Application of Neuromarketing: Scientific mapping and bibliometric analysis

[1]**Arpit Singhmar,** [2]**Abhishek Kumar Singh,** [3]**Purva Mittal,** [4]**Dr. Lokesh Jindal,** [5]**Prof. Arvind Kuma**r

[1]Ph.D Scholar, Jawaharlal Nehru University, New Mehrauli Road, JNU Ring Rd, New Delhi, 110067, Email ID: arpit42_sme@jnu.in;

[2]Ph.D Scholar, Jawaharlal Nehru University, New Mehrauli Road, JNU Ring Rd, New Delhi, 110067, Email ID: abhish12_sme@jnu.in;

[3]Ph.D Scholar, Faculty of Management Studies, North Campus, University of Delhi, Delhi - 110007, Email ID: purva.m15@gmail.com;

[4]Dr. Lokesh Jindal, Associate Professor, Jawaharlal Nehru University, New Mehrauli Road, JNU Ring Rd, New Delhi, 110067, Email ID: lokeshjindal@jnu.ac.in;

[5]Dr Arvind Kumar, Professor, Jawaharlal Nehru University, New Mehrauli Road, JNU Ring Rd, New Delhi, 110067, Email ID: prof.kumar.arvind@gmail.com

Corresponding Author: [1]Ph.D Scholar, Jawaharlal Nehru University, New Mehrauli Road, JNU Ring Rd, New Delhi, 110067, Email ID: arpit42_sme@jnu.in;

Introduction

The notion that all human feelings, thoughts, and actions—even consciousness itself—are simply the byproducts of neuronal activity in the brain is known as the astounding hypothesis, according to Nobel laureate Francis Crick. The promise of this theory for marketers is that it can lessen the ambiguity and guesswork that have previously hampered efforts to understand consumer behaviour. In order to forecast and possibly even influence consumer behaviour and decision-making, the field of neuromarketing, also referred to as consumer neuroscience, analyses the brain. Neuromarketing, which was up until recently thought of as an extravagant "frontier science," has been strengthened over the recent five years by a number of ground-breaking research that show it has the ability to benefit marketers. The term "neuromarketing" is used colloquially to describe the measurement of physiological and neural signals to obtain knowledge of customers' underlying motives, desires, and choices. This information can then be used to inform product development, pricing, and other marketing areas as well as creative advertising. The two most popular techniques for measuring are brain scanning, that analyzes neural activity, and physiological tracking, which monitors eye movement and other proxies for that activity.

Neuromarketing (NM) involves the use of neuroimaging and physiological tools to document the neural correlates of consumers' behaviour toward different types of marketing stimuli such as brands and advertisements.

The purpose of this study is to present the current tools used in empirical research over the last 16 years. To select empirical and review papers that used NM tools in the last five years, we used the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) framework and a bibliometric analysis. To answer our research questions, we extracted and

analysed twenty-four documents from the Scopus and WOS database. In order to be able to understand the evolution of neuro marketing, analysing the progress, the fields of progress and the relevant advantages of the same in the marketing domain will be the problems we are looking at in this study.

Keywords: neuromarketing; consumer neuroscience; consumer behavior; scientific mapping; bibliometrics; systematic review.

Objectives of the study:

The primary goal of this study is to provide the current status of the research advances in financial literacy and well-being with the help of the research Meta-Data from the top-tier journals over the past two decades. The following questions have been put for defining the study's scope:

RQ1. What are the publication trends from 2006 to 2022 in the discipline of Neuro-marketing and subjects covered?

RQ2. Who are the most relevant authors, Sources (Journals on Scopus, WOS), most productive countries publishing the studies in the concerned field?

RQ3. What is the intellectual structure (Co-occurrence, Co-authorship, and Co-citation) in Neuro-marketing and its practice in the marketing domain?

RQ4. What are the contemporary topics being researched in the discipline of Neuro-marketing and its employability in the marketing domain?

RQ5. What is the progression of the application of Neuro-marketing in the field of marketing and consumer behavior and their applications from a marketing perspective?

Methodology

The study aims to showcase the development in the literature on Neuromarketing and its employability into the marketing practices. The research advancement in the field has been studied for the past 16 years, from 2006–2022, in the top-tier journals indexed on the Scopus database by Clarivate analytics. The decision of taking data from Scopus has been taken in accordance with other bibliometric study on Neuromarketing (*Neuromarketing Research in the Last Five Years: A Bibliometric Analysis*, Ahmed H. Alsharif et. al. 2021) and Scopus has the greatest number of Journals on the topic Neuromarketing. A quantitative bibliometric analysis along with the scientific mapping analysis (SMA) has been done for this purpose. A search query based on the requirement of the study was entered into the database, and the results were filtered based on the actual requirements of the analysis.

Analysis method

The present study used bibliometric and SMA, as well as network analysis, to analyze existing literature on neuromarketing and its employability in the marketing domain. The methodological flow of the study is divided into five steps which are based on the recommendations of Aria and Cuccurullo (2017); Firdaus et al. (2019).

The methodological flow ranges from designing the study to visualization and interpretation of the finding.

1. Study Design: The research questions are defined to set a foundation for the bibliometric analysis of the literature and further for Scientific Mapping Analysis for the same.

2. Data collection: Meta-Data from the top-tier journals have been first identified based on the search query, and subsequently, the results are narrowed down using filters of Document type, language, and categories. 3. Data analysis: Biblioshiny application of the Bibliometrix package of the R studio is primarily used for the bibliometric analyses. 4. Data Visualization: Social networks among Top authors (Collaboration), Cooccurrence networks for the identification of various thematic clusters, and Citation network of various studies for creating the visual map of the clusters of citations among different documents using bibliographic coupling has been created using the orange software.

5. Interpretation: The interpretation of the research findings has been discussed in the conclusion section of the study. This methodological flow is the most suggested methodology for synthesizing current studies and is highly respected when determining the research gap.

Data inclusion:

In order to be able to execute comprehensive analysis on the subject "Neuromarketing" was entered in the Title with the Area as Business, Management and Accounting. The records eliminated from our study were 6 in number because they were not directly related to the subject of interest instead the term neuromarketing was just mentioned in the same. As a result,
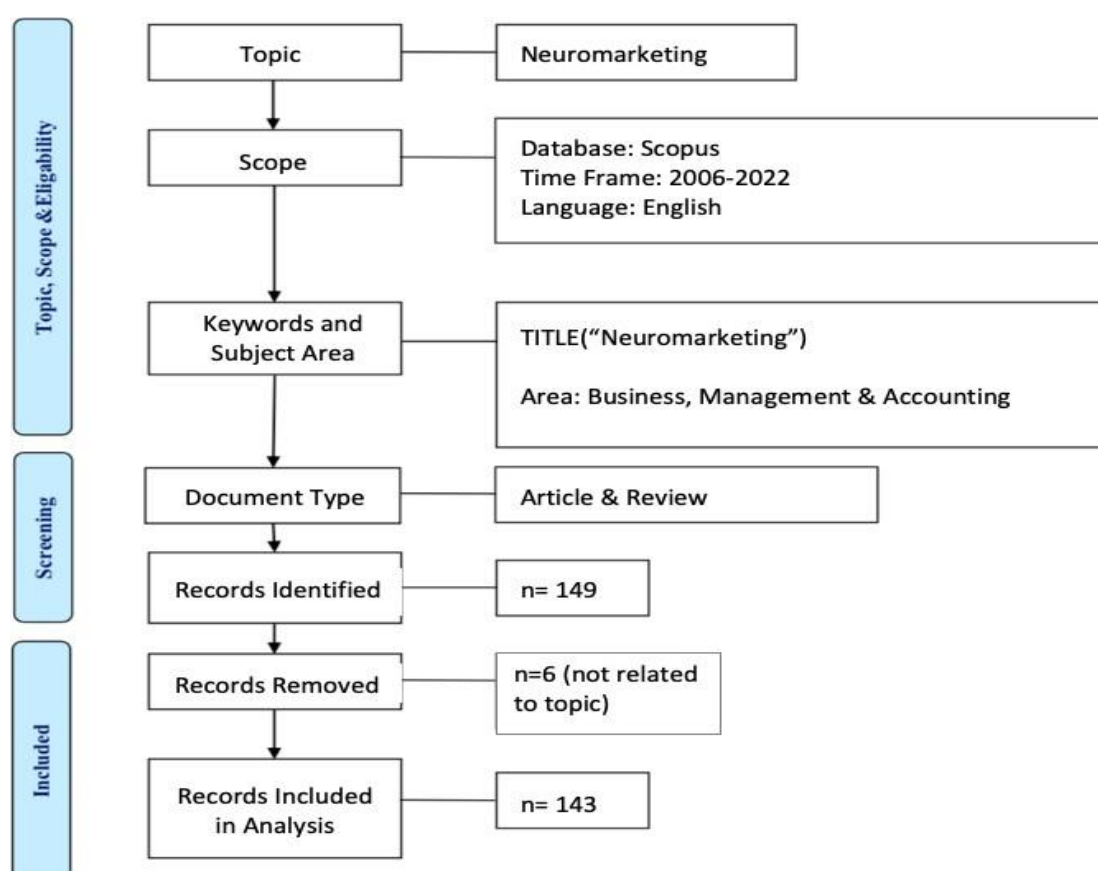
in the end the shortlisted records were 143 in total.

Results and discussion:

The time span considered for the study includes 2006 to 2022 in order to be able to execute comprehensive analysis on the subject involving every single study on the subject of interest. As you can see from the table mentioned below on an average the citation per document is above 20 which indicates cumulative knowledge on the subject complimenting each study.

Table 1. Main information

| MAIN INFORMATION ABOUT DATA	
Timespan	2006:2022
Sources (Journals, Books, etc)	95
Documents	143
Annual Growth Rate %	18.92
Document Average Age	5.43
Average citations per doc	21.11
References	7971
DOCUMENT CONTENTS	
Keywords Plus (ID)	157
Author's Keywords (DE)	387
AUTHORS	
Authors	392
Authors of single-authored docs	23
AUTHORS COLLABORATION	
Single-authored docs	24
Co-Authors per Doc	3.06
International co-authorships %	22.38
DOCUMENT TYPES	
article	134
review	9

Annual scientific production

Citations include the cumulative learning on the subject which have seen a monumental rise in the recent years 2014 to be specific as more companies are willing to accept the use of the same in creating effective marketing stimuli, this subject is becoming more relevant due to the objective results obtained in the same.

3

Annual Scientific Production
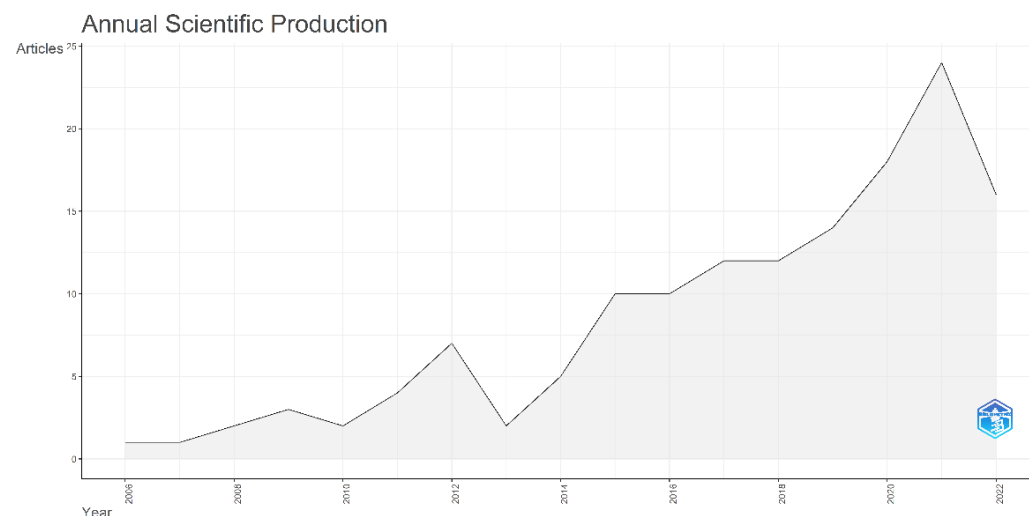
Average citation per year

Average citation in terms of articles as you can see is peaking in 2022, which implies the study on the subject is more relevant to the marketing domain now than ever and it will increase as we move forward as the technology becomes more accessible and the depth of the subject is explored.


Average Article Citations per Year
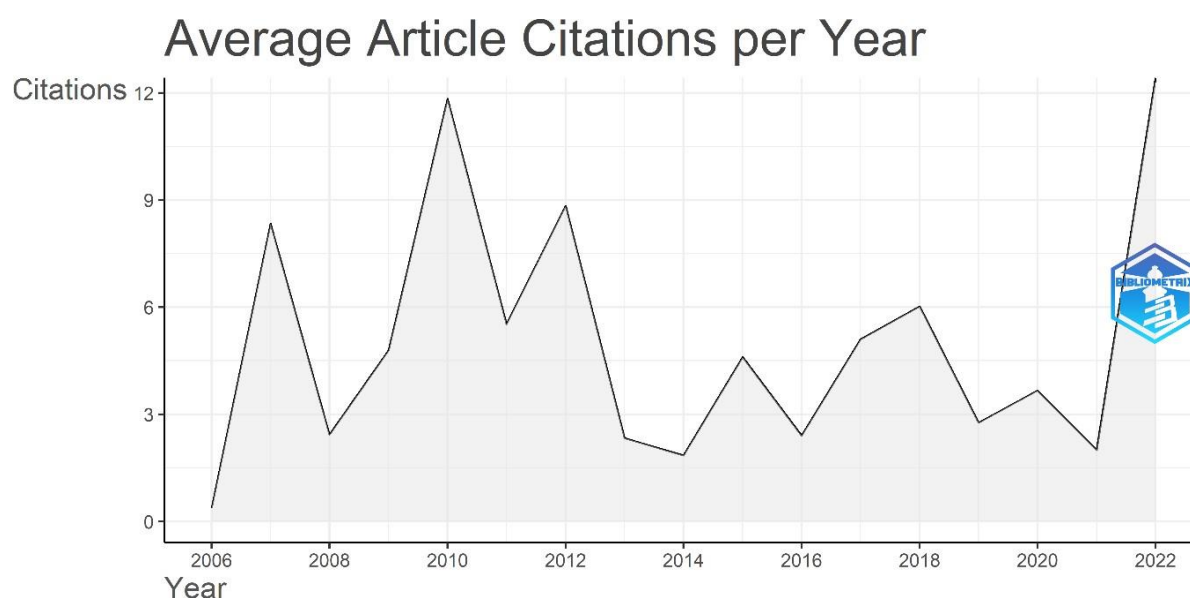
Three field Plot

The three-field plot constructed involves Keywords Plus on the left, Authors in the middle and sources on the left in order to understand the major subjects by the authors contributing the most on the subject in correspondence to the journals they were published in.

3
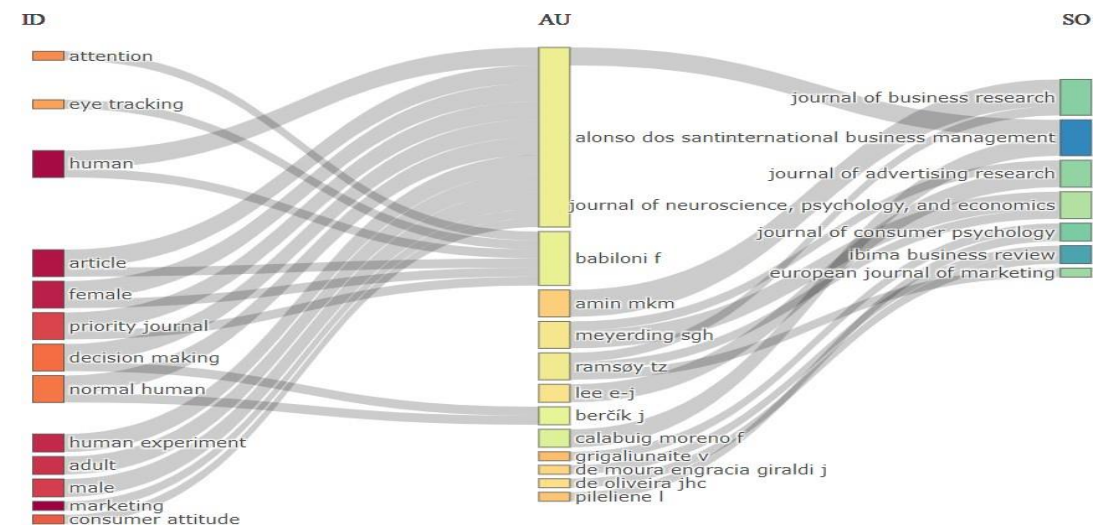
Most relevant source

As is evident from the table the major contribution is on the part of the Journal of Neuroscience, Psychology and Economics as it operates in the same niche as the subject of concern. Other major journals contributing in the same deal with the marketing and the advertising aspects.
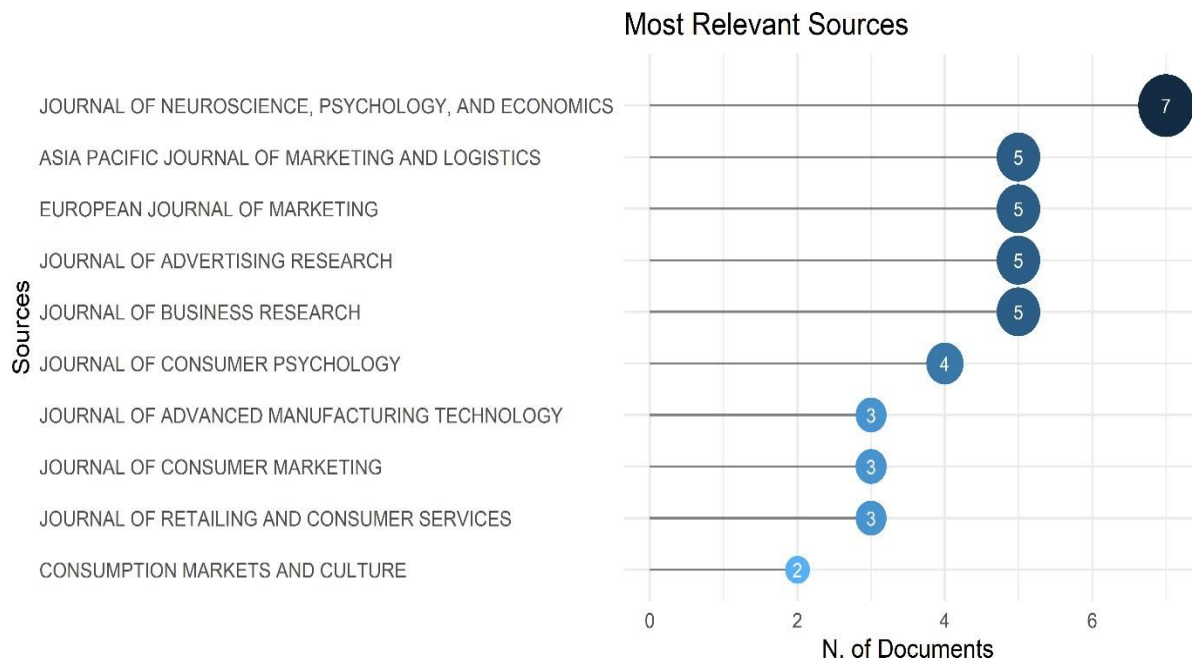
SO	Rank	Freq	cumFreq	Zone
JOURNAL OF NEUROSCIENCE, PSYCHOLOGY, AND ECONOMICS	1	7	7	Zone 1
ASIA PACIFIC JOURNAL OF MARKETING AND LOGISTICS	2	5	12	Zone 1
EUROPEAN JOURNAL OF MARKETING	3	5	17	Zone 1
JOURNAL OF ADVERTISING RESEARCH	4	5	22	Zone 1
JOURNAL OF BUSINESS RESEARCH	5	5	27	Zone 1
JOURNAL OF CONSUMER PSYCHOLOGY	6	4	31	Zone 1
JOURNAL OF ADVANCED MANUFACTURING TECHNOLOGY	7	3	34	Zone 1
JOURNAL OF CONSUMER MARKETING	8	3	37	Zone 1
JOURNAL OF RETAILING AND CONSUMER SERVICES	9	3	40	Zone 1
CONSUMPTION MARKETS AND CULTURE	10	2	42	Zone 1

Most Local Cited Source, Core Sources and Source dynamics

As witnessed from figure 4, we can observe that the major locally cited sources involve Journal of Marketing Research, Neuroimage and Journal of consumer research. The various sources as we can see in the figure below, the study on the subject has been going on since 2008 with a major outbreak on the topic however, the highest contribution on an overall level has been the Journal of Neuroscience, Psychology and Economics followed by Journal of Business research which also make up the core sources on the subject. Asia Pacific Journal of Management is yet another core source that has had a major impact on the subject knowledge lately.
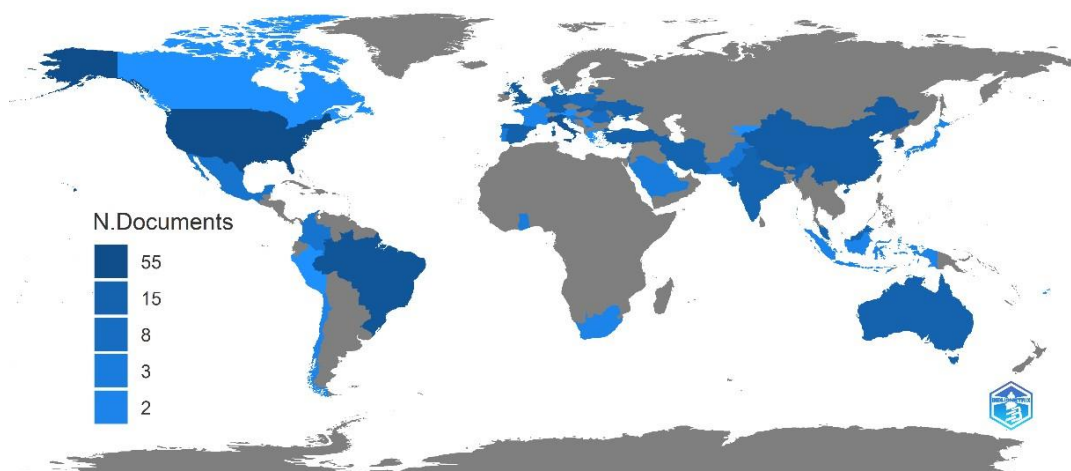
Most Local Cited Sources
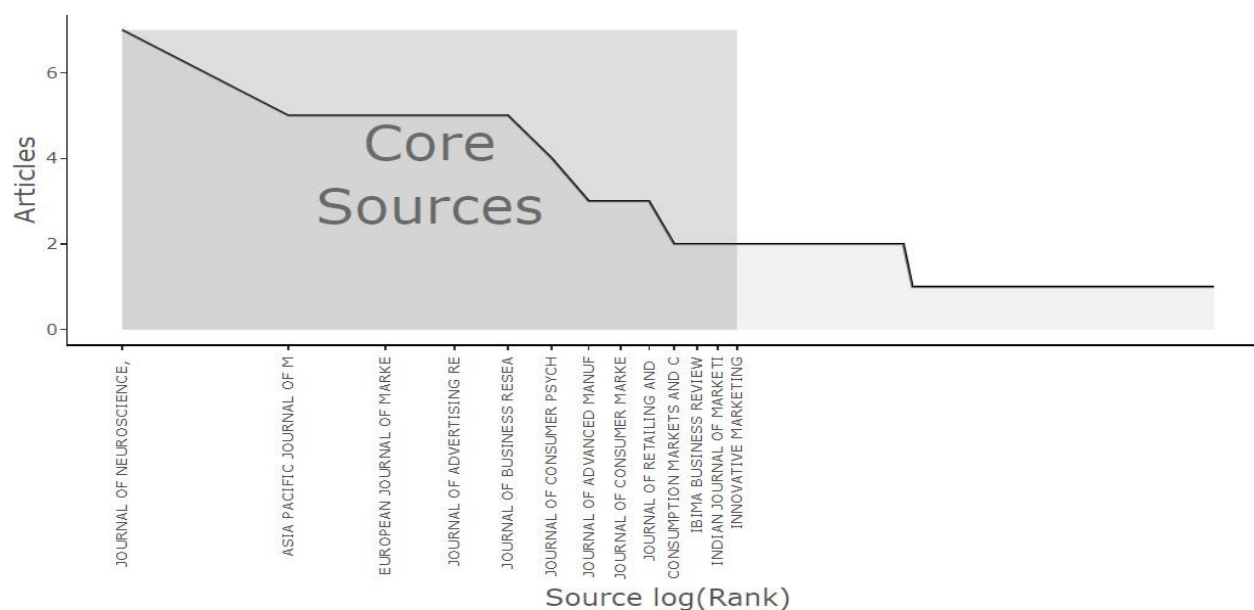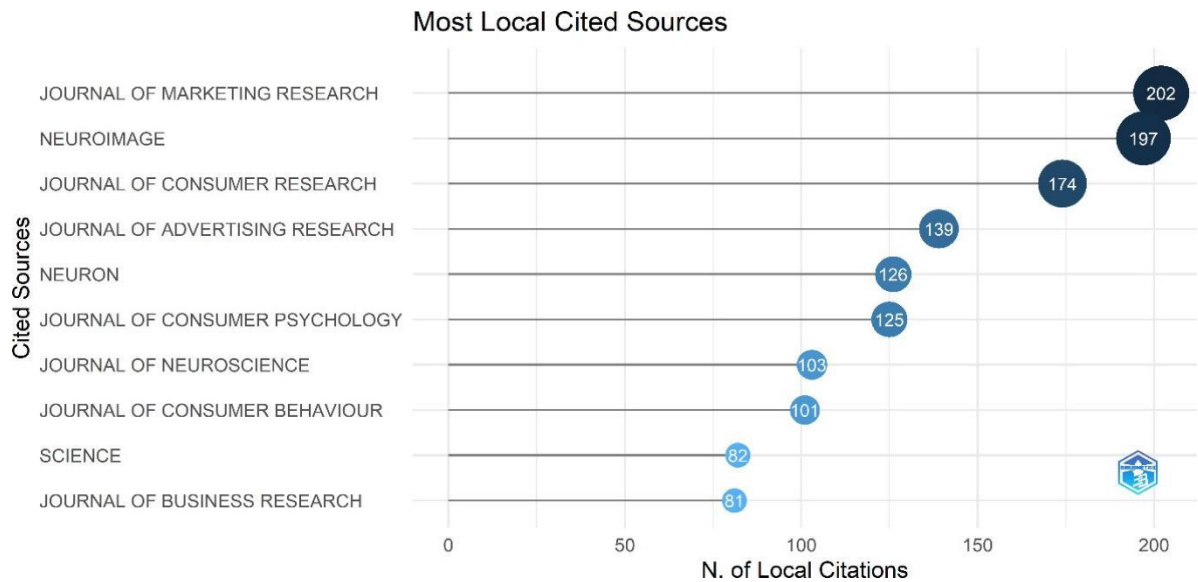
Source Dynamics

Country Scientific Production

region	Freq
USA	55
ITALY	33
BRAZIL	32
UK	23
CHINA	21
NETHERLANDS	20
SOUTH KOREA	17
SPAIN	17
SLOVAKIA	16
AUSTRALIA	15
GERMANY	15
TURKEY	15
INDIA	14
UKRAINE	14

Post studying Table 3, we can positively conclude that most major scientific production has been done by USA, Italy and Brazil. Amongst these the highest contribution in terms of research has been done by USA with the highest frequency of 55 when compared to the nest highest which is 33 for Italy. However, the overall contribution requires the citation scores of these to be on higher side in order to effectively calculate the contribution.

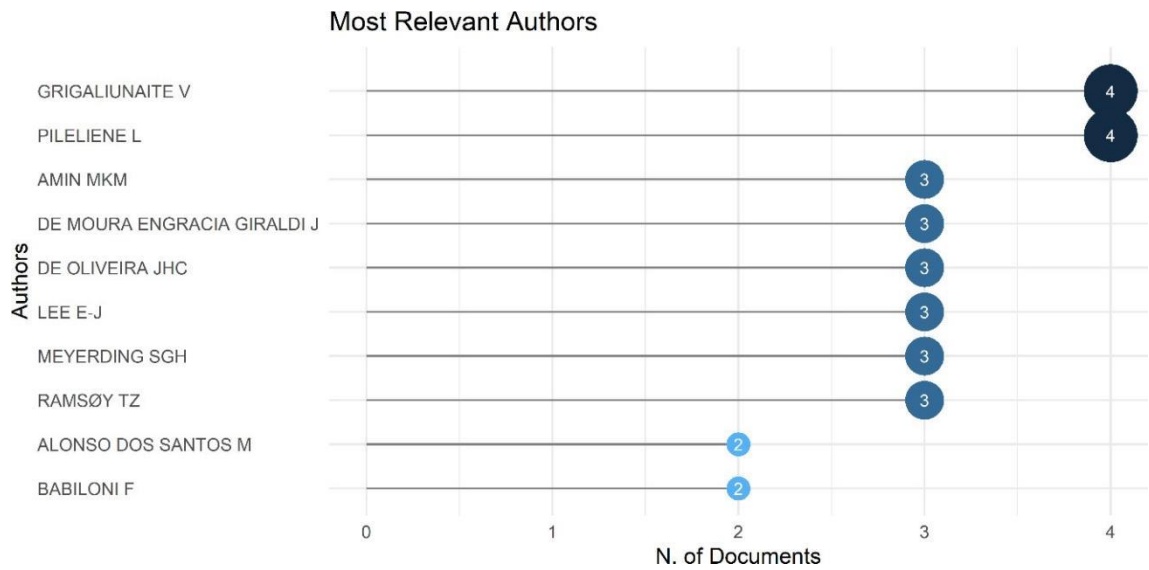**Most Relevant Authors**
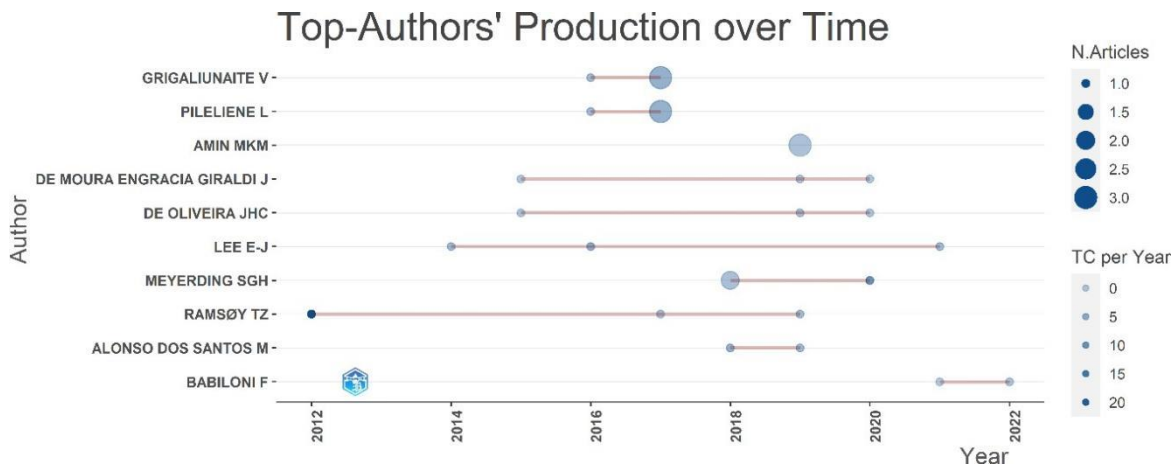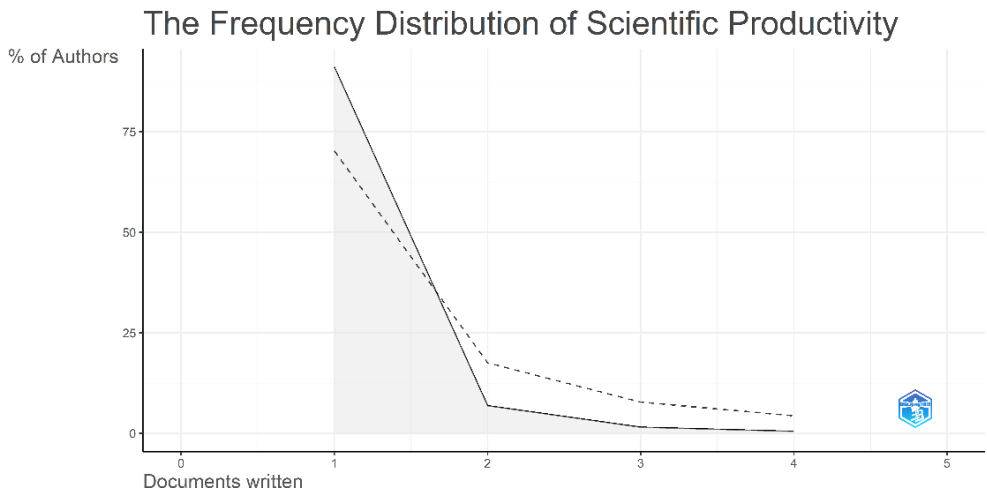
Most Relevant Authors

Table 4. Dictates that Grigaliunaite V and Pileliene L have contributed the most in terms of the literature written on the subject. However, after intersecting it with the three-field plot, we can see that Alonso Dos Santos M, even with his limited work in terms of documents published has provided the most meaningful contributions on the subject that has been cited widely.
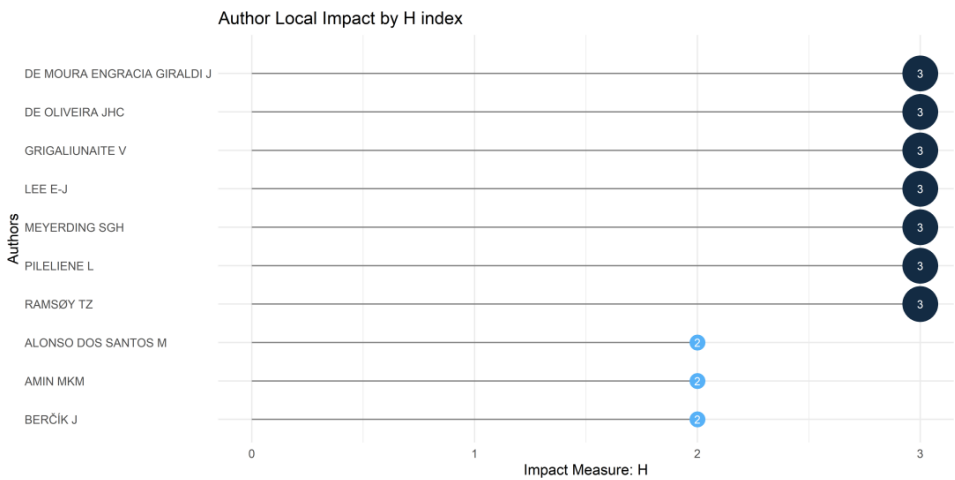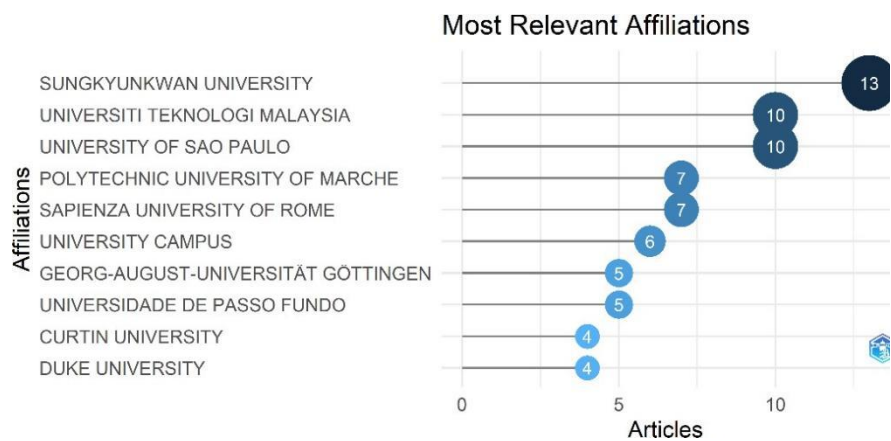
Authors' Production over time

Top-Authors' Production over Time

Author Productivity through Lotka's Law


Author Local Impact


Most Relevant Affiliations

Corresponding Authors Country

As is witnessed from figure 6., we can see that USA clearly stands out as far as Multiple country publications are considered or the total sum of multiple country contributions and single country contributions. However, in terms of single country contributions, we observe that USA, Netherlands, Italy, and Japan have a major say in terms of the author contribution from each country.

SCP: Single Country Publications, MCP: Multiple Country Publications
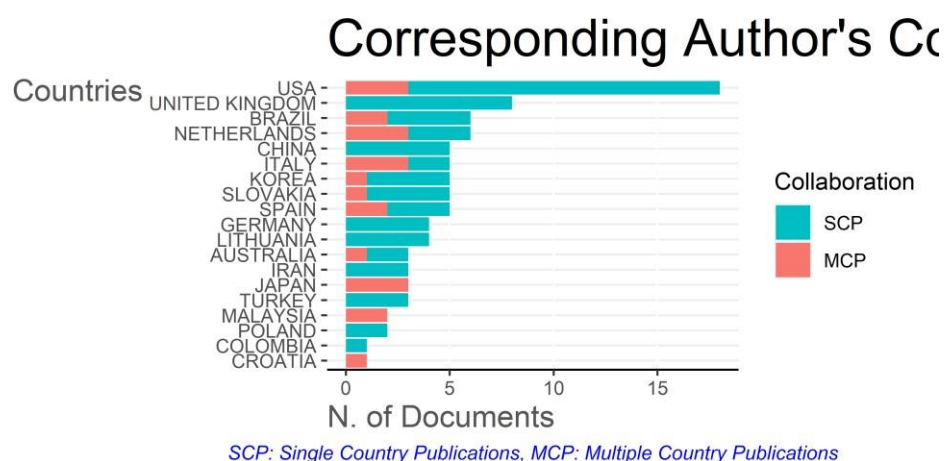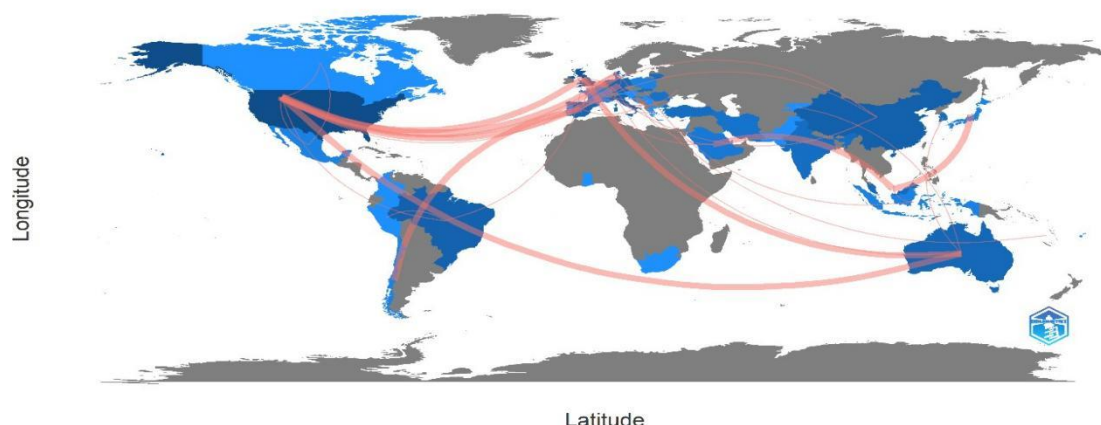
Most Cited Countries and Collaboration Map

As is clear from figure 7, in terms of citations USA pulls far ahead of any of the other countries due to the. Extensive research on the subject as well as the corporates present adopting the technology in order to create marketing stimuli for their consumers. As the technology and instruments employed in order to effectively study the subject becomes more common and accessible to other countries these numbers will eventually go up depending on the pace of adoption of technology and the number of researchers involved on the subject.

Most Cited Countries

Most Global Cited Documents
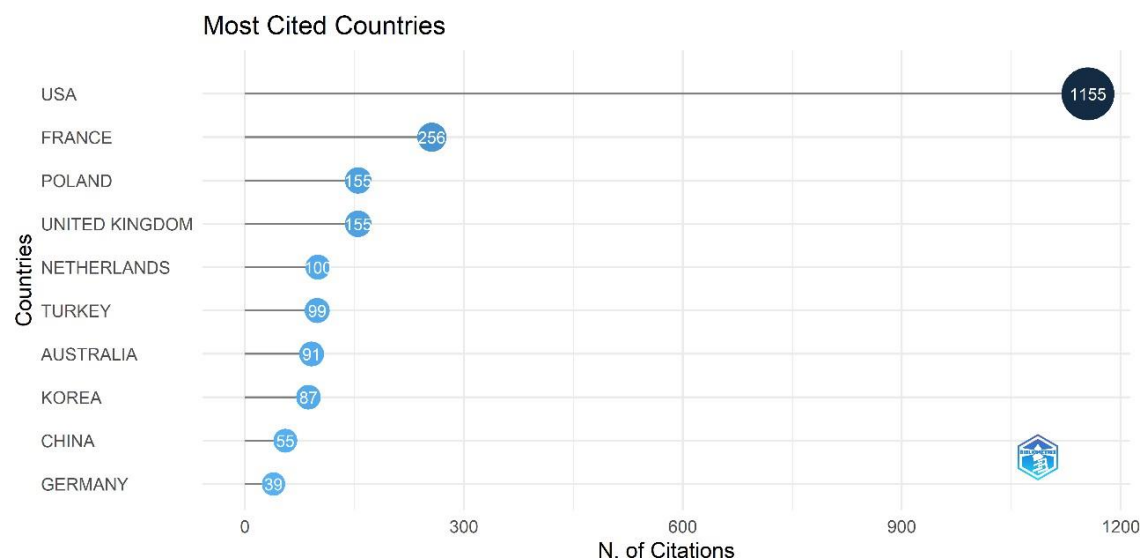
Most Global Cited Documents
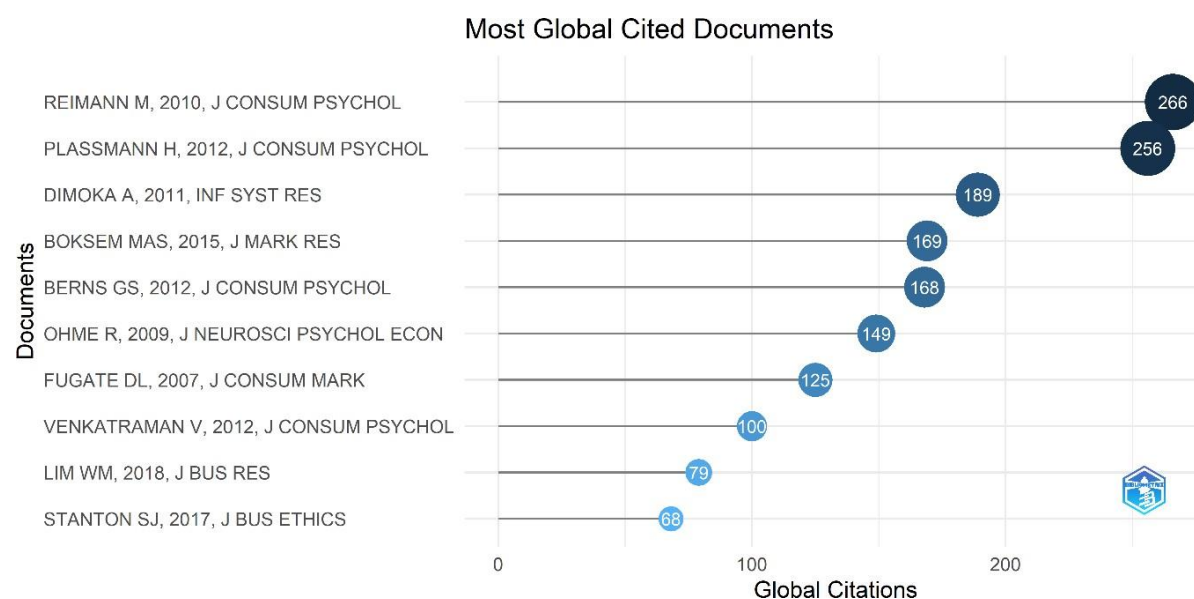
In terms of globally most cited documents, Reimann M, 2010 and Plassmann H, 2012 have been the most useful citations on the subject. Reimann M, in his paper on Aesthetic Packaging and its effect on people, which employed various image capturing techniques in order to effectively differentiate in terms of reaction of the subjects in the study. Plassmann in his study captured the details of application of Neuroscience in marketing, the limitations and the applications of the same in marketing and advertising domain.

Word Cloud

Word cloud is a visual depiction of all the contemporary topics related to the field of subject matter, which is neauromarketing in this study. It helps in identifying the different trending topics which assist in analysing the current and future scope of the area. As we can observe

from figure 8, majority of the progression in neuromarketing involves different aspects of advertising and marketing with elements of specific in neuroscience.

The treemap given in figure 9 is just another way of representing the same with more statistical figures. It can be inferred from the treemap that the theme 'marketing' is trending the most and is being talked about the most with the frequency of 10 i.e. 8% of the whole set. Other such themes. that we will discuss in detail in clusters involve behavioral responses and the ethical aspects of the same.

Tree
                                                                                                                    Map
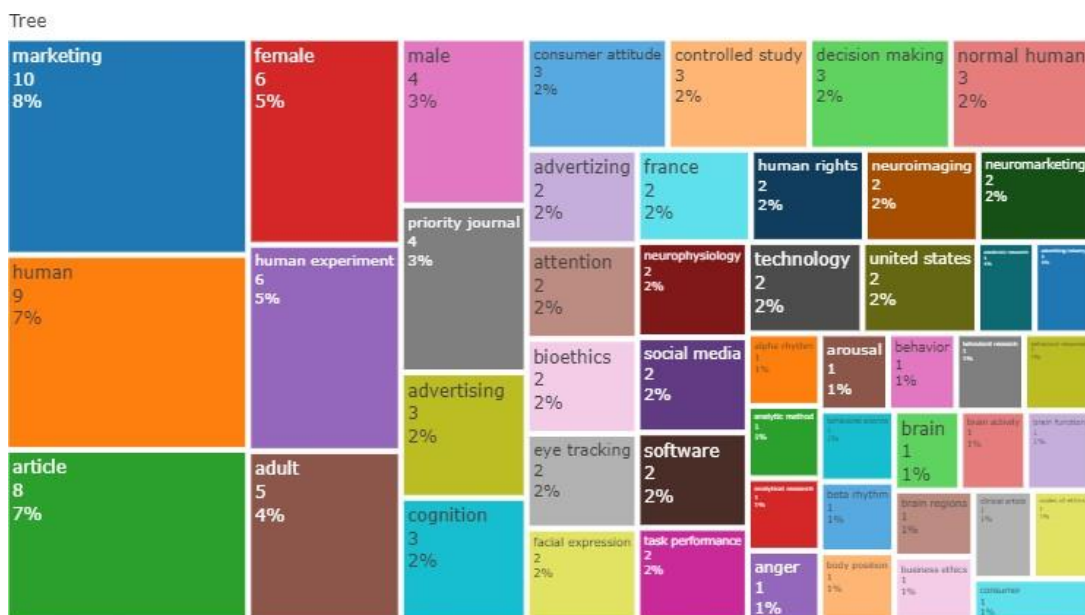
Thematic Map

Fig 10 is a graphic representation of the relevant themes mentioned in the data set used for this bibliometric analysis. The relevance degree is depicted on the x-axis and the development degree on the y-axis. The top left quarter is of niche themes and as it can be seen no niche themes are mentioned in the data set. The bottom left quarter talks about the emerging themes which are neuromarketing and social media mainly. With the digital advancement, social media has become an inevitable part of our lives and has immense scope in the future. Neuromarketing on the other hand is still in it's development stage and requires much more research to be considered as a basic theme depicted by the bottom right corner.
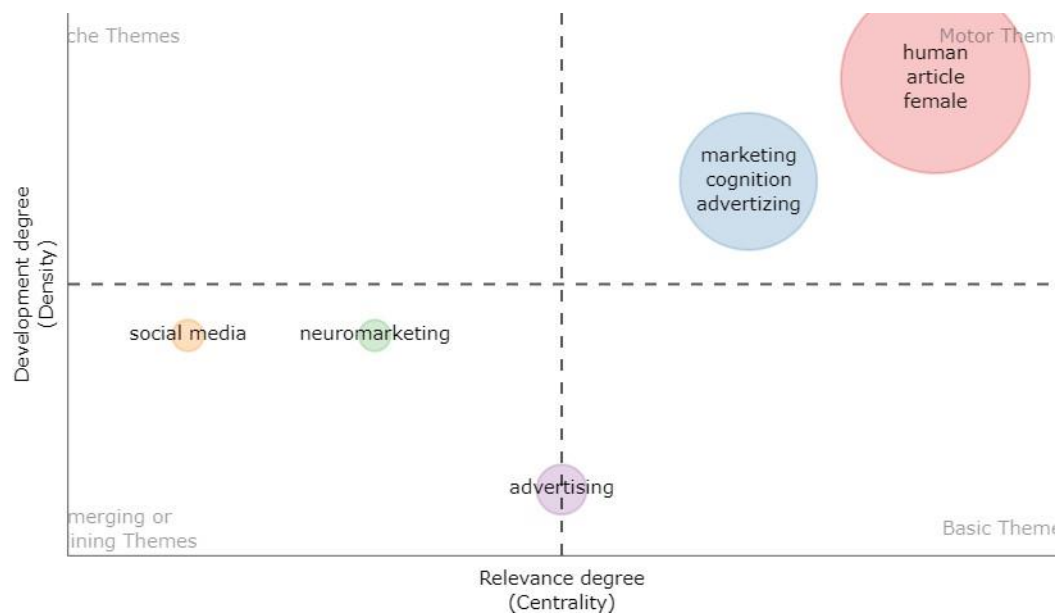
Cluster Analysis

	Prominent Authors	Content Analysis
Cluster brown	(Ulman, Cakar, Yildiz, 2014); (Flores, Baruca, Saldivar, 2014).	It is important to understand the ethical issues attached with the use of neuromarketing tools to understand the customer and enhance business practices. This cluster talks about the ethicalness of employing neuromarketing tools and why it is necessary to find the consumers' perception on it.
Cluster blue	Lee N., Chamberlain L., Brandes L. 2018 Boz H., Arslan A., Koc E. 2017 Mileti A., Guido G., Prete M.I. 2016 Berčík J., Horská E., Gálová J., Margianti E.S. 2016 Cruz C.M.L., De Medeiros J.F., Hermes L.C.R., Marcon A., Marcon É. 2016 Schneider T., Woolgar S. 2012	This cluster is about every version of consumerism being important but neuromarketing provides an objective enactment and a newer, more enhanced version of consumer, also better understanding of the principles of decision-making and the strategy of customer and consumer behavior in economic processes through neuromarketing tools, psychological and neurobiological concepts and knowledge.

	Prominent Authors	**Content Analysis**
Cluster green	(Lim W.M,2018) ; Halkin A. 2018 ; (Alcauter S., Cervantes J.;Barrios F., 2014); (Ohme R., Reykowska D., 2013)	Green cluster talks about the future role of neuromarketing as a provider of new usage of advancing marketing science and what all other tools such as Galvanic skin response (GSR) and heart beat per minute (BPM) are used to assess the effect of environment on emotional fatigue of the consumer during shopping. This cluster also talks about the role of gestures in enhancing effectiveness of the current advertisement
Cluster red	(Spence C., 2019); (Hsu M.Y.-T., Cheng J.M, 2018); (Al Kwifi, 2016)	This cluster contributes to the literature on customer sentiment by exploring the importance of fMRI, EEG and other technique in evaluating brain activities during decision-making to adopt a brand/product/packaging.

	Prominent Authors	Content Analysis
Cluster orange	(Alvino et al., 2019), (Michael et al. 2018); bastiaansen m. (2018); page g. (2012); ohme r. (2009)	Neuromarketing techniques are useful in understanding the emotions evoked in customers when they are exposed to various advertisements, images, words and various promotional methods. Emotions guide the purchase behaviours of consumers and neuromarketing tools can be used to examine the effectiveness of marketing strategies, especially in the field of tourism.
Cluster sky blue	Lewinski P., 2015 ; Baldo D., Parikh H., Piu Y., Müller K.-M., 2015 ; Hamelin N., Moujahid O.E., Thaichon P., 2017; Sung B., Wilson N.J., Yun J.H., LEE E.J, 2020.	Cluster talks about how some neuromarketing tools like FMRI and EEG can analyze customer brain in real time and gfk-EMO scan for facial recognition can segregate between the low emotional and high emotional advertisement and can also measure the popularity of different videos or advertisements, Cluster also talks about how neuromarketing can improve the success rates of different commercials.

	Prominent Authors	Content Analysis
Cluster purple	Alonso Dos Santos M., Calabuig Moreno F.(2018); Pileliene L., Grigaliunaite V. (2017); Grigaliunaite V., Pileliene L. (2016).	This cluster talks about how different spokesperson can affect the advertising campaigns and their effectiveness. How neuromarketing has the potential to become the next big thing in marketing communication. Model of influence and qualities of the spokesperson can be a key determinant in the effectiveness of the advertisement.
Cluster yellow	Hsu M.2017; Stanton S.J., Sinnott-Armstrong W., Huettel S.A. 2017; Çakir M.P., Çakar T., Girisken Y., Yurdakul D. 2018; Gountas J., Gountas S., Ciorciari J., Sharma P. 2019; Lee E.-J. 2016.	This cluster talks about how neuromarketing provides more objective results than traditional marketing. Neuromarketing can provide quantitative results with respect to buy or pass decisions customers will make and this can further quantify different customer perspectives like feelings, thoughts, opinion and intentions.

Findings:

Keeping our defined objectives in mind, we can see from our analysis of research papers from 2006 to 2021, we can see the progress from complete reluctance on behalf of the marketers to eventually understand how relevant neuromarketing can be for them. The first effective use could be seen in the packaging and how the colours of the same tend to be perceived by the customers. Appropriate elements of the advertising and the resultant impact on brand perception in the mind of the customers could be objectively seen and proven for the first time before which they had mostly relied on empirical data and trial and error methods in order to

be able to get the most efficient combination. There's still scope in terms of the width of the study however, the current speed will eventually help the marketers understand the consumer perception of elements better.

Now, the application runs through to a lot more elements such as customer journey mapping, relevant mediums of advertisement that are objectively effective on customers, branding colours, other elements of advertising find usage due to neuromarketing as well.

One of the most straightforward uses of applied neuromarketing is branding. A brand is ultimately nothing more than an idea that consumers have in their minds. Through several touchpoints, such as the consumption of its goods or services, web exposure, conventional marketing efforts, customer experiences, etc., this concept is established. Explore a few of the most prevalent neuromarketing studies:

Brand emotional evaluation: assesses the feelings elicited by a brand and its rivals.

A brand's personality is determined by how strongly a group of assets are associated with it or its rivals.

Assessment of unique resources: determines which distinctive asset contributes more to equity by comparing the association power of two distinctive assets to other brand assets. In order to identify those that are truly distinctive, it can also evaluate the influence that various distinctive assets have on the brand or competitors.

Investigation of fresh global corporate image: assesses and contrasts new designs of various branding elements (logo, brand applications, etc.) with existing elements and/or competition.

Applications in Product/Packaging of products/services

Packaging design comparison: evaluates various designs to see which one generates the deepest emotional and cognitive responses.

Display Visibility: Using heat maps, compares several packaging designs displayed on actual or simulated point-of-purchase displays to see which one garners the greatest interest.

Product feature testing: measures how strongly two distinct packaging designs are associated with the brand's or category's features.

Consumption experience management: assesses how a product's (such as soft drinks, chocolate, chips, cosmetics, etc.) consumption experience is impacted by its brand, packaging, price, or other factors.

Applications in Advertising:

Campaign evaluation: identifies the portions of a campaign that could want improvement and pinpoints the graphic aspects that are most attention-grabbing.

Examines the emotional impact of digital exposure as well as its visibility and interactivity in a particular setting when evaluating digital marketing, while also considering analysis of a commercial in detail to identify places for improvement, chooses essential scenes, and assists in obtaining several versions based on the channel.

Radio campaign evaluation: examines various commercials to see which one has the most emotional impact on listeners.

Evaluation of promotional materials at the point of sale: Examines several POEs to identify any weak points and confirms whether they draw the customer's attention and elicit an emotional response.

References-

- Aasted, C. M., Yücel, M. A., Cooper, R. J., Dubb, J., Tsuzuki, D., Becerra, L., ... Boas, D. A. (2015). Anatomical guidance for functional near-infrared spectroscopy: AtlasViewer tutorial. Neurophotonics, 2(2), 020801. https://doi.org/10.1117/1.NPh.2.2.020801.

- Ariely, D., & Berns, G. S. (2010). Neuromarketing: The hope and hype of neuroimaging in business. Nature Reviews Neuroscience, 11, 284–292. https://doi.org/10.1038/nrn2795.

- Balardin, J. B., Zimeo Morais, G. A., Furucho, R. A., Trambaiolli, L., Vanzella, P., Biazoli, C., & Sato, J. R. (2017). Imaging brain function with functional near-infrared spectroscopy in unconstrained environments. Frontiers in Human Neuroscience, 11(258), https://doi.org/10.3389/fnhum.2017.00258.

- Beaver, J. D., Lawrence, A. D., van Ditzhuijzen, J., Davis, M. H., Woods, A., & Calder, A. J. (2006). Individual differences in reward drive predict neural responses to images of food. The Journal of Neuroscience, 26(19), 5160–5166. https://doi.org/10.1523/jneurosci.0350-06.2006.

- Brouwer, A.-M., Zander, T. O., van Erp, J. B. F., Korteling, J. E., & Bronkhorst, A. W. (2015). Using neurophysiological signals that reflect cognitive or affective state: Six recommendations to avoid common pitfalls. Frontiers in Neuroscience, 9(136), https://doi.org/10.3389/fnins.2015.00136.

- Çakir, M. P., Çakar, T., Girisken, Y., & Yurdakul, D. (2018). An investigation of the neural correlates of purchase behavior through fNIRS. European Journal of Marketing, 52(1/2), 224–243. https://doi.org/10.1108/EJM-12-2016-0864.

- Chen, Y.-P., Nelson, L. D., & Hsu, M. (2015). From "where" to "what": Distributed representations of brand associations in the human brain. Journal of Marketing Research,52(4), 453–466. https://doi.org/10.1509/jmr.14.0606.

- Condon, B., McFadzean, R., Hadley, D. M., Bradnam, M. S., & Shahani, U. M. A. (1997). Habituation-like effects cause a significant decrease in response in MRI neuroactivation during visual stimulation. Vision Research, 37(9), 1243–1247. https://doi.org/10.1016/S0042-6989(97)85231-5.

- Cui, X., Bray, S., Bryant, D. M., Glover, G. H., & Reiss, A. L. (2011). A quantitative comparison of NIRS and fMRI across multiple cognitive tasks. NeuroImage, 54(4), 2808–2821. https://doi.org/10.1016/j.neuroimage.2010.10.069.

- Fazli, S., Mehnert, J., Steinbrink, J., Curio, G., Villringer, A., Müller, K.-R., & Blankertz, B.(2012). Enhanced performance by a hybrid NIRS–EEG brain computer interface.NeuroImage, 59(1), 519–529. https://doi.org/10.1016/j.neuroimage.2011.07.084.

- Fehse, K., Simmank, F., Gutyrchik, E., Sztrókay-Gaul, A., & Briesemeister, B. (2017).Organic or popular brands—Food perception engages distinct functional pathways. An fMRI study. Cogent Psychology, 4(1), 1284392. https://doi.org/10.1080/23311908.2017.1284392.

- Ferrari, M., Giannini, I., Sideri, G., & Zanette, E. (1985). Continuous non-invasive monitoring of human brain by near infrared spectroscopy. In F. Kreuzer, S. M. Cain, Z.Turek, & T. K. Goldstick (Eds.). Oxygen transport to tissue VII (pp. 873–882). Boston,MA: Springer US.

- Ferrari, M., & Quaresima, V. (2012). A brief review on the history of human functional near-infrared spectroscopy (fNIRS) development and fields of application. NeuroImage, 63(2), 921–935. https://doi.org/10.1016/j.neuroimage.2012.03.049.

- Grabenhorst, F., & Rolls, E. T. (2011). Value, pleasure and choice in the ventral prefrontalcortex. Trends in Cognitive Sciences, 15(2), 56–67. https://doi.org/10.1016/j.tics.2010.12.004.

- Grabenhorst, F., Rolls, E. T., & Bilderbeck, A. (2008). How cognition modulates affective responses to taste and flavor: Top-down influences on the orbitofrontal and pregenual cingulate cortices. Cerebral Cortex, 18(7), 1549–1559. https://doi.org/10.1093/cercor/bhm185.

- Heekeren, H. R., Marrett, S., Ruff, D. A., Bandettini, P. A., & Ungerleider, L. G. (2006). Involvement of human left dorsolateral prefrontal cortex in perceptual decision making is independent of response modality. Proceedings of the National Academy of Sciences of the United States of America, 103(26), 10023–10028. https://doi.org/10.1073/pnas.0603949103.

- Herrmann, M. J., Huter, T., Plichta, M. M., Ehlis, A.-C., Alpers, G. W., Mühlberger, A., & Fallgatter, A. J. (2008). Enhancement of activity of the primary visual cortex during processing of emotional stimuli as measured with event-related functional near-infrared spectroscopy and event-related potentials. Human Brain Mapping, 29(1),28–35. https://doi.org/10.1002/hbm.20368.

- Hocke, L., Oni, I., Duszynski, C., Corrigan, A., Frederick, B., & Dunn, J. (2018).Automated processing of fNIRS data—A visual guide to the pitfalls and consequences. Algorithms, 11(5), https://doi.org/10.3390/a11050067.

- Hoshi, Y., Kobayashi, N., & Tamura, M. (2001). Interpretation of near-infrared spectroscopy signals: A study with a newly developed perfused rat brain model. Journal of Applied Physiology, 90(5), 1657–1662. https://doi.org/10.1152/jappl.2001.90.5.1657.

- Huppert, T. J. (2016). Commentary on the statistical properties of noise and its implication on general linear models in functional near-infrared spectroscopy.Neurophotonics, 3(1), 010401. https://doi.org/10.1117/1.NPh.3.1.010401.

- Jackson, P., & Kennedy, D. (2013). The application of near infrared spectroscopy in nutritional intervention studies. Frontiers in Human Neuroscience, 7(473), https://doi.org/10.3389/fnhum.2013.00473.

- Köchel, A., Plichta, M. M., Schäfer, A., Leutgeb, V., Scharmüller, W., Fallgatter, A. J., & Schienle, A. (2011). Affective perception and imagery: A NIRS study. International Journal of Psychophysiology, 80(3), 192–197. https://doi.org/10.1016/j.ijpsycho.2011.03.006.

- Krampe, C., Strelow, E., Haas, A., & Kenning, P. (2018). The application of mobile fNIRS to 'shopper neuroscience': First insights from a merchandising communication study. European Journal of Marketing, 52(1/2), 244–259. https://doi.org/10.1108/EJM-12-2016-0727.

- Kühn, S., Strelow, E., & Gallinat, J. (2016). Multiple 'buy buttons' in the brain: Forecasting chocolate sales at point-of-sale based on functional brain activation using fMRI. NeuroImage, 136, 122–128. https://doi.org/10.1016/j.neuroimage.2016.05.021.

- Lee, M.-H., Fazli, S., Mehnert, J., & Lee, S.-W. (2015). Subject-dependent classification for robust idle state detection using multi-modal neuroimaging and data-fusion techniques in BCI. Pattern Recognition, 48(8), 2725–2737. https://doi.org/10.1016/j.patcog.2015.03.010.

- Lee, N., Chamberlain, L., & Brandes, L. (2018). Welcome to the jungle! The neuromarketing literature through the eyes of a newcomer. European Journal of Marketing,52(1/2), 4–38. https://doi.org/10.1108/EJM-02-2017-0122.

- Lim, W. M. (2018). Demystifying neuromarketing. Journal of Business Research, 91,205–220. https://doi.org/10.1016/j.jbusres.2018.05.036.