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Neuromarketing through consumer behaviour: Bibliometric review with PRISMA approach

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Article Info

Abstract

The research article discusses the field of neuromarketing and its application in understanding consumer behavior for developing marketing strategies. Neuromarketing is the intersection of neuroscience and marketing, and it involves the use of brainwave analysis to understand how people subconsciously react to marketing cues. The article provides a systematic review of the literature on neuromarketing, focusing on recent trends, influential aspects of publication, major expansions in the field, and the impact of neuromarketing on consumer buying decisions. The study identifies consumer preferences as subjective individual tastes, likes, and dislikes, and predispositions. The authors used a bibliometric analysis and descriptive analysis to summarize the progress and research trends of literature along with systematic review to enhance the influence of neuromarketing on consumer buying decision. The study highlights the neuromarketing effect as the center of consumer decision-making and outlines the neuromarketing frontiers through a systematic review.

1. Introduction

A recent explosion of neuroscientists studies the cortical functions with respect to frequency, time and space these techniques have been quickly applied in both psychological and physiological techniques for understanding the brain and cognition. However, in terms of social sciences neuro imaging is yet to be accepted by researchers meanwhile economics has applied the neuro imaging tools and techniques and result in creating neuro economics. In the field of marketing science it is still a slow progress still under utilizing the benefits of neuro imaging whereas both the economics and marketing science share the common ideology regarding the decision making (Lee, N., Broderick, A. J., & Chamberlain, L. 2007; Braeutigam, S., 2005; Kenning, P., Plassmann, H., 2005; Rustichini, A., 2005) [57, 54, 32, 9]. Both scientists and the business world no longer found traditional marketing techniques to be effective, then neuromarketing was born. A new, far more precise, stringent, and scientifically validated data collection method was thus required for the commercial context. Brainwave analysis could indicate how people subconsciously react to marketing cues. (*Ariely & Berns, 2010; Calvert & Thensen, 2004; Kenning & Linzmajer, 2011; Morin, 2011; Pradeep, 2010)*, Sebastian, V. (2014) [7, 9, 10, 11, 12]. The intersection between neuroscience and marketing is known as neuromarketing. The phrase "the study of the cerebral mechanism to comprehend customer behaviour in order to develop marketing strategies" was first used and created by Ale Smidts in 2002. (Boricean, 2009, p. 119) [13] Lim, W. M. (2018) [14]. Lindstrom (2010) [6] has discussed the advantages of neuromarketing techniques for both customers and businesses. They made the argument that by assisting customers in making decisions rather than manipulating them, products and advertising campaigns developed using neuromarketing methods will benefit consumers. When it comes to businesses, they can ensure that they will save a significant portion of the budget that is used for unproductive and inefficient advertising initiatives. Alsharif, A. H., Salleh, N. Z. M., Baharun, R. O. H. A. I. Z. A. T., & Yusoff, M. E. (2021) [1].

The goal of neuromarketing is to understand instinctive (or natural) human behaviour in terms of cognitions and emotions, conscious and unconscious, in response to a marketing stimulus such as markets or marketing exchanges. This study attempts to recollect the essence of existing literature on neuromarketing. We conducted bibliometric analysis to summarize the progress and research trends of literature along with systematic review to enhance the influence of neuromarketing on consumer buying decision. Further, the systematic review was conducted with the following research questions

RQ1: What are recent trends of neuromarketing in research studies?

RQ2: What are the influential aspects of publication in terms of time, author, articles, journals and sources?

RQ3: What were the major expansion in the field of neuromarketing over the recent years and what are current trends?

RQ4: What are neuro marketing component influencing buying decision of consumer and other various neuroscience discipline?

The existing literature work address that the Neuromarketing is generally used to objectively identify consumer preferences (Fortunato, Giraldi, & de Oliveira, 20134) [3], Ismajli, A., Ziberi, B., & Metushi, A. (2022) Consumer preferences are subjective individual tastes, likes and dislikes, and predispositions (Booker, 2017), Ismajli, A., Ziberi, B., & Metushi, A. (2022).

This study is different from the previous research :1) the study performs a review on literature on neuromarketing influencing the consumer buying decision, (2) we have applied citation, trends, analysis by maintaining the existing literature., (3) the study also aims to systematically find out the key determinants of neuromarketing which include systematic and bibliometric review. The study outlines neuromarketing frontiers through a systematic review and highlights the neuromarketing effect as the center of consumer decision-making. The study is structured as follows: Section 2 sheds light on data methodology used in paper. Section 3 deals with bibliometric analysis. Section 4 &5 presents descriptive analysis. Section 6 sums up the article with conclusion and future scope of this study.

2. Data and Methodology

Every research project needs to have a literature review. In order to identify potential research gaps, relevant literature is evaluated and examined through literature reviews. The research gaps ought to be of the kind that, if filled, would advance the discipline. (Tranfield et al., 2003) [16] Kamble, S. S., Gunasekaran, A., et al (2018) [15]. Saunders et al. (2016) [17] Kamble, S. S., et al (2018) [15] prescribed an iterative cycle of selecting appropriate search terms, looking up the pertinent literature, and doing the analysis at the conclusion results in a structured literature review. The authors used a similar review process in their paper. First, pertinent publications covering advancements in the disciplines of neuromarketing and consumer behaviour were found for this paper. For this, the authors referred to papers from the Scopus database, which contains a significant number of renowned publications, like Emerald, Taylor and Francis, Springer, IEEE, and Elsevier. (Kamble, S. S., et al (2018) [15]; Lamba and Singh, 2017; Arunachalam et al., 2017; Nguyen et al., 2017; Wamba et al., 2015; Mishra et al., 2016) [15, 20].

The following study used Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines for conducting a systematic review ((Bhardwaj, S., Rana, G. A. et al (2023) [23]; Wittorski, 2012). Sometimes systematic reviews lack standardization and scientifically adequate method (Bhardwaj, S., Rana, G. A. et al (2023) [23]; Abelha et al., 2020). As a result, PRISMA rules offer a defined, acknowledged technique with a 27-item checklist to uphold the review process' transparency and quality (Page, Matthew J., et al., 2020; (Bhardwaj, S., Rana, G. A. et al 2023) [23]. Regular meetings among authors are therefore conducted to carry out a defined protocol-based deduction of pertinent literature, article selection criteria, search strategy, data extraction, and data analysis methods (Bhardwaj, S., Rana, G. A. et al 2023) [23].
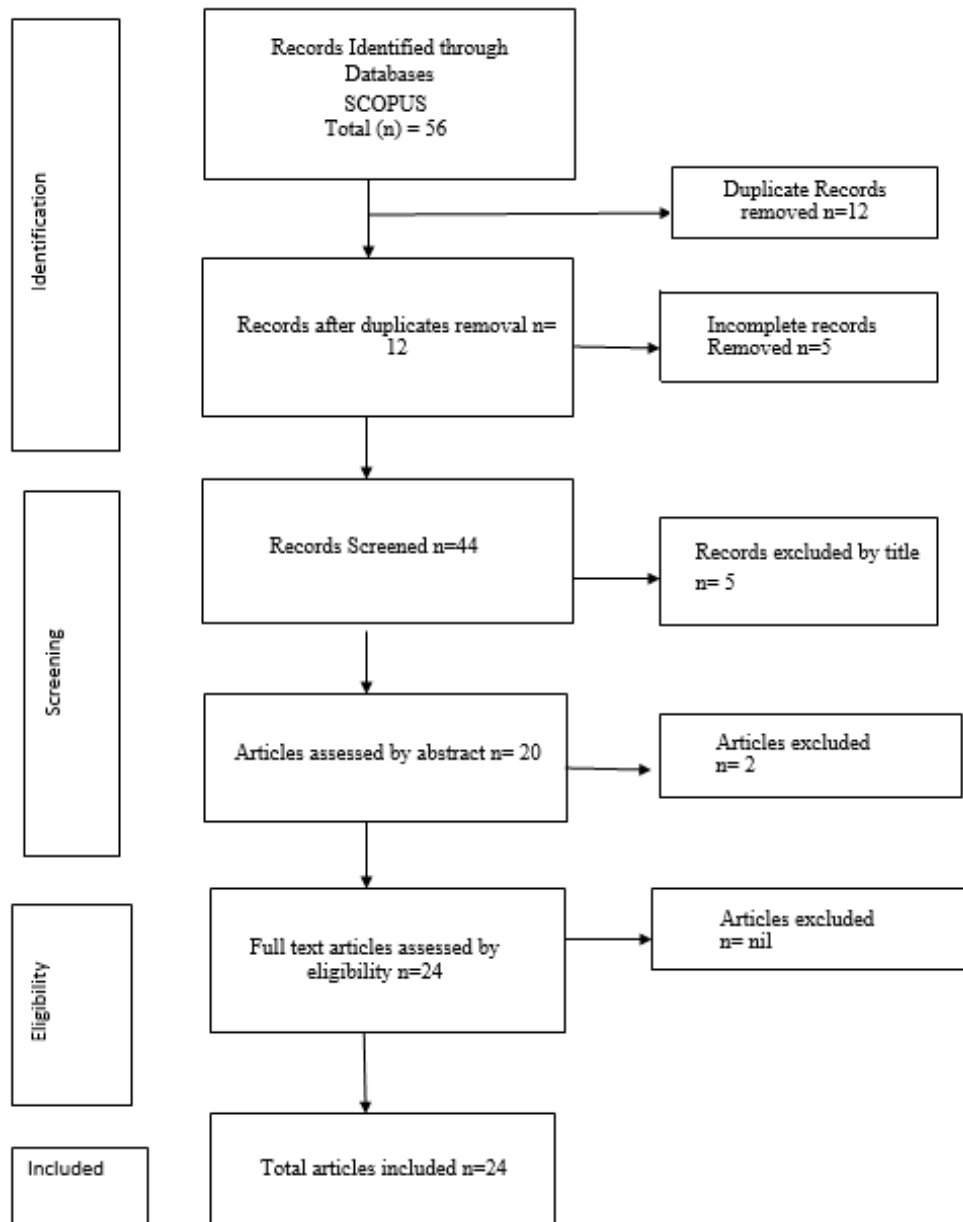
Fig 1: PRISMA

2.1. Selection of database
The development of the search strategy started with a review of the pertinent data sources. The Scopus database was chosen so that users would have access to a broad range of academic and conference papers. Scopus is one of the most extensive Elsevier abstract and citation databases and includes thousands of peer-reviewed journals in the fields of life sciences, social science, physical, health science. Several publishing companies, including Elsevier, Springer, Emerald, Taylor & Francis, and IEEE, publish these peer-reviewed journals.

2.2. Keyword selection
The authors cited the most relevant and appropriate research publications related to the topic to establish a reproducible, comprehensive, and unbiased article search process. The keywords used by the authors fell into the following two categories: Neuromarketing keywords: i)neuro-marketing, ii) neuromarketing, iii) neuroscience, iv)consumer neuroscience, Consumer buying behavior keywords: i) consumer behavior ii) consumer decision, iii) consumer buying iv) consumer buying behavior. One key word from each category was used at a time as part of a paired query that was used to conduct the search.

2.3 Collection of articles
The initial search queries resulted in a total of publications. The writers made sure that many aspects of consumer buying behavior and neuromarketing were included. To ensure that the research came from academic sources, book chapters, books, doctorate theses, white papers, editorial notes, etc. were eliminated from the search. (Ramos *et al*., 2004; Lamba and Singh, 2017; Kamble, S. S., Gunasekaran, A., *et al* (2018) [15, 25, 20]. The total number of articles dropped to 24.

2.4. Filtering (inclusion/exclusion)
The authors eliminated duplicates, papers that appeared in several keyword combinations, and publications with insufficient bibliographic data points in order to further refine the results. The articles were also screened for their applicability to the subject. A total of 24 papers were selected for the final review.

3. Analysis Method

The study uses a bibliometric approach for the thorough science mapping. It is a time-tested research technique used in library and information science to analyse scientific books statistically and mathematically in order to increase the efficacy and efficiency of libraries (Tella and Olabooye, 2014) [30]. This package facilitates comprehensive bibliometric study including data analysis and data visualization (Ingale, K. K., & Paluri, R. A. 2022) [29].
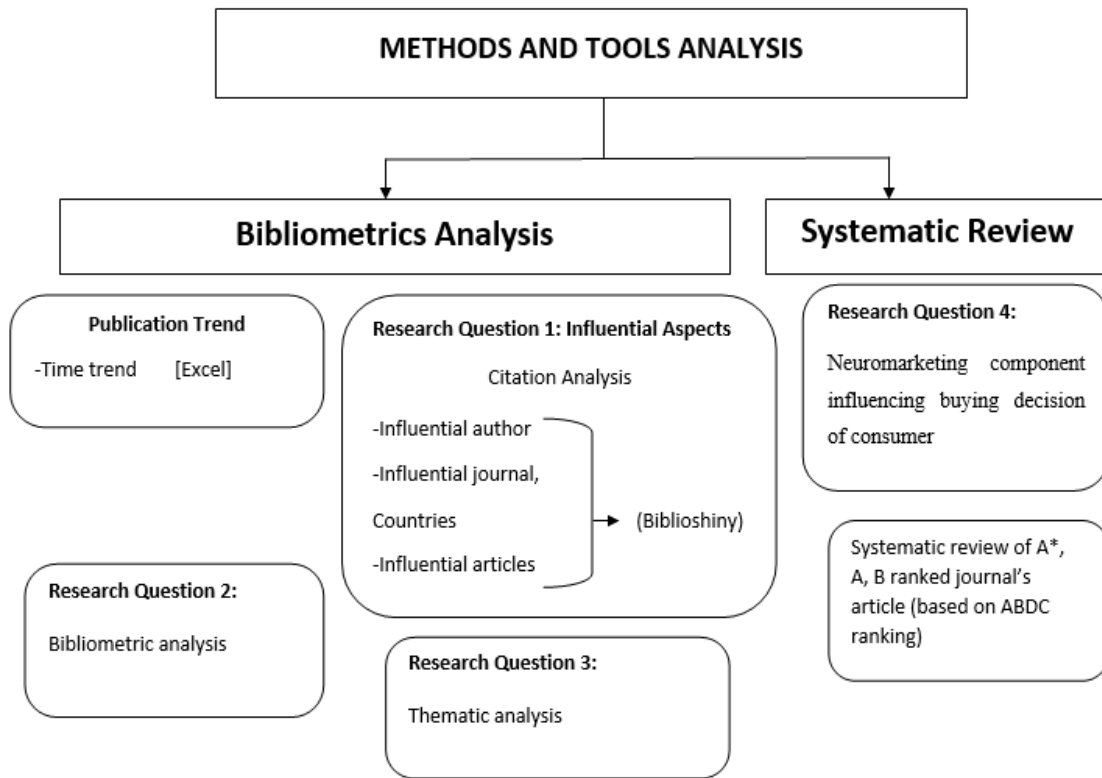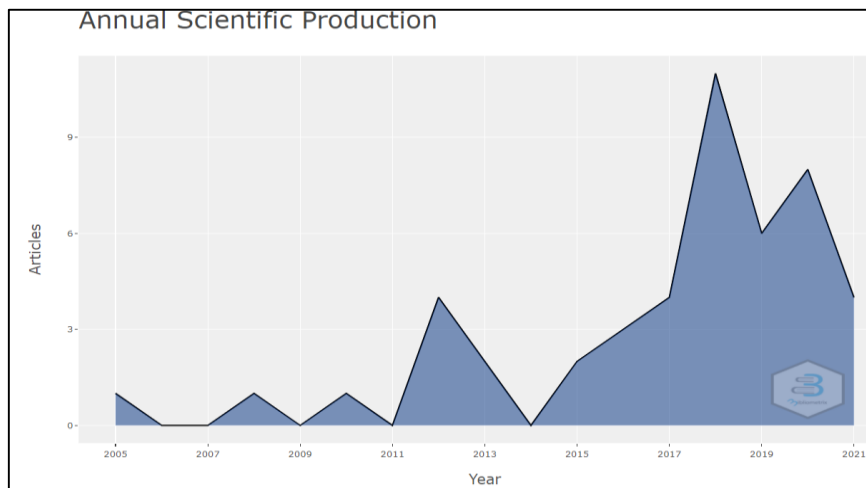

Fig 2: Methods and Tools Analysis

Fig 3: Annual Scientific Production

The figure indicated the evolution of the top trending article on 2 dimensional scale number of articles on the vertical axis and on the horizontal axis publication years. It shows highest number of articles were published in 2018. There was a rise in article since 2013 and went to peek in 2018. There is increase in articles to 2021**. (Low and Siegel, 2019)** stated that the issue has not yet reached maturity, despite the fact that the number of publications on the subject has been steadily increasing. The phases of research domain development are as follows which are precursor, exponential growth, consolidation of body of knowledge and decrease in the number of articles. When comparing the literature to the aforementioned stages, the notion of neuromarketing and its association with consumer behaviour was found to be in the growth stage, with a steady increase in the number of publications.
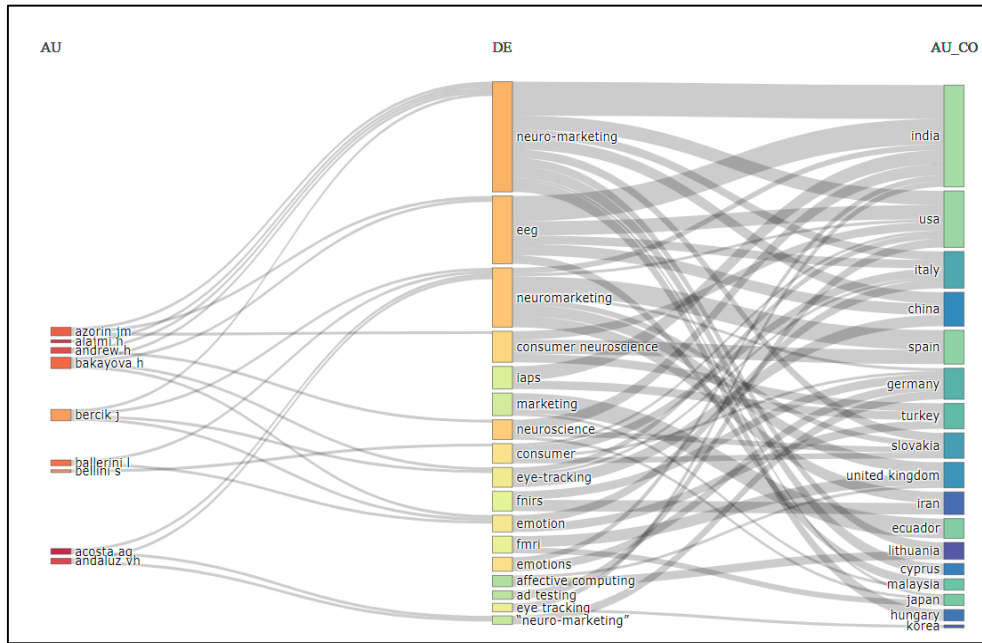
Fig 4: Three field plot

(Riehmann *et al.*, 2005) analyzed Sankey Plots are used to show the relationship between three fields in a three field plot (Figure 2), where the size of the part is proportional to the value of the node. The authors are on left side of Sankey Plot, keywords in middle row, sources/countries that were chosen for analysis are on the right side.. All the items are depicted with appropriate certain keywords such as neuro marketing, eye-tracking, neuroscience, consumer, emotions, along with their sources and authors. The authors mentioned the topic "neuromarketing" indicated relevant role in shaping "consumer behaviour". "consumer neuroscience", "eye tracking", "ad testing" are equally important topics stated by the authors.
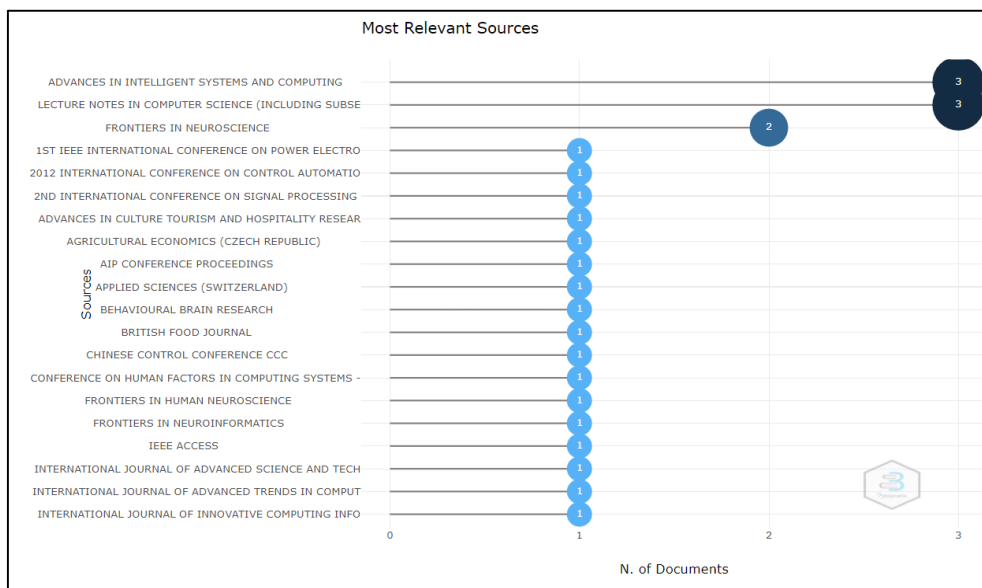

Fig 5: Local Impact H index

Figure 3 and 4 represents a closer look at the journals which reveals that a majority of the literature is relating to neuro marketing. Based on the h-index, the most influential scholarly publications in the discipline. This statistic evaluates the effect and productivity of journals based on their citation impact. The H-index has a maximum value of "n," where "n" is the number of journals that have published "n" articles with "n" citations. Neither the journals with the most articles in the field nor the journals with the most citations can be used to exclusively represent the journal's contribution to the field. A better indicator of a journal's quality, quantity, or effect can be through seen H-index.
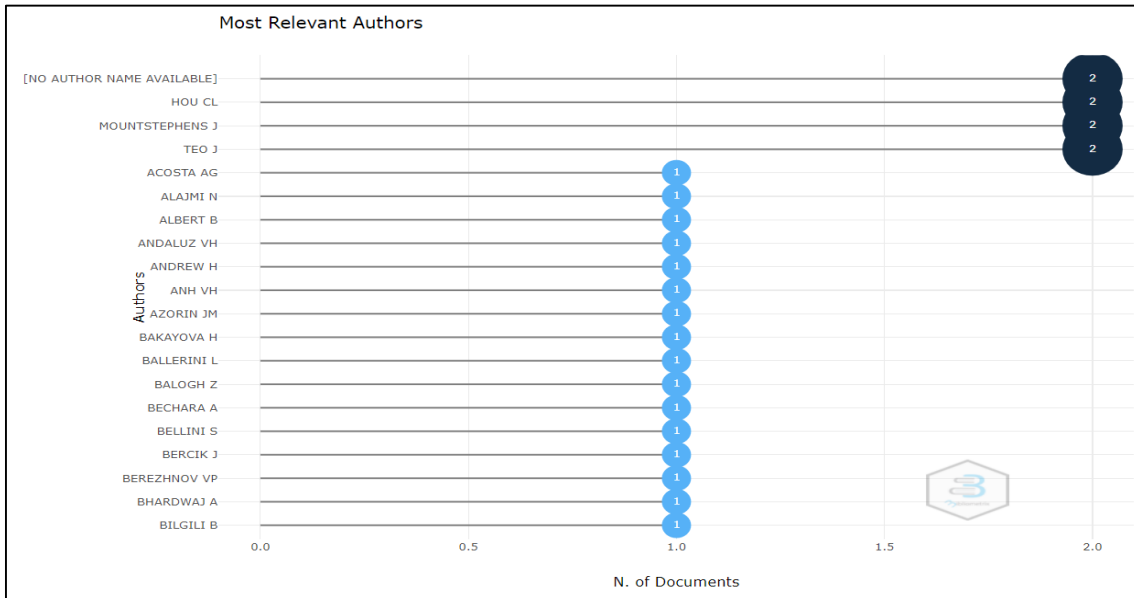
Fig 6: Most relevant Authors

In Figure 5 authors. Hou.CL, Mount Stephens, Teo J, Acosta AG, Alajmi N, Albert B, are known to be the most productive authors who had there publications in the neuro marketing. Authors Hou.CL, Mount Stephens, Teo J had maximum publications and more articles in this field. H-index analysis of the authors shows that Hou.CL, Mount Stephens, Teo J are known to be most impactful authors. (Figure 6) These articles have related the same influential information as above figure and are important for future research in the area of neuro marketing.
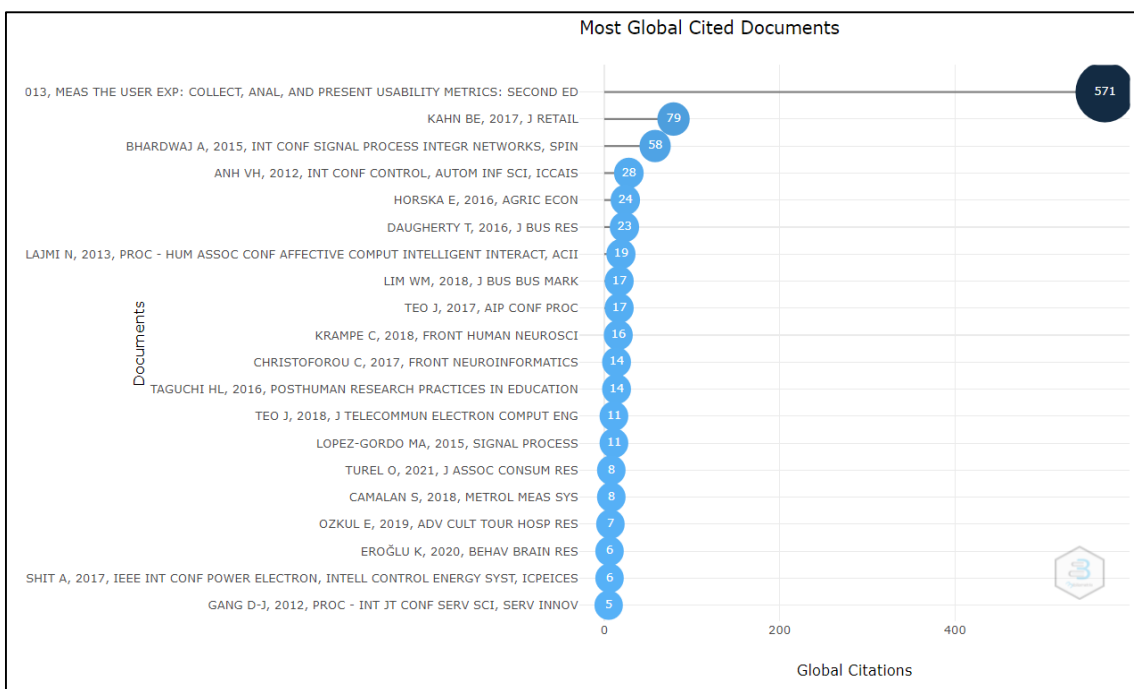

Fig 7: Most global cited documents

The top 20 most global cited documents are being presented in above figure. These articles have more than 100 citations. In all total there are more than 571 citations. The importance of neuro marketing is being mentioned in the articles also with its various factors. As key reference articles these top articles can be cited.
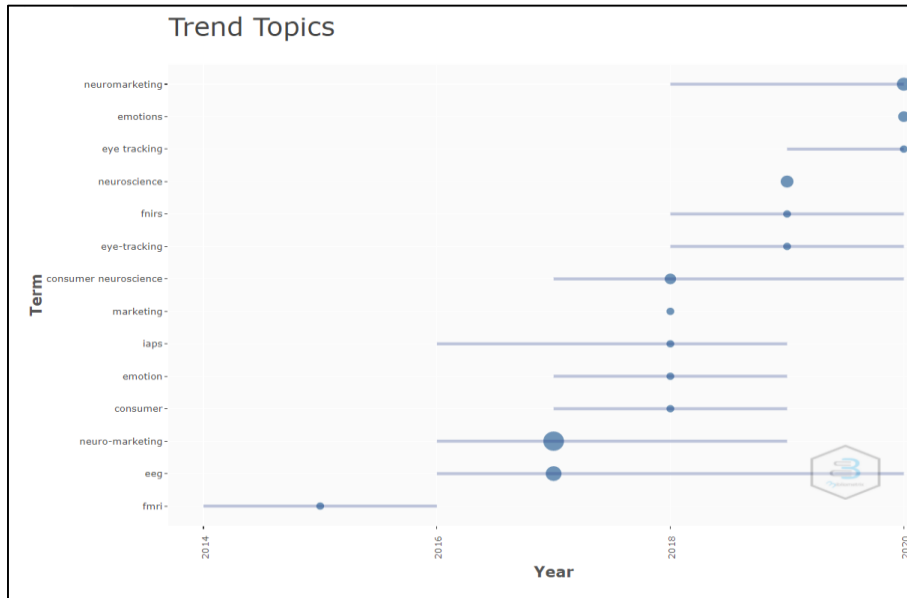
Fig 8: Trend Topics

Figure no. 10 indicates the evolution of the top trending topics on a two dimensional scale with logarithmic value of frequency on the vertical axis and on the horizontal axis publication years. An interesting pattern was created which was reviewed from topics in last five years. Major topics revolved around fmri in 2015. The focus shifted towards neuro marketing and eeg in year 2016 and 2017. On the other hand, the trend shifted to the dominant topics in 2018, that were consumer, emotion, laps, marketing, consumer neuro science, focusing on the behavioural perspective. In the year 2020 topics such as neuro marketing, eye-tracking, emotions.
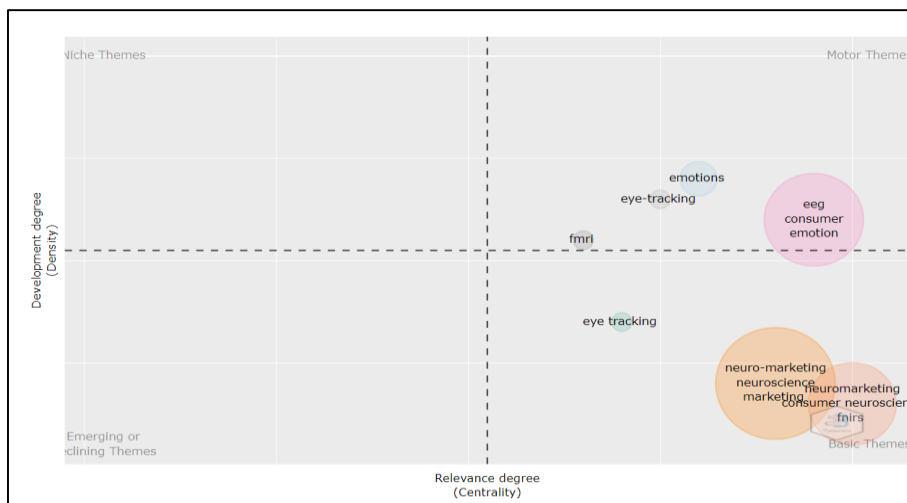

Fig 9: Thematic Map

On a two-dimensional layout, a thematic map plots the typological topics (Cobo *et al.*, 2011). The terms are found using keyword clusters and word analysis, resulting in the generation of themes in the research domain. These themes can be divided into four quadrants on the two-dimensional graph based on their density and centrality. Each theme is represented by a bubble on the map. "Emotions", "consumer emotions", "eye tracking", "fmri"and "eeg" can be seen plotted as bubbles on the graph. The motor subject "emotions," which has a high density and centrality in the upper right quadrant, is at the foundation of the field and is the most widely discussed topic. The primary subject of neuro marketing, which occurs in the lower right quadrant, denotes significant yet underdeveloped field. The niche subject "information" in the upper left quadrant is well-developed with internal links but has poor exterior ties and is

of moderate value. The emerging subject in the lower left quadrant is underdeveloped and of minor consequence. (Ariaa and Cuccurullo, 2017; Huang and *et al.*, 2020) indicates both growing and fading ties.

4. Neuro marketing component influencing buying decision of consumer
4.1. Advertisement effectiveness
Focus groups, interviews, recall tests, and other conventional methods of market research are frequently used in the conventional testing of new advertising campaigns. The advocates of brains canning claim that while people see visuals or videos for a new advertising campaign, they may be hooked to imaging devices. The subject's unconscious thought patterns can be inferred based on which brain regions "lit up." Intent of the advertising agency, such as enthusiasm,

emotion, antagonism, humour, attentiveness, etc., may probably be matched to the general region of the brain where these concepts are processed. It is clear that the advertisement has failed this critical test if that brain area is unaffected after exposure to the advertising stimulus (McConnon and Stead, 2007). Promotional experiments on car ads have been conducted by Ford Motor Company and Pre-Diction, a research organisation with offices in the UK. Similar to this, the EEG was used to assess one of Unilever's TV commercials, a British multinational. The Unilever advertisement's brand message and product demonstration elicited substantially weaker reactions than anticipated. Though the total effectiveness of the spot was below expectations, the elements meant to create negative feelings performed significantly better. Such a prescription for fresh ad executions ought to aid the marketing team in discovering something fresh and worthwhile to offer to their creative endeavours (Harris, 2006; Fugate, D. L. 2007) [49].

4.2. Product
Product designers typically use consciously generated consumer preferences to determine which product designs are most appealing to their target markets (Fugate, D. L. 2007) [49]. Product fairness metric assesses how confident a customer is that the store provides a safe product and accurate information Cheung & To (2021) [56]. It made the customer believe that product which is being offered are safe and fit for their intended uses. It also build a trust to the offered products that they do not contain deceptive packaging/quality specifications. All the Information regarding the substantial risks associated with the product is being fully disclosed. The reason when selling the product, its employees treat customers respectfully is due to the product fairness Cheung & To (2021) [56]. Meirovich and Bahnan (2008) proposed that negative emotions are result of low product qualities. Dissatisfaction and repurchase intention forms a mediator that is negative emotion (Khan, 2010) which adversely affects consumer purchase and decision-making (Lu *et al*., 2012) (Hsu & Cheng, 2018). FMRI neuro imaging may provide deeper insight into both cognitive and emotional processes (Reimann *et al*., 2011) in relation to which the product fairness states higher the brain activity variations leads to the higher negative emotions. Ravaja *et al*. (2013) found that positive emotions will cause higher purchasing intention, and negative emotions will decrease purchasing probabilities of consumers (Otto *et al*., 2004) (Hsu & Cheng, 2018).

4.3. Price
In case of price increase the customer compares the perceive price fairness by the other references and that would be evaluated as unfair (Lyn Cox, 2001). Price moderation is the degree to which a consumer believes that the retailer sets an appropriate price for the product without any hidden price to it. (Vitell *et al*. 1993) (Cheung & To 2021) [56]. The price also plays as an extrinsic factor in determining the quality of product. In evaluation of price, Price moderation is considered as consumer's assessment and the associated emotions which makes the difference in case there is a difference in the sellers price and the other party selling price which could or could not be reasonable, acceptable or justifiable(Xia *et al*., 2004, p. 3) (Konuk (2019). Price

moderation arises as "a customer's subjective perception of a price as correct, just, or legitimate vs incorrect, unjust, or illegitimate"(Campbell, 2007, p.261) (Konuk (2019). The current study examines consumer perceptions of markets, the environment, and vendor constraints in order to determine the cognitive perceived value measure of price fairness (Bolton *et al*., 2003; David *et al*., 2007) Konuk (2019). According to studies, price fairness is a mental activity carried out by customers who may respond to pricing with cognitive (thinking) and affective (emotional) components (Xia, Monroe, & Cox, 2004), (Konuk, 2019). Neuro-scientific methods states that when a consumer tends to buy a product before evaluation of the price that strongly resonates the attractiveness or the urge to buy the product which also determines the alterations in the cognitive process of valuation (Lim, 2018) [14]. Market segmentation, targeting, and positioning activities which are useful for better market engagement can also create a pathway through neuromarketing techniques which will help in better understanding of the consumer mind (Lim, 2018) [14].

4.4. Branding
Consumer thinking process can be predicted through the patterns formed out of neural activations in the brain which can reveal the brand associations of consumer through which quality they are being stretched towards the brand(Ambler, Braeutigam, Stins, Rose, & Swithenby, 2004; Chen, Nelson, & Hsu, 2015; Santos, Seixas, Brandao, & Moutinho, 2012; Lim, 2018) [14, 55]. Advertisement has always been a target of explanation of brand uniqueness which indicates the brand equity and brand reputation which reflects the consumer perceptions which will lead to brand differentiation strategy by companies so to attract the audience from the past purchase decision or preferences(Chaudhuri, 2002), Romaniuk *et al*. (2007), Gupta, Gallear, *et al* (2020). The uniqueness provides a reason for comparsion among brand to its competitor which reveals the customer choices and preferences. In competitive market uniqueness determine an impotent aspect which requires to build a brand management model with proper mind set to market orientation Gupta, Gallear *et al* (2020). Luxury brands are being highly in attention which have emotional connect and also the motivational significance to the consumer in comparison to which the non-luxurious brand are not into high connect after viewing the consumer perception were one goes for the luxury branded product the other also turns towards the luxury brand by delivering same emotional value to it Pozharliev, Verbeke, Van Strien, and Bagozzi (2015), (Lim, 2018) [45, 14]. Several brand traits can be identified by the studies of neuroscience which relates to the choices and preferences (Chen *et al*., 2015; Venkatraman, Clithero, Fitzsimons, & Huettel, 2012; Yoon, Gutchess, Feinberg, & Polk, 2006) of consumer which include the attention (Gakhal & Senior, 2008; Plassmann *et al*., 2012), learning (Plassmann *et al*., 2012),, experienced value Plassmann *et al*., 2012),, the brand value, (Plassmann *et al*., 2012; Ratnayake, Broderick, & Mitchell, 2010), brand choice (Reimann, Castano, Zaichkowsky, & Bechara, 2012), brand tarnishment (Boshoff & Boshoff, 2016), brand switching behavior which explains that all these methods has be used to assess the human response and perception towards the different brands(Lim, 2018) [14].

Table 1: List of reviewed studies for each topic/sub-topic

Theme	Sub theme	Author & Year
Advertising		Ismajli, A., Ziberi, B., & Metushi, A. (2022)
	Attention	Alsharif, A. H., Salleh, N. Z. M., *et al* (2021) [1]
	Memory	Cheung, M. F., & To, W. M. (2021) [56]
		Gupta, S., Gallear, D., Rudd, J., & Foroudi, P. (2020) [52]
	Preferences	Opris, I., Ionescu, S. C., Lebedev, M. A., *et al.* (2020) [51]
		Sung, B., Wilson, N. J., Yun, J. H., & Lee, E. J. (2020) [42]
		Andrew, H., Haines, H., & Seixas, S. (2019) [55]
		Constantinescu, M., Orindaru, A., Pachitanu, A., *et al.* (2019) [53]
		Lim, W. M. (2018) [14]
		Daugherty, T., Hoffman, E., & Kennedy, K. (2016) [50]
		Fugate, D. L. (2007) [49]
		Kenning, P., & Plassmann, H. (2005) [32]
Product		Alsharif, A. H., Salleh, N. Z. M., *et al* (2021) [1]
		Chattopadhyay, R. (2020) [37]
	Purchase Intention	Sung, B., Wilson, N. J., Yun, J. H., & Lee, E. J. (2020) [42]
	Design	Aragoncillo, L., & Orus, C. (2018) [28]
	Innovation	Daugherty, T., Hoffman, E., & Kennedy, K. (2016) [50].
		Fugate, D. L. (2007) [49]
		Kenning, P., & Plassmann, H. (2005) [32]
Price		Chattopadhyay, R. (2020) [37]
	Sales	Sung, B., Wilson, N. J., Yun, J. H., & Lee, E. J. (2020) [42]
	cost	Aragoncillo, L., & Orus, C. (2018) [28]
		Daugherty, T., Hoffman, E., & Kennedy, K. (2016) [50].
		Fugate, D. L. (2007) [49]
		Kenning, P., & Plassmann, H. (2005) [32]
Brand		Chattopadhyay, R. (2020) [37]
		Gupta, S., Gallear, D., Rudd, J., & Foroudi, P. (2020) [52]
	Brand logo	Sung, B., Wilson, N. J., Yun, J. H., & Lee, E. J. (2020) [42].
	experience	Aragoncillo, L., & Orus, C. (2018) [28]
	Attention	Daugherty, T., Hoffman, E., & Kennedy, K. (2016) [50]
		Fugate, D. L. (2007) [49]
		Kenning, P., & Plassmann, H. (2005) [32]

5. Neuroscience in various disciplines

5.1. Neuroscience in economics

With the aim of creating a biological model of decision-making in economic situations, neuroeconomics is a multidisciplinary field of study that combines economics, psychology, and neuroscience. Neuroeconomic studies investigate the relationship between in-the-moment brain activity and a variety of decision-making processes, including weighing choices, weighing risks and benefits, making decisions, and engaging with people who may be impacted by the decisions (Camerer, Loewenstein, & Prelec, 2005; Gui, X. U. E., Chuansheng, C. H. E. N., Zhong-Lin, L. U., *et al* (2010) [34, 33]. Prior to the development of neuroeconomics, behavioural economists created a number of models to explain, forecast, and direct how people make economic decisions. Two general categories can be used to classify these models. The so-called normative or prescriptive models fall under one group and focus on the best choices. These theories explain how people should make the best decisions by presuming that they are completely informed, rational, and rationally capable. The second group, the so-called descriptive or predictive models, is concerned with how individuals really come to judgements in daily life. Understanding the neurological causes of irrationality, or why people frequently do not make the best decisions, is one

of the main goals of neuroecnomics Gui, X. U. E., Chuansheng, C. H. E. N., Zhong-Lin, L. U., *et al* (2010) [34, 33]. When humans obtain some useful good (such as money, juice, or other incentives) by making judgements, neuroeconomic methods may help to tackle these problems. In several experiments, activation in the brain's so-called "reward regions" was seen Kenning, P., & Plassmann, H. (2005) [32]; S. Erk, M. Spitzer, A.P. Wunderlich, *et al* (2002) [31] People rarely know with confidence what effects different courses of action will have when selecting between them; the majority of decisions are made in risky situations wherein neuroeconomics helps in finding the decision making power of consumer Loewenstein, G., Rick, S., & Cohen, J. D. (2008) [35].

5.2. Neuroscience in organizational behaviour

An original viewpoint is offered by organisational neuroscience, which contends that a neuroscientific approach enhances rather than replaces a social scientific one. Due to their nature, humans are greatly influenced by their social environment. The human brain is designed to live and work in social groupings (Cacioppo & Patrick, 2008; Goleman, 2006; Haidt, 2006) [39, 40]. Our biology not only helps to explain individual differences but also why and how we are influenced by social cues Becker, W. J., Cropanzano, R., &

Sanfey, A. G. (2011) [36]. The field of social neurosciences that focuses on brain signals in connection with trust, competition, social norms, and empathy has already been identified through studies (Rilling and Sanfey, 2011; Chattopadhyay, R. (2020) [38, 37]. The addition of organisational neuroscience raises the level of analysis. This compels researchers to examine new levels of reduction that reduce people to separate brain functions, which has potential benefits but also risks (Ashkanasy, 2003; Barsade, Ramarajan, & Westen, 2009; Becker, W. J., Cropanzano, R., & Sanfey, A. G. (2011) [36] Neuroscientists are aware of this problem. To be sure, neuroscience has relentlessly pursued reductionism, making great progress in breaking down brain activities to the molecular level (Bickle, 2006). The complexity of human cognition and behaviour must be explained by interactions between higher and lower levels, according to neuroscience Becker, W. J., Cropanzano, R., & Sanfey, A. G. (2011) [36]. To incorporate neuroscientists' accomplishments into the associated sciences within organisational behaviour have made significant progress in comprehending a variety of challenges, such as human perception, attitude creation, and so on.

5.3. Neuroscience in marketing
Every marketing literature aims to comprehend the consequences of diverse marketing stimuli. Consumer behavior literature in particular has recognized that messages from marketing communications and numerous other stimuli can either elicit core or peripheral processes (Petty *et al*., 1983) [46]. The effects of peripheral signals, or more subtle, implicit parts of advertisements, are not yet well established in the marketing literature, whereas the influence of marketing stimuli results in central processes that are aware and explicit. Researchers in marketing are now able to systematically examine the effects of subliminal advertising thanks to neuro scientific methods. According to a meta-analysis of fMRI research, being exposed to subliminal arousing stimuli can cause some brain regions to become active. (Brooks *et al*., 2012) [47]. According to a meta-analysis of fMRI studies by Bartra, *et al*. (2010) [48] While "subjective values" are significantly correlated with the activity of the prefrontal and orbito frontal cortices, "reward" is always associated with the activity of the striatum. "Subjective values" are mostly associated with some strategic marketing considerations, such as packaging and brand choice, aside from product quality and pricing Chattopadhyay, R. (2020); Sung, B., Wilson, N. J., *et al* (2020) [37, 42]. According to recent studies, it is becoming increasingly advantageous to evaluate consumers' physiology, such as their facial expressions, in order to reveal their psychology, such as their emotions in relation to marketing techniques or stimuli (Lajante and Ladhari, 2019). The benefit of neuromarketing techniques is that they make it possible to closely examine unnoticed internal mechanisms. Marketing stimuli cause a series of reactions, including those involving attention, emotion, memory, and learning. Pozharliev *et al*. (2015) [45] ERP study looks at how consumers' attention to premium brands alters depending on whether or not they are with company Sung, B., Wilson, N. J., *et al* (2020) [42]. Self-reported measures are frequently used in marketing research to evaluate consumer reactions to advertising stimuli. Although these methods are straightforward and affordable, they have come under fire for failing to record the first unconscious emotional responses to stimuli and for distorting

emotional responses through the socially desirable response effects (Li *et al*., 2014) [43].

6. Conclusion
The purpose of this study is to present the a comprehensive review of the wide- ranging spectrum of neuroscience techniques and evaluates their suitability for consumer neuroscience applications In a very short time, consumer neuroscience has established a clear research link between the brain sciences and the applied business-related types of research. The new scientific field of consumer neuroscience is gradually building momentum and credibility as the interface of neuroscience, consumer psychology, marketing, economics, and decision sciences. The findings suggested that neuroimaging and physiological methods/techniques are highly significant to capture/record consumers' mental and physiological responses toward the marketing mix.
This study finds neuroscientific research works were started to identify the different patterns of neuro signals in response to various marketing activities, the different discipline has entered into consumer psychology domain where depth variables of psychological aspects can be tracked through neuroscientific techniques.
In broader sense, organizational behaviour has extended mainly through neuroscientifc techniques by understanding consumer psychology. Other discipline and technique are equally important but are not independently alone enough. Management have embraced multidisciplinary approaches by incorporating different disciplines such as economics, psychology, organizational behavior, finance, marketing and therefore integration of neuroscience in these field will help further expansion in more knowledge of consumer psychology.

7. Future scope
Based on review of existing literature this study identifies three major areas where neuromarketing techniques can be rewired and can be broadly expanded for further research. Ethics, cost and small sample are areas where neuromarketing broadly faces challenges. The first challenge is ethical concern around neuromarketing many research have collected data of human mind at conscious and unconscious levels which is considered as disregarded. The most often concerns involve loss of privacy, lack of control of brain data, threat to consumer choice. Neuromarketing studies are only aim to predict consumer behaviour not to fore consumer to purchase product. The second challenge is cost psychological tools that is neuromarketing tools FMRI and EEG in comparison to other are expensive. The rental cost, the usage cost and the purchasing cost overall limit the use of machines to a certain level. Training the operators to correct usage of machines is itself an expensive cost. Overall neuromarketing tools and technique cost higher whereas the collaboration of neuroscientists with certain business schools and top marketing journal could serve as medium in reduction of high end cost. The third challenge to neuromarketing is small sample size in traditional research. The sample size determine the result of the neuromarketing data carrying out the generability and validity of the results. The concern over reliability of data and accurate findings is questionable to small sample size.
Loss of privacy is the major issues in neuro marketing at all industry level. Although researchers conduct the experiments under the consent maintaining the ethical concerns. To collect

data which is not to be shared among public a strict guidelines to follow code of ethics has become the criteria.

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