered as a software tool which is used to creating the bibliometric maps. We have created maps by VOSviewer programme include items, these items are the goals of interest (i.e., author keywords and countries), sometimes there is a link between these pair items, The stronger link means higher value and expresses about this strength link by the positive numerical value. Whereas the strength co-authorship analysis among countries indicated the number of publications between these countries. While the total strength of the co-authorship which link countries with each other was referred to as the total link strength. in co-occurrence, the number of publications in which two keywords happen together was referred to the link strength between author keywords. For more details about VOSviewer software, it can be found in the user manual [23].

2.2.1 Co-authorship analysis

We have found 37 countries into five continents such as Asia, Europe, Oceania, Africa, and America with 360 authors.

2.2.2 Co-occurrence analysis

We found 403 keywords from 137 journal articles. Before export these keywords to VOSviewer, it has been analyzed the synonymic and congeneric phrases. For example, consumer neuroscience was counted as NM. In VOSviewer, it has identified the minimum occurrences of a keyword and it has chosen an overlay visualization approach to display the average publication a year, link strength of keywords, and the number of occurrences.

2.3 Applications of NM

It has been compared the keyword co-occurrences (central theme) and total publication (sub-theme), for instance, if fMRI is the application, thereby it has been counted keywords occurrences for 'fMRI' and 'MRI' in VOSviwer software, also, we have analyzed these countries which have the largest number of NM articles.

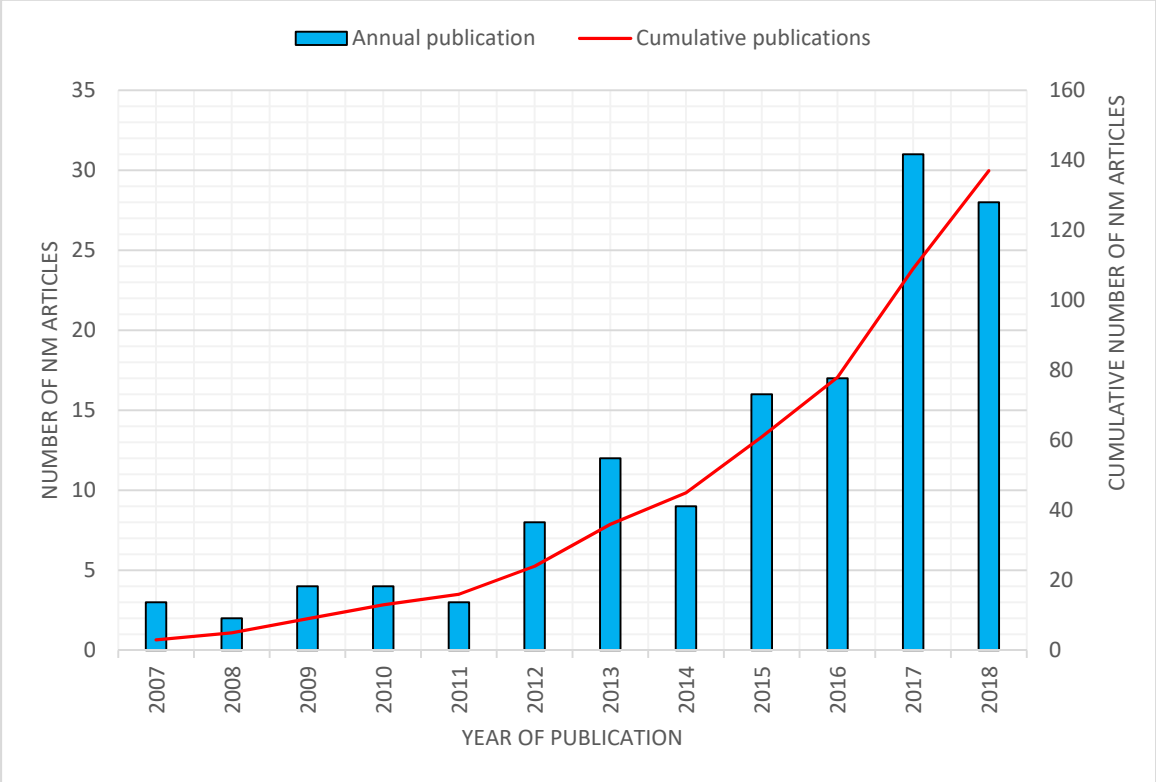

Figure 2: The number of annual and total publications on neuromarketing indexed in Scopus 2007-2018.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

3. RESULTS AND DISCUSSION

3.1 Publication Output and Growth of Research Interest

Over 11 years, 137 journal articles have been published in "Figure 2". The first publication date was in 2007 [24]. As we can observe that from "Figure 2" there is a fluctuation growth in the number of publications between 2007 and 2011 where the publications number between 2 and 4 articles yearly, then after, the interesting of neuromarketing has increased year by year, terms the number of publications by 2013 was reaching approximately four-times as in 2007. Thereafter, the publications have been increased steadily, which result in a quick rise in the cumulative total publications, terms the number of publications reaches the peak in 2018, almost ten-times as in 2013. Therefore, there is a strong interesting in the neuromarketing field. Undoubtedly, it is expected that the publication will rise annually, however, the majority of these publications are not free for researchers. If this article is published in open-access journals, it would potentially receive more citations, where it has published approximately 9 articles (6.6%) in 2018 in open-access.

NM is considered as a multidisciplinary field, where publications were categorized under several journals such as Business Management and Accounting (46 articles, Social Sciences (34 articles), Psychology (22 articles), Neuroscience (18 articles). NM experiments were once given a novelty approach in studying the consumer behaviour toward marketing stimuli which increased the chance to study the distortion of consumer choices.

Findings have shown that 9 various languages that have used in publish articles. English (109 articles; 79.56%) was the most commonly used language followed by Spanish (17 articles; 12.41%), and French (3 articles, 2.19%). Other languages (8 articles; 5.84%) such as German, Italian, Japanese, Persian, Polish, and Romanian. When a publisher submits an article in a foreign language to be indexed in Scopus, the article should have a title and abstract in English.

3.2 Preferred Journals

The results of this study showed that four journals of the top 20 most productive journals are owned by two various publishers (e.g., Emerald and Springer Nature) "Table 1". The Emerald publisher was at the top of publishers which was published articles about neuromarketing, as well as, Emerald publisher ranked the first and fourth position of publisher list. While the Springer Nature publisher ranked eighth and tenth position in the same list. The rest journals were published by several publishers.

The most productive journal was European Journal of Marketing with 4 articles covering 2.9% of the total publications, followed by Espacios with approximately 2.2%, then Journal of Advertising Research by almost 2.2% and BioSocienties (2 articles, 1.5%) which is belonging to Springer Nature journal with 12 total citations and this is not the high number of citations.

According to 2018 report CiteScore, nine journals had two CiteScore and above. Journal of the highest CiteScore belongs to the Journal of Business Research (5.32), and the lowest CiteScore belongs to ILU (0.07). Compared with other journals we found that ILU had the lowest CiteScore and the total citation. This potentially because of the language of the article which is in Spanish.

Moreover, we can understand that CiteScore might impact the author's decisions in selecting journals which are more novel and important. Scopus database uses CiteScore which is considered as the alternative to Impact Factor in the Clarivate Analytics. To save our fellow researchers time to find the journals related to NM, we included the top top 20 CiteScore journals in "Table 1".

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Table 1: The Top 20 most productive journals on NM.

#	Journal	TP (%)	TC	Cite Score 2018	The most cited article (reference)	Times cited	Publisher
1	European Journal of Marketing	4 (2.9%)	16	2.34	Welcome to the jungle! The neuromarketing literature through the eyes of a newcomer [25]	4	Emerald
2	Espacios	3 (2.2%)	2	0.19	Emotional arousal brands. A review of the color associated with stimulation of Logos in the context of neuromarketing [26]	1	Sociacion de Profesionales y Tecnicos del CONICIT
3	Journal of Advertising Research	3 (2.2%)	28	1.94	How reliable are neuromarketers' measures of advertising effectiveness: Data from ongoing research holds no common truth among vendors [27]	14	The Advertising Research Foundation
4	Journal of Consumer Marketing	3 (2.2%)	93	2.17	Neuromarketing: A layman's look at neuroscience and its potential application to marketing practice [28]	48	Emerald
5	Journal of Neuroscience Psychology and Economics	3 (2.2%)	13	1.11	Don't Look Blank, Happy, or Sad: Patterns of Facial Expressions of Speakers in Banks' YouTube Videos Predict Video's Popularity Over Time [29]	5	APA
6	Profesional De La Informacion	3 (2.2%)	11	1.39	Situación del neuromarketing en España [30]	6	EPI SCP
7	Amfiteatru Economic	2 (1.5%)	15	0.86	Ethical responsibility of neuromarketing companies in harnessing the market research - A global exploratory approach [31]	15	Academy of Economic Studies
8	Biosocieties	2 (1.5%)	12	2.40	Measurement devices and the psychophysiology of consumer behaviour: A posthuman genealogy of neuromarketing [32]	3	Springer Nature
9	Cogent Psychology	2 (1.5%)	3	0.95	Conducting neuromarketing studies ethically-practitioner perspectives [33]	2	Cogent OA
10	Cognitive Neurodynamics	2 (1.5%)	30	3.22	Electronic evaluation for video commercials by impression index [34]	13	Springer Nature

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11	Comunicar	2 (1.5%)	8	2.79	Neuroscience for content innovation on European public service broadcasters [35]	3	Grupo Comunicar, Colectivo Andaluz de Educacion en Medios de Comunicacion
12	Consumption Markets and Culture	2 (1.5%)	37	2.49	Technologies of ironic revelation: Enacting consumers in neuromarkets [36]	23	Taylor & Francis
13	Frontiers in Neuroscience	2 (1.5%)	42	3.99	Fusion of electroencephalographic dynamics and musical contents for estimating emotional responses in music listening [37]	31	Frontiers Media S.A.
14	Historia Y Comunicaion Social	2 (1.5%)	4	0.29	Research on viewers' attention while watching television: Latest developments and future challenges [38]	2	Universidad Complutense de Madrid
15	IEEE Pulse	2 (1.5%)	34	0.60	Understanding the impact of TV commercials: Electrical neuroimaging [39]	17	IEEE
16	Ilu	2 (1.5%)	0	0.07	Music persuasion in audio-visual marketing. the example of Coca-Cola [40].	0	Servicio de Publicaciones, Universidad Complutense
17	International Journal of Market Research	2 (1.5%)	7	0.69	Scientific realism: What 'neuromarketing' can and can't tell us about consumers [9].	7	N T C Publications Ltd.
18	International Journal of Mechanical Engineering and Technology	2 (1.5%)	0	2.13	Neuromarketing compulsive hoarding [41].	0	IAEME Publication
19	Journal of Advanced Computational Intelligence and Intelligent Informatics	2 (1.5%)	2	0.42	Computer-generated emotional face retrieval with P300 signals of multiple subjects [42].	2	Fuji Technology I
20	Journal of Business Research	2 (1.5%)	15	5.32	Empathy can increase customer equity related to pro-social brands [43].	1	Elsevier

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3.3 Countries, Institutions, and Global Collaboration

The top 20 most productive countries which contribute to rising NM research worldwide were shown in "Figure 3". The USA, Spain and the UK were the key players in the progress of NM research which published approximately 38% of the global publications. Where the USA has published 22 articles in various journals, covering16.1% of the total global articles, Spain was in the second rank with 17 articles. Although the total publications (TPI) from Universidade de Vigo was slightly lower than the Villanova School of Business. In addition, Niagara University, Drexel University, and Indiana University have been considered as the most productive academic institution in the USA with 2 articles for each institution respectively. We also included the top 20 most productive institutions relied on the publications number of NM in "Figure 3". This "Figure 3" involves academic and non-academic institutions. According to Scopus database, based on the top 20 most productive academic institutions and countries in NM articles, there are several countries such as Turkey, India, Colombia, France, Lithuania and Malaysia with 100% single-country publications (SCP). Next, Spain, Japan, Romania and Brazil had more than 80% SCP, which refer to a strong collaboration in these countries. On the opposite side of the spectrum, Denmark was the country of at least SCP with approximately 33.3%, where one article out of three publications was connected to different countries. The pros of global cooperation are not limited to the widening network, exchanging information and sharing experiences, but also an effective and efficient strategy for ranking up. Although Denmark is being a small country, it published 2 articles, the percentage of global cooperation articles approximately 66.7% which affiliated with the USA, where Denmark ranked in 17th productive country.

Rank	Country	TPC	SCR(%)	The most productive academic institution	TPI	Rank	Country	TPC	SCR(%)	The most productive academic institution	TPI
1	USA	22	50.0	Villanova School of Business	2	11	Canada	4	75.0	INRS- Energy, Materials and Telecommunications	1
2	Spain	17	94.1	Universidade de Vigo	3	12	India	4	100	University of Madras	1
3	UK	13	61.5	Aston Business School	3	13	Poland	4	75.0	University of Economics and Innovation	1
4	Italy	12	75.0	Universita degli Studi di Roma La Sapienza	6	14	Taiwan	4	75.0	Ming Hsin University of Science and Technology	2
5	Germany	7	57.1	Zeppelin University	2	15	Australia	3	66.7	Murdoch University	1
6	Japan	7	85.7	University of Toyama	2	16	Colombia	3	100	Funlam Sede Medellin	1
7	Romania	6	83.3	Bucharest University of Economic Studies	3	17	Denmark	3	33.3	Copenhagen Business School	3
8	Brazil	5	80.0	Universidade de Sao Paulo	2	18	France	3	100	Fondation FondaMental	1
9	China	5	00.0	Hangzhou Dianzi University	3	19	Lithuania	3	100	Vytautas Magnus University	3
10	Turkey	5	100	Middle East Technical University	2	20	Malaysia	3	100	Universiti Malaysia Sabah	2

Figure 3: The Top 20 Most Productive Countries And Academic Institutions in NM Publications.
TPC: total publications by country; TPI: total publication by an academic institution; SCP: single-country publications.

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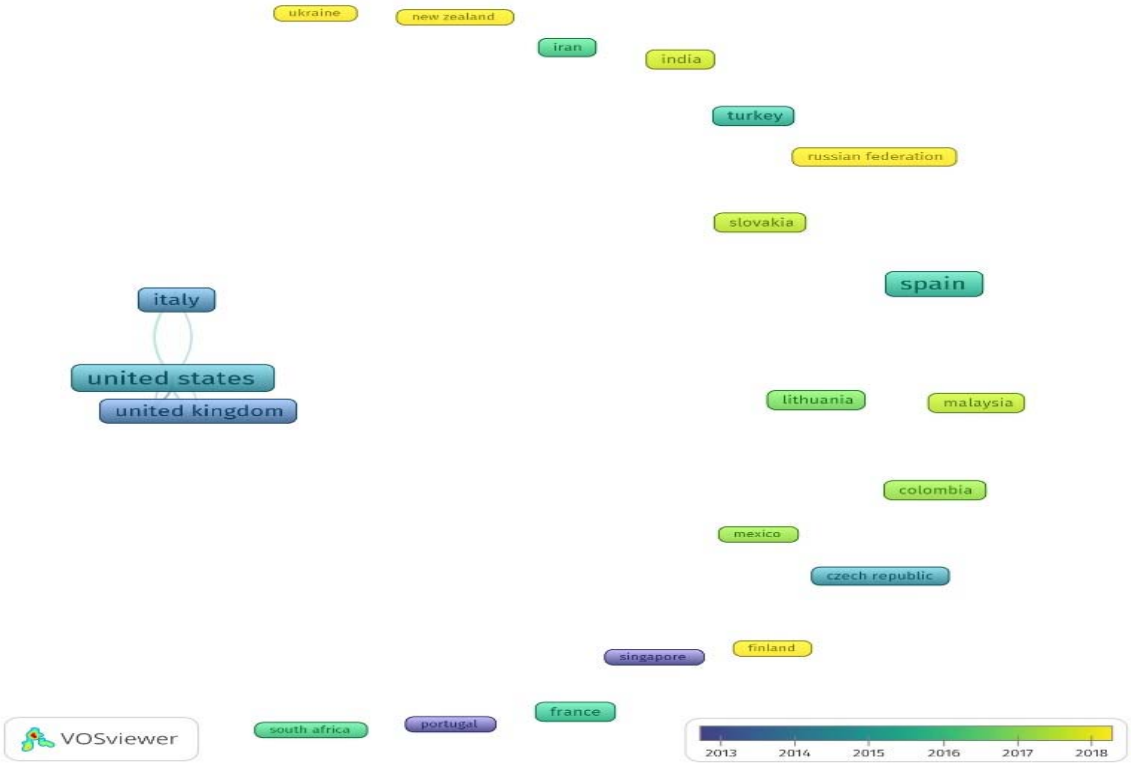

Figure 4: Bibliometric Map of Co-authorship.

3.4 Leading Authors

"Table 2" lists the 20 most prolific authors in neuromarketing, affiliated to eleven countries as follows; Italy (8 authors), UK and Lithuania side by side with (2 authors) for each one, USA, France, and so forth until the end of "Table 2" with (1 author) for each one. The first publication ranged between 2007 and 2017 year in which were 7 authors as the first author, 5 as the second author, and 8 as co-author. The affiliations of the authors showed that neuromarketing research was within fields related to neuroscience, psychology, mathematics, medicine and decision science.

Babiloni, F. from Italy led the list with a record of 5 publications since 2008, 4 h-index, and 141 times citations. The 2nd author, Vecchiato, G is affiliated with the Consiglio Nazionale Delle Ricerche, the 3rd and 4th top authors, Chamberlain, L. and Lee, N. are both affiliated with Warwick Business School. Since then, authors who belong to Universita Degli Studi di Roma La Sapienza have a brilliant ranked in the 20 most prolific authors list, terms Astolfi, L., Cincotti, F., and Maglione, A.G. ranked 5th, 6th, and 11th consecutively, including, the 1st author (Babiloni, F.). Therefore, we can observe that the majority of authors in the neuromarketing field belongs to Universita Degli Studi di Roma La Sapienza. It should be noted that the authors for the most cited articles listed in "Table 1" do not necessarily appear in "Table 2" Their names would only be found in both tables if they had published prolifically such as authors Babiloni, F., Chamberlain, L. and Lee, N.

3.5 Author Keywords

Where a total of 403 author keywords was recorded based on mapping in VOSviewer.

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Table 2: List of the 20 most prolific authors in Neuromarketing research.

#	Author	Scopus Author ID	Year of 1st Publication*	TP	h-index	TC	Affiliation	Country
1	Babiloni, F.	7006787992	2008[c]	5	4	141	Università degli Studi di Roma La Sapienza	Italy
2	Vecchiato, G.	30567911800	2010[a]	5	4	106	Consiglio Nazionale delle Ricerche	Italy
3	Chamberlain, L.	15764302300	2007[c]	4	4	340	Warwick Business School	UK
4	Lee, N.	18037701400	2007[a]	4	4	340	Warwick Business School	UK
5	Astolfi, L.	6603156928	2008[a]	3	3	91	Università degli Studi di Roma La Sapienza	Italy
6	Cincotti, F.	7003991802	2008[c]	3	3	91	Università degli Studi di Roma La Sapienza	Italy
7	Crespo-Pereira, V.	57192107316	2016[a]	3	2	9	Pontificia Universidad Catolica del Ecuador	Ecuador
8	De Vico Fallani, F.	23388121000	2008[b]	3	3	91	Institut du Cerveau et de la Moelle Épinière	France
9	Grigaliunaite, V.	56442732900	2016[a]	3	2	7	Vytautas Magnus university	Lithuania
10	Kong, W.	12804023400	2012[b]	3	2	46	Hangzhou Dianzi University	China
11	Maglione, A.G.	35318192300	2012[c]	3	3	62	Università degli Studi di Roma La Sapienza	Italy
12	Mattia, D.	7003828922	2008[c]	3	3	91	IRCCS Fondazione Santa Lucia	Italy
13	Pileliene, L.	56442735300	2016[b]	3	2	7	Vytautas Magnus university	Lithuania
14	Barreda Angeles, M.	56013169300	2013[a]	2	1	2	Eurecat, Technology Centre of Catalonia	Spain
15	Cherubino, P.	54894299700	2012[c]	2	2	36	BrainSigns Srl	Italy
16	Chew, L.H.	56941524600	2016[a]	2	1	12	Universiti Malaysia Sabah	Malaysia
17	Ciceri, A.	55561284400	2017[c]	2	2	12	Universita IULM	Italy
18	Dabija, D.C.	33567775800	2014[b]	2	1	15	Universitatea Babes-Bolyai din Cluj-Napoca	Romania
19	Gaines, J.	55225148700	2008[b]	2	2	95	Brenau University	Germany
20	Hill, R.P.	7404752922	2008[c]	2	2	95	American University	USA

*Role in co-authorship, superscripts.

[a] First author.

[b] Second author.

[c] Co-author.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

3.5.1 Terminology and concept

Our results showed that 'NM' was the most frequently encountered keyword with 68 occurrences and 218 links to other keywords "Figure 5". We also came across the use of general terms such as 'consumer neuroscience' (6 occurrences, 22 links), 'advertising' (9 occurrences, 34 links), 'marketing' (12 occurrences, 52 links) and 'neuroscience' (16 occurrences, 73 links). neuromarketing was also seen co-occurred with conceptual keywords including 'fMRI', 'EEG', 'eye-tracking', 'emotion', 'memory', 'attention', 'advertising', and 'consumer neuroscience'. Besides, we noticed several features, mechanism, and configuration, were used in naming the neuromarketing. It is also interesting to see how a particular term is established. For instance, Ale Smidts [3, 44] was the first one who coined the neuromarketing word, and he defined it as the study of the brain's mechanisms to understand consumer behaviour to optimise the marketing strategies [44, 45]. Then it has been popularized by European research groups consistently. Consequently, the term is widely used in many publications related to the NM which related to the brand, emotion and the consumer's brain responses.

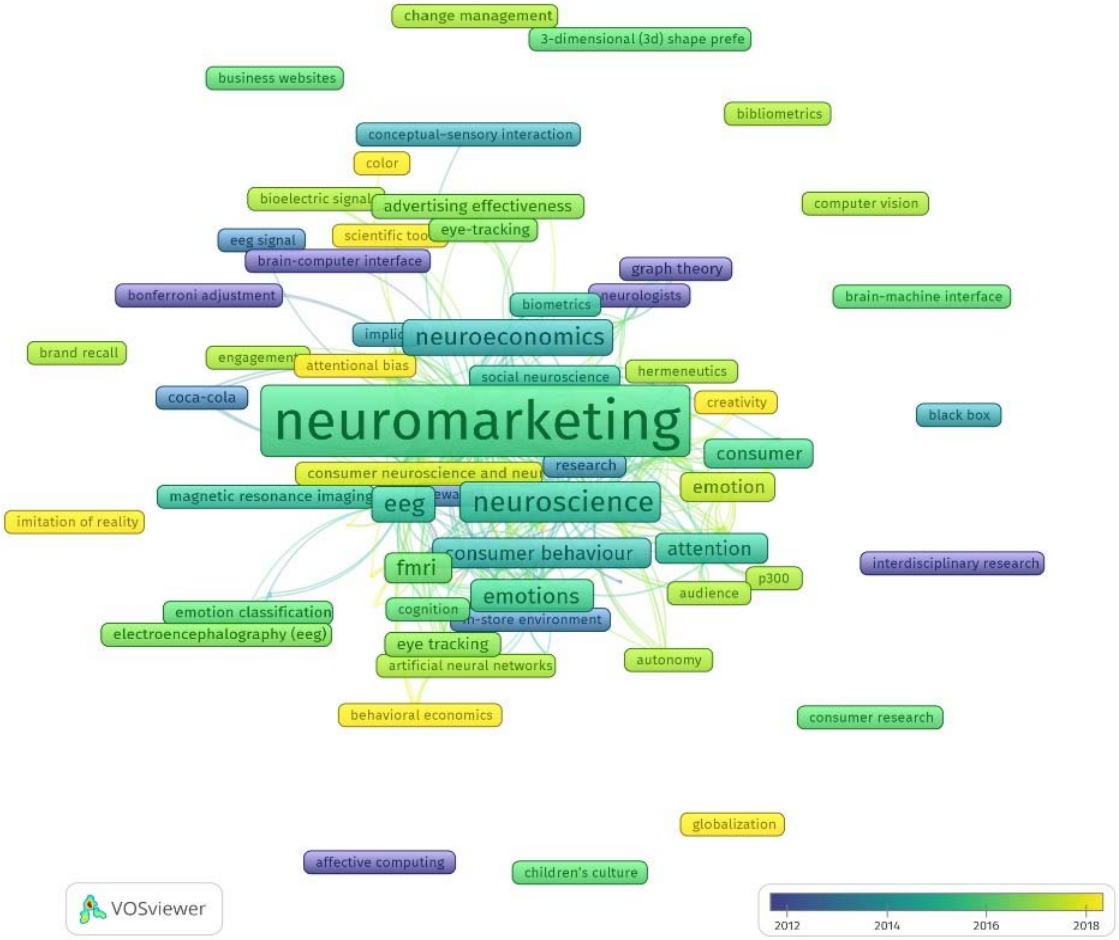

Figure 5: Bibliometric Map Created Based On Author Keywords Co-Occurrence. Minimum Occurrences Of A Keyword Are Set To One.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

3.5.2 Topics of interest

As an evolving technology, NM is often evaluated by consumer neuroscience. In NM research, selection of substrates, reactor components, and operational conditions are among the key's parameters. In comparison to many neuromarketing sources (substrates), 'emotion' appeared the most by 4 occurrences. The emotion originated from multiple sources, including the limbic brain, and cognitive. Even before fMRI is featured, several companies and organisations used electroencephalography (EEG) [7, 11]. In neuromarketing, a fully developed fMRI is essential to measure subtle cortical activity regions in the consumer's brain toward marketing stimuli. The keywords 'fMRI' appeared 10 times, 'EEG' has appeared 10 times also, 'SST' appeared once, 'GSR' has appeared once also. Although marketing is important, excessive growth of aggressive competition lead to discovering new methods to study consumer behaviour and making-decision accurately, which led to emerged neuromarketing field [6, 46].

Although neuromarketing is in its embryonic stage, researchers and companies cannot ignore this upcoming field. Neuromarketing provides more precise information than conventional methods that can shed light on consumers' behaviour in terms of decision making [4, 7, 14, 16-18]. Keywords associated with neuromarketing such as 'decision making' and 'consumer behaviour' have appeared 7 and 11 times respectively. The expensive maintenance requirement of the fMRI method has led to reducing neuromarketing researches, but with sophisticated technology, the scientists expect cheaper techniques in future [6, 47].

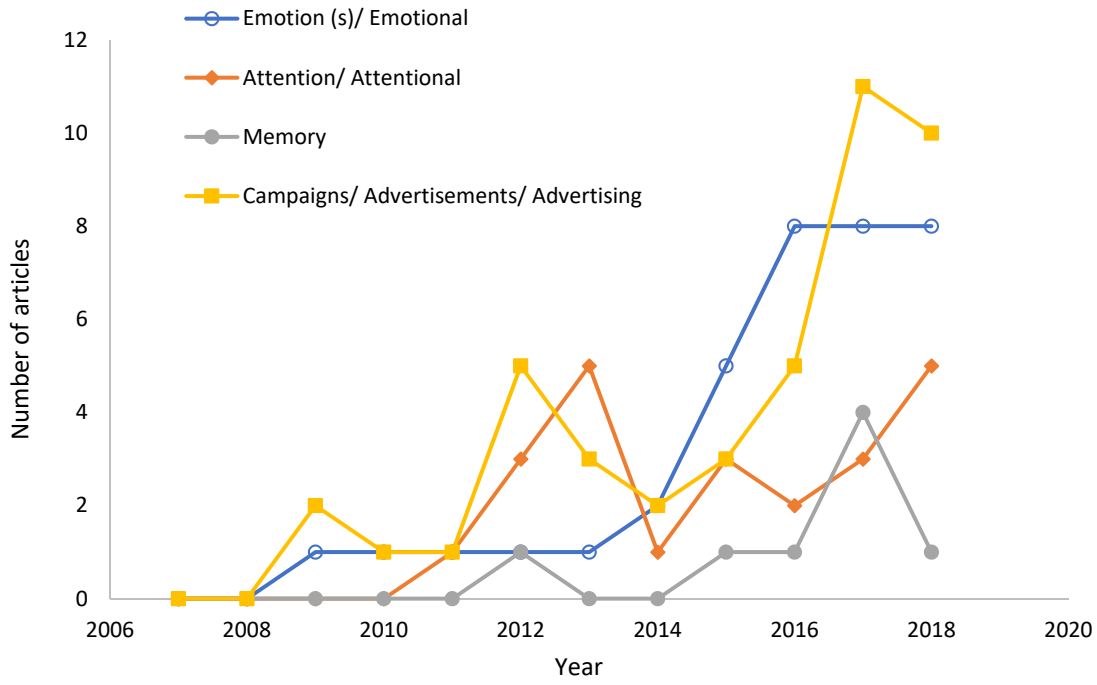

Figure 6: The Selected Major Application In Neuromarketing.

3.6 Distribution of NM Publications Based on Major Applications

There were positive links between the sub-theme and the central theme search based on the number of articles and author keyword occurrences. "Figure 6" shows that campaigns/advertisements/ advertising (search phrase: ("neuro*marketing" AND (campaign* OR advertis*))) was the most popular application with 43 articles in Scopus and 120 occurrences in VOSviewer. This was followed by emotion/emotions/emotional (search phrase: ("neuro*marketing" AND ("emotion*"))) with 36 articles and 128 occurrences, attention/ attentional with 23 articles and 86 occurrences and memory with 8 articles and 32 occurrences. NM was not connected with purposes other than emotion and campaigns before 2009. Articles attributed to

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

attention were published from 2011 until nowadays. But the first article of memory was in 2012 then stopped for two years before starting again. Researchers have realized that purchasing decision is not the only goal but using the benefits of NM to understand the consumers' brain responses toward marketing stimuli.

Moreover, research attention in certain zones can also be analysed by the connection strength of two keywords. For example, 'emotion' had 24 links (i.e. connected to 24 other keywords), namely, 'memory', 'advertising', and 'market research'. It is suggested that research interest on memory and advertising were stronger than market research where they compared as shown by the link strength which was 2 and 1 respectively. We found that most articles associated with the emotion/emotional/emotions, attention/ attentional, memory, and campaigns/advertisements/advertising came from Italy with Spain being the second "Figure 7". As well, the USA, the UK, Japan, Germany, Columbia, Poland, and Australia were among the top five countries publishing articles on each NM application. Other countries such as Malaysia, Turkey, China and Brazil were included in different applications of NM.

3.7 Limitation of the Study

By selecting the abstract and titles to restrict the search of "neuro*marketing", the result perhaps does not cover all NM studies which available on Scopus. Due to several authors had not referred to their articles as NM, but instead used various terminology such as neuroscience, consumer neuroscience and so forth. It is important to conduct studies in future to compare the outputs of the Scopus database and Web of Science. Where the most popular articles have been displayed automatically in Web of Science by feature namely 'hot paper', which is missed in the Scopus database.

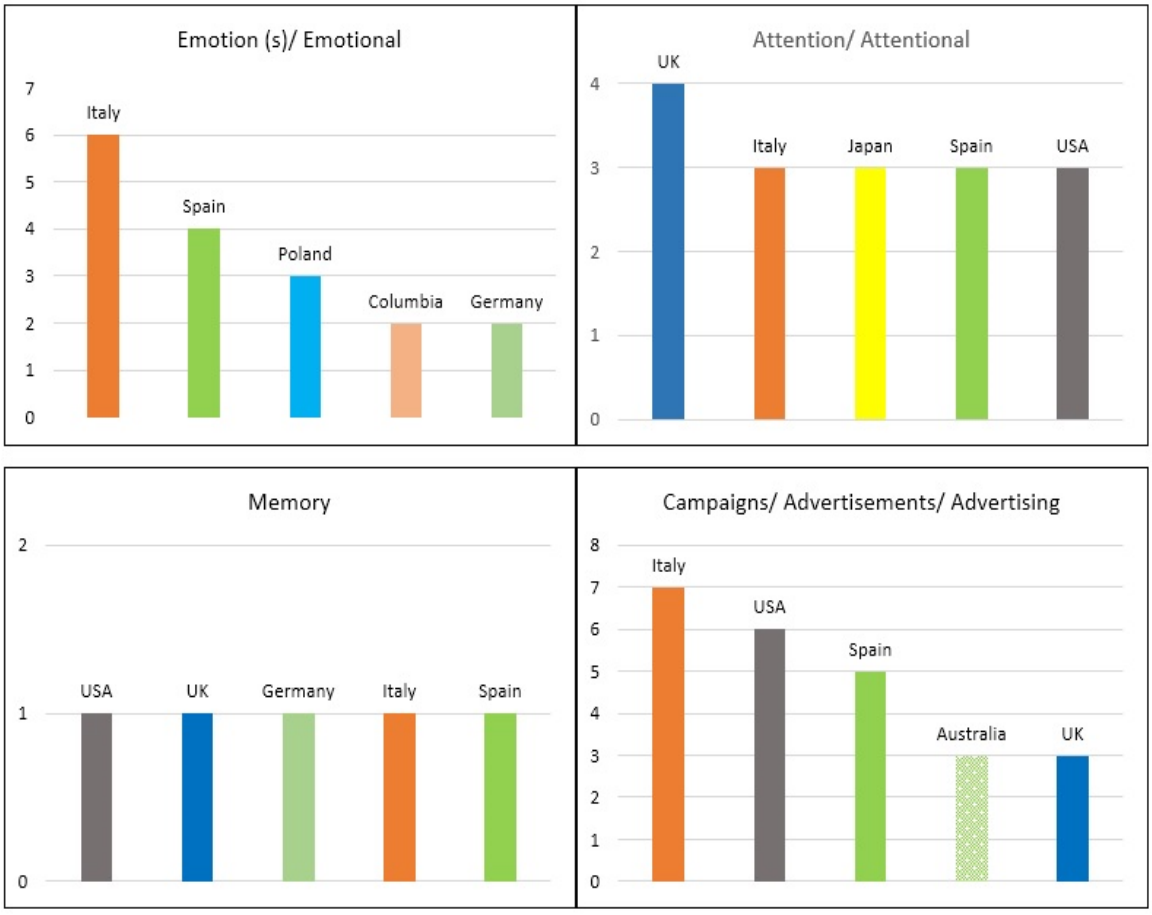

Figure 7: Five Countries With The Most Publications On The Selected NM Major Applications.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

4. CONCLUSION

This study provided an overview of NM research and the number of publications, where the result was 137 journal articles retrieved from Scopus database. Obviously, the number of publications had quickly growth since the last decade, and it is forecasted to increase continuously. We have explored academic institutions based on countries and we found that Italy and Spain have a high. number of articles and highly cooperation. It can be an opportunity for several researchers from countries such as Malaysia and Columbia to expand their cooperations. We have discussed a few areas newly investigated with NM (e.g., advertising/ Campaigns) which can potentially be got subjects for studies in future. Not to mention, the constant efforts to find low-cost tools which are non-harm and available easily.

ACKNOWLEDGEMENT:

The authors would like to thank Azman Hashim International Business School (AHIBS) for supported this study

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