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Research Paper

Global Trends and Evolution in Eye Tracking Research: A Scientometric Analysis Using VOS Viewer

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Abstract

Introduction and Objective: Introduction: Eye-tracking has emerged as a powerful tool in psychology, education, and technology, and understanding its global research trends is essential for mapping its scholarly evolution. This study aims to explore the global trends and developmental trajectory of Eye Tracking research by employing a scient metric analysis to offer a holistic overview of its scholarly growth and impact.

Research Methodology: A systematic search was conducted in the Web of Science database, retrieving 4,370 relevant articles published between 1990 and 2021. The data were analyzed using VOS viewer software through co-authorship networks, keyword co-occurrence mapping, and trend visualization techniques.

Findings: The results reveal a significant and accelerating growth in Eye Tracking publications, particularly over the past decade. Prominent keywords such as Eye-tracking, Movements, Information, Attention, Perception, Children, and Performance reflect the field's thematic diversity and growing relevance across various disciplines. A notable shift in research focus is observed—from early investigations into psychological disorders to more recent emphasis on cognitive processes and executive functions.

Conclusion: This study provides a comprehensive roadmap of the evolution of Eye Tracking research, offering valuable insights into past trends, present hotspots, and future directions, with implications for its application in domains such as education, marketing, and technology.

Value: The novelty of this research lies in its integrative use of scient metric tools to identify emerging topics, map interdisciplinary connections, and highlight underexplored areas in Eye Tracking studies.

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Introduction

Understanding the intricate relationship between visual perception and cognitive processes remains a central focus in cognitive neuroscience and psychology. The human visual system serves as a primary channel for information intake, and its study provides insights into how individuals perceive, process, and respond to stimuli in their environment. Among the technologies that have advanced this understanding, eye tracking stands out as a non-invasive, precise method for capturing eye movements and measuring visual attention in real time (Ivanchenko et al., 2021).

Eye tracking enables researchers to determine where individuals are looking (fixations), how quickly their gaze shifts (saccades), and how long they focus on specific elements. These metrics offer valuable data about attentional focus, cognitive load, and information processing strategies (Eraslan et al., 2015; Rainoldi & Jooss, 2020). The classification of eye movements—such as fixations, saccades, and smooth pursuits—helps researchers infer the sequential nature of cognitive processes and how attention is allocated across visual scenes (De Cock et al., 2019). The eye–mind hypothesis, which posits a direct link between gaze location and mental focus, further supports the use of eye tracking as a proxy for studying cognition (Strukelj & Niehorster, 2018).

Beyond the foundational studies, recent advances in infrared camera technologies, machine learning algorithms, and data analytics have greatly enhanced the accuracy and applicability of eye tracking across fields like education, marketing, user experience design, and medical diagnostics (Elbaum et al., 2017; Hassoumi et al., 2018). These technological improvements not only allow for more detailed observation of visual behavior but also enable researchers to explore individual differences, learning patterns, and decision-making processes with greater precision.

Given the exponential growth in publications and the multidisciplinary expansion of eye tracking applications, it becomes increasingly important to understand the structure, evolution, and thematic focus of this research domain. Scientometric analysis, which combines bibliometric data with visualization tools, provides a robust framework for mapping scientific production, identifying influential studies, and highlighting emerging trends. Therefore, this study employs scientometric methods using VOSviewer to systematically analyze global research on eye tracking from 1990 to 2021, offering a comprehensive view of the field's development and future directions.

To further explore the structure and development of scientific knowledge in eye tracking research, scientometric methods offer powerful tools for quantitatively analyzing large volumes of scholarly data. These methods help researchers assess research productivity, identify influential authors and institutions, visualize thematic trends, and map the intellectual and social structure of a given field (Aria & Cuccurullo, 2017; Donthu et al., 2021). Through the analysis of co-authorship, co-citation, and keyword co-occurrence networks, scientometrics enables the identification of collaboration patterns, research clusters, and the evolution of scientific discourse.

Furthermore, the visualization of scientific collaboration networks—in which nodes represent entities such as authors, countries, or institutions, and links indicate collaborative relationships—provides insights into the dynamics of knowledge exchange and interdisciplinary integration. Modern tools like VOSviewer facilitate this process by generating visual maps that highlight the proximity and strength of connections between research elements (van Eck & Waltman, 2010). In this study, scientometric techniques are used to systematically examine the global landscape of eye tracking research, focusing on key contributors, publication trends, and emerging themes.

One of the most widely adopted tools for generating bibliometric maps is the Visualization of Similarities (VOS) method, implemented in the software VOSviewer. This tool allows researchers to map, analyze, and visually explore the structure of scientific knowledge within a research domain. VOSviewer operates based on co-occurrence matrices, which are data tables that indicate how frequently pairs of items (such as terms or authors) appear together in a dataset. These matrices are normalized to account for different scales of occurrence and form the basis for measuring similarities between terms (Van Eck & Waltman, 2010).

VOSviewer applies clustering algorithms that group related terms into clusters, each typically represented by a different color. Terms positioned closely on the map are interpreted as having stronger semantic relationships, reflecting shared contexts in the literature. For example, clusters may reveal thematic subfields or research specialties within a broader scientific area. The proximity of terms visually indicates how frequently they co-occur and their conceptual relatedness (Perianes-Rodriguez et al., 2016).

Moreover, the software enables temporal visualizations, where terms can be color-coded by the year of publication, helping track the evolution of research trends over time. VOSviewer also adjusts font sizes and box dimensions to reflect the frequency or weight of terms—larger fonts indicate higher relevance or frequency of appearance. Beyond keywords, VOSviewer supports the visualization of networks related to countries, institutions, authorship collaborations, and citation patterns, offering a comprehensive overview of the scientific landscape (Waltman et al., 2023).

Designing scientific and social structure of researchers in a scientific field supplies useful information on their status in a scientific body (Esmaeili Mahyari et al., 2021). Bulk of scientific productions indexed on ISI database known as Thomson Reuters is a significant criterion for evaluating and ranking scientific status of countries, researchers and universities (Verma et al., 2020).

Some bibliographic studies examined the trend of scientific production in various fields of science (Zancanaro, Todesco & Ramos, 2015). In regard to searching in scientific resources in the field of eye movement tracking, no bibliometric review of "eye movement tracking" topic in web of science database has been conducted yet. Current study is carried out with the aim of bibliometric analysis of scientific productions published in web of science database concerning with the topic of eye movement tracking and designing the world scientific map in this field. To do so, top journals, researchers, countries and institutions in the world, most cited articles, most frequent keywords and co-authorship status are investigated.

Visual apparatus is one of the most specialized perceptive organs and one of the most important senses (Toivanen et al., 2017). Therefore, visual data are the most reliable of all. Perception is a process during which sensory information is received via sensory apparatuses and interpreted in the brain (Rigas et al., 2018). Numerous psychological theories are developed to understand visual processing (Anderson, 2015).

Eye tracking dates back to 100 years ago when it was applied for the first time in researches about how to study and interpret. This technology first began by installing electrodes around eyes to measure their movements. As a result, a metal coil was implanted around a large lens used to surround the cornea and sclera of the eye (Grüner & Ansorge, 2017). Eye tracking is done by measuring the fluctuation in the electromagnetic field based on the movement of the coil corresponding to the eye movements.

Not only dose eye tracking process measure gaze points but also measure eye movements when head is fixed. Eye tracking tool is used to gather data from parts of stimuli drawing one's attention in real-time (Klaib, et al., 2021).

Main assumption in eye tracking researches is eye-mind hypothesis (Blignaut, 2018). According to this hypothesis, during a visual task gaze point indicates mental functions which one is engaged in. In this hypothesis, exact scan path (gazing) refers to what a person is thinking about currently. This thinking may indicate that a person is interested in a problem he/she is faced with. Processing data that are drawn from words received in the form of images through eyes is shown in figures 1 and 2. Eye tracking can reveal the succession of subjects' activities (Chen et al., 2024).

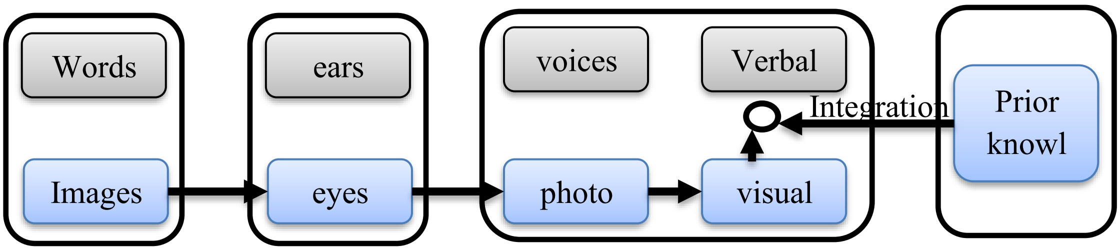

Figure 1. Processing of visual data through the eye (Holzinger, 2014)

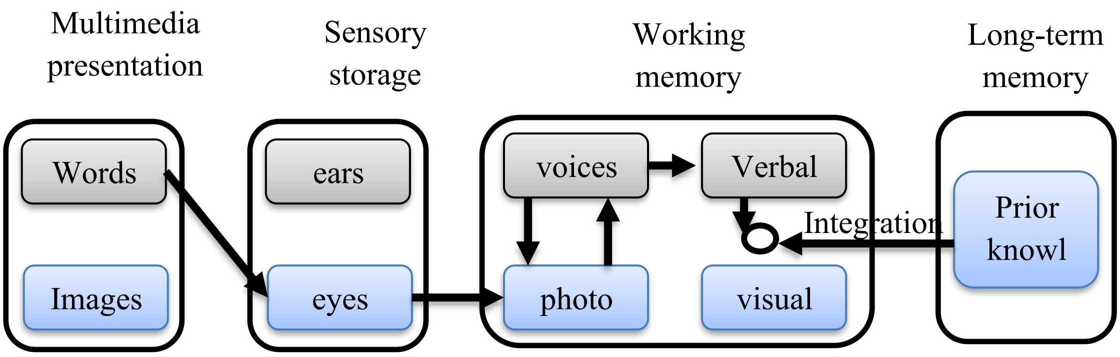

Figure 2. Processing of Verbal data through the eye (Holzinger, 2014)

The volume of data processed for an object in a visual point can be estimated by assessing or measuring other aspects of eye movements such as gazing (the moment when the eyes are relatively fixed and receiving or encoding data) (Horsley & et al., 2013).

By tracking eye movements, we can determine what a subject is looking at and how long it lasts. The location, movement, and size of a pupil are measured by eye tracking systems to determine which parts of a visual scene a subject is interested in. eye tracking can be applied in various research fields such as visual systems (Ulutas et al., 2020; Hasse & Bruder, 2023); neuroscience and psychology(Cutumisu, et al., 2019); psychology and health cares (Park & et al., 2017; Chen & et al., 2018); Interactions and experiences of users (Lukander, 2016); Achieving professional results, costumer researches and marketing (Hang, Yi, & Xianglan, 2018); clinical research , economy and education (Colliot & Jamet, 2018); sport performance and researches, product designing and software engineering (Obaidellah, Al Haek, & Cheng, 2018; Sharafi, Soh & Guéhéneuc, 2015); transportation (Carter & Luke, 2020); virtual reality (Clay, König, & König, 2019). The eye tracking system detects pupil size, processes images, filters data, and records eye movements using fixed point, fixation time, and saccades (Klaib et al., 2021).

In recent years, several bibliometric and scientometric studies have attempted to explore different dimensions of eye-tracking research. For example, Chen et al. (2024) conducted a co-citation analysis to uncover influential works and key authors in the field, while Li and Zhao (2022) mapped collaboration networks and thematic trends. However, these studies tend to focus on isolated metrics such as citation frequency or co-authorship patterns, offering limited insight into the semantic landscape and evolving structure of research topics. Moreover, there is a noticeable lack of co-word analysis studies that systematically trace the conceptual development and interconnectedness of key terms across time.

Despite the considerable number of publications on eye movement tracking, previous research in this domain often lacks a systematic overview of the intellectual structure, thematic evolution, and keyword dynamics within the field. While many studies have addressed specific experimental or technical aspects, few have provided a comprehensive scientometric analysis that uncovers underlying conceptual frameworks, topic clusters, and temporal research trends.

This study addresses this gap by employing co-occurrence analysis of keywords to construct a scientific knowledge map of research on eye tracking indexed in the Web of Science. By identifying frequent terms, core themes, and the structure of topic clusters, the study aims to reveal how research topics have evolved over time and which subjects have attracted the most scholarly attention. Furthermore, the mapping of keyword networks enables the identification of conceptual linkages among research areas and highlights underexplored domains that could be considered as potential avenues for future investigations.

Thus, the novelty of this research lies in its integrated bibliometric approach to visualize and interpret the knowledge structure of the field, offering scholars a clearer roadmap of past achievements, current hotspots, and future directions in eye movement tracking research.

Methodology

In this descriptive-analytical study, a bibliometric analysis was conducted using scientometric techniques, particularly co-word analysis, to explore the intellectual and thematic structure of the field. Scientometric methods refer to the quantitative analysis of scientific publications to evaluate trends, patterns, and knowledge structures within a research domain. This method was selected due to its capacity to uncover hidden relationships among topics and to visualize the evolution of research trends over time.

Additionally, network analysis techniques were employed to examine the co-occurrence of keywords and identify conceptual linkages between different areas of study. It is important to clarify that the term "social media analysis" in this context does not refer to the analysis of social media platforms, but rather to the application of social network analysis principles—commonly used in social sciences—for mapping scholarly collaboration networks and keyword connections.

The research population includes all scientific publications related to eye movement tracking indexed in the Web of Science (WoS) database. Records were retrieved from the Core Collection of WoS using the keyword "Eye Tracking" in the Title field. The search was conducted without any time restrictions on June 16, 2022. To ensure the relevance and quality of the dataset, only peer-reviewed articles and conference papers were included, and duplicates or records lacking bibliographic completeness were excluded from the analysis.

The retrieved records were downloaded from the Web of Science (WoS) database in both Excel (.csv) and text (.txt) formats. These formats were selected due to their compatibility with bibliometric analysis software such as VOSviewer, and their ability to organize large datasets in a structured and editable manner. The Excel format facilitates sorting, filtering, and preliminary statistical analysis, while the .txt format ensures proper data encoding for use in co-occurrence and network visualization tools.

To address the research questions, several bibliometric indicators provided by the WoS database were used, including publication counts, citation counts, and country and author affiliations (Mas-Tur et al., 2020). Full records including titles, abstracts, keywords, author information, references, and source titles were extracted and imported into VOSviewer version 1.6.18 for advanced analysis.

The data were analyzed using co-word analysis to identify the frequency and co-occurrence of keywords, co-authorship analysis to explore collaboration patterns among authors and countries, and citation analysis to detect the most influential works. In co-occurrence analysis, keywords that appeared at least five times in the dataset were included. For country-level analysis, only countries with at least five publications were considered to ensure statistical reliability and comparability.

The main goal of this study is to report the trend of publications and citations from the beginning of the field of eye movements tracking onwards and design knowledge map. In this regard, we aim to find dynamics and the trend of publications in this field, most cited articles, most prolific journals, countries, authors and institutions and the pattern of collaboration between institutions and countries and most frequent words and the trend of transformation of the most frequent words during the time.

Results

As the results of this study revealed, a total of 4,370 scientific documents related to *eye movement tracking* were retrieved from the Web of Science database. These publications span the period from 1938 to 2021. Figure 3 presents a graphical representation of the annual publication trends, illustrating the evolution of research in this field over time.

The earliest record, published in 1938, accounts for only 0.023% of the total retrieved documents (1 out of 4370). The peak of publication activity was observed in 2020, with 569 articles, which comprises approximately 13% of all documents. This trend reflects a growing scholarly interest in eye tracking technologies and their applications across diverse scientific domains.

The first indexed ISI article in this field appeared in *COMPTES RENDUS DES SEANCES DE LA SOCIETE DE BIOLOGIE ET DE SES FILIALES*. Authored by Masson Editor, the article was titled *"The role of the eyes and the oculo-hypophysial nerve track in gonad stimulation by artificial light in a domestic duck"*.

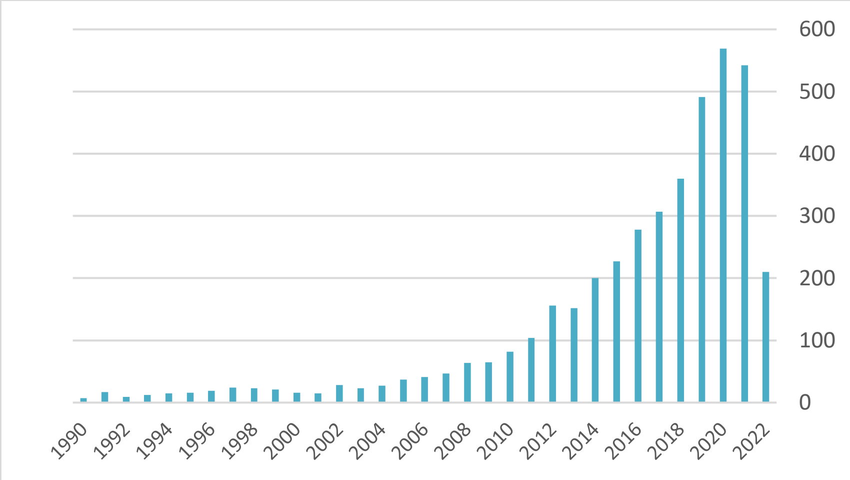

Figure 3. Annual number of published articles on eye tracking (1938–2021)

Table 1 lists the ten most highly cited publications in the field of eye tracking research according to Web of Science data. These articles, published between 1961 and 2015, have each received at least 300 citations. The table includes the authors, year of publication, article titles, total citations, and citations per year.

The most cited work is by Allopenna, PD; Magnuson, JS; and Tanenhaus, MK (1998), titled *"Tracking the time course of spoken word recognition using eye movements: Evidence for continuous mapping models"*, with 883 citations and an average of 35.32 citations per year in WoS. According to Google Scholar, this article has received approximately 892 citations, indicating its substantial influence.

Another seminal article is by C. Rashbass (1961), titled *"Relationship Between Saccadic and Smooth Tracking Eye Movement"*, with 769 citations in WoS and 1,224 citations in Google Scholar, reflecting its foundational role in early eye movement research.

These highly cited articles cover a range of research themes, including psycholinguistics, human-computer interaction, clinical psychology, and neurophysiology, showcasing the interdisciplinary impact of eye tracking studies.

Table 1. Eye tracking's most influential articles

Rank	Total Citations	Title	Authors	Publication Year	Cites Per Year
1	883	Tracking the time course of spoken word recognition using eye movements: Evidence for continuous mapping models	Allopenna, PD; Magnuson, JS; Tanenhaus, MK	1998	35.32
2	769	Relationship Between saccadic and smooth tracking eye movement	RASHBASS, C	1961	12.4
3	701	Terrestrial animal tracking as an eye on life and planet	Kays, R., Crofoot, M. C.,	2015	87.63

			Jetz, W., & Wikelski, M.		
4	642	The Eyelink Toolbox: Eye tracking with MATLAB and the psychophysics toolbox	Cornelissen, FW; Peters, EM & Palmer, J	2002	30.57
5	537	Eye tracking of attention in the affective disorders: A meta-analytic review and synthesis	Armstrong, T & Olatunji, BO	2012	48.82
6	492	A breadth-first survey of eye-tracking applications	Duchowski, AT	2002	23.43
7	416	Eye gaze tracking techniques for interactive applications	Morimoto, CH & Mimica, MRM	2005	23.11
8	412	Eye-tracking dysfunctions in schizophrenic patients and their relatives	Holzman, P. S., Proctor, L. R., Levy, D. L., Yasillo, N. J., Meltzer, H. Y., & Hurt, S. W.	1974	8.41
9	382	Eye-tracking patterns in schizophrenia	Holzman, P. S., Proctor, L. R., & Hughes, D. W.	1973	7.64
10	307	Expertise Differences in the Comprehension of Visualizations: A Meta-Analysis of Eye-Tracking Research in Professional Domains	Gegenfurtner, A; Lehtinen, E & Saljo, R	2011	25.58

The authors, institutions, and countries associated with Eye Tracking are presented in this subsection. Among the top 10 contributors to Eye Tracking, Table 2 lists their names. The results are ordered by the number of publications only on Eye Tracking. More than ten articles have been published by the authors on this list, and more than 100 citations have been received from them. A list of articles presents associated affiliation, total citations, the H-index, country, and the total number of citations per article. The American continent makes up the majority of contributions. Among the countries represented, the United States is the most representative. According to research published by Iacono WG from the University of Minnesota System in the USA, he has 25 publications on Eye Tracking. Holzman PS of McLean Hospital in the USA and Levy DL of Harvard University in the USA are the second and third most productive authors, with 22 and 17 articles, respectively. Scientists' contributions to a particular research area can be evaluated using the H-index (Hirsch, 2005). The amount of work a certain author produce is directly related to their visibility and quantity (Bornmann & Daniel, 2007). A total of more than 100 citations were received by each of these 10 most cited authors, and their H-index ranged from 5 to 16. The most cited scholar, Iacono WG, has an H-index of 16, followed by Holzman PS and Levy DL. In addition to being the most referenced authors, Iacono WG and Levy DL also rank as the most influential authors with 1029 and 2158 citations, respectively.

Table 2. The most influential and productive eye tracking writers

Rank	Author	Affiliation	Country	Total Publications	Total Cites	h index	Cites Per Publication
1	Iacono WG	University of Minnesota System	USA	25	1029	16	41.16

2	Holzman PS	McLean Hospital & Psychol Res Lab	USA	22	2158	13	98.09
3	Levy DL	Harvard University & McLean Hosp	USA	17	1459	10	85.82
4	Thaker GK	University of Maryland Baltimore & Sch Med	USA	17	315	7	18.53
5	Holmqvist K	Nicolaus Copernicus University & Dept Psychol	POLAND	15	322	8	21.47
6	Hooge ITC	Utrecht University & Helmholtz Inst	NETHERLANDS	15	180	7	12
7	Lencer R	University of Muenster	Germany	15	322	9	21.47
8	Moeller K	Leibniz Institut fur Wissensmedien	Germany	14	281	9	20.07
9	Wang Y	Chinese Academy of Sciences & Shanghai Inst Ceram	CHINA	14	119	5	8.5
10	Samadani U	University of Minnesota System & Dept Bioinformat & Computat Biol	USA	13	123	5	9.46

As shown in Table 3, the 10 major university affiliations of Eye Tracking authors are listed according to the total number of publications on the subject. With 339 publications, 6709 citations, a H-index of 41, and an average of 19.79 citations per publication, the League of European Research Universities has the most publication numbers, citations, and cited publications (339). HARVARD UNIVERSITY (USA) has a higher citation rate of 34.31, despite having fewer publications and citations (72 and 2470, respectively).

Table 3. Institutions contributing to the development and application of Eye Tracking

Rank	Institution	Country	Total Publications	Total Cites	H index	Cites per Publication
1	League of European Research Universities	Belgium	339	6709	41	19.79
2	University of California	USA	124	3901	30	31.46
3	University of London	UK	103	1305	22	12.67
4	Centre national de la recherche scientifique	France	80	1069	17	13.36
5	Eberhard Karls University of Tübingen	Germany	80	1554	23	19.43
6	Udice French Research Universities	France	79	1305	20	16.52
7	Pennsylvania Commonwealth System of Higher Education	USA	73	1277	18	17.49
8	Harvard University	USA	72	2470	24	34.31
9	University College London	UK	64	819	16	12.8
10	State University System of Florida	USA	55	959	17	17.44

A graphic representation of the co-authorship network of Eye Tracking authors is shown in Figure 4. In order to create this map, the authors' co-citation data was analyzed. Each author is assigned a color according to the clustering technique based on his/her affiliation with the group. In its simplest sense, clustering represents the relationships between authors. In comparison to tools like SPSS and Pajek, the VOS viewer is one of its major advantages. Overlapping labels, for example, hinder clear visualization in these tools.

Eight groups of co-authors are highlighted in the graph. Group 1, consisting of M. Ishii, J. Chen, J. liu, J. Zheng, I. Wang, Q. Z. Wang and L. Li represented by red. group 2 consisting of C. Lui, F. guo, S. Wang, H. liu and B. laeng represented by yellow. Orange denotes group 3 which consists of, C.C. Tsai, C.Y. Wang, M.J. Tsai and F.Y. Yang. Purple corresponds to group 4, consisting of, S.W. Cheng, Y. liu, Y. Wang and T. Jackson. Brown corresponds to group 5, consisting of, ITC. Hooge, T. Falck-ytter and R.S. Hessels. Green corresponds to group 6, consisting of, M.J. Pickering, S.P. Liversedge, S. Schroeder, J. Hyona, H. Fu and J. Li. light blue corresponds to group 7, which is formed by, D. C. Niehorster, M. Stridh, M. Nystrom and K. Holmqvist. Finally, Dark blue corresponds to group 8, which is formed by T. Van gog, H. Jarodzka, K. Scheiter, P. Gerjets and Y. Kammerer. Three of the most important authors in the field (Table 2) are in group one, which connects the two other groups.

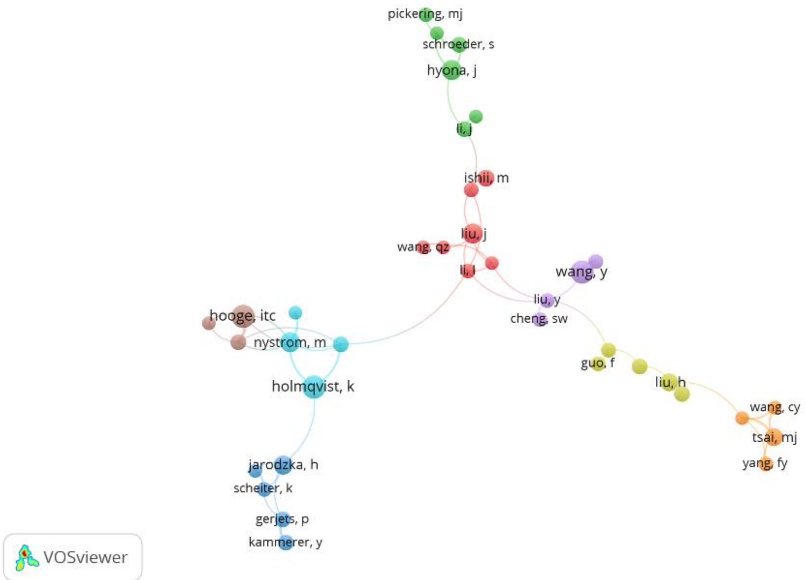

Figure 4. Map of co-authorships. Notes: Five documents are required per author, A total of 38 authors out of 12,519 meet this requirement.

Keywords are very important. They are main concepts through which author communicate with readers. Frequent words are shown by circle or rectangle. Larger and smaller circles and fonts mean more and less frequent words, respectively. Most frequent keywords in Figure 5 are Eye-tracking, Movements, Information, Attention, Perception, Children and Performance. According to co-occurrence of words, most frequent ones are clustered in five clusters each one is indicated with different color. Each cluster is titled appropriately based on most frequent words fallen into. Some more appropriate words and titles are mentioned in table 4.

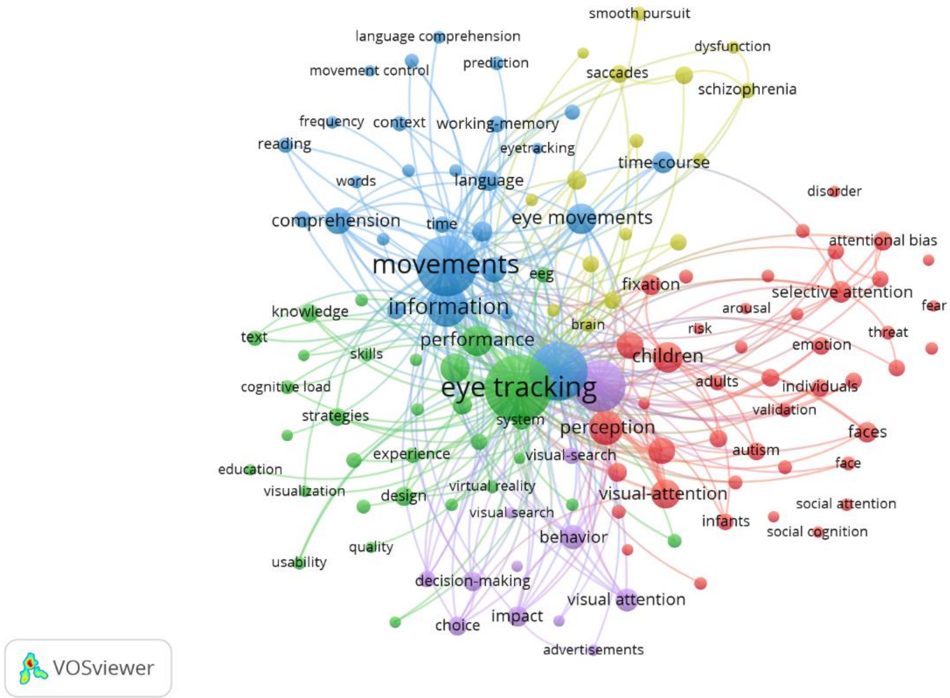

Figure 5. Conceptual overview of eye tracking. Notes: The keyword must appear at least 20 times; A total of 52 keywords meet these criteria out of 3,367

Table 4. Keyword clustering

Rank	Cluster Name	Keyword
1	Psychology	Adolescents, Adults, Anxiety, Attention bias, Attentional bias, Autism, Autism spectrum disorder, Avoidance, Children, Cognitive, Control, Contact, Depression, Disorders, Emotion, Emotion recognition, Emotional faces, Expressions face, Faces, Facial expressions, Fear gaze, Individuals, Inhibition, J attention, Mood, Risk scale, Selective attention, Social anxiety, Social attention, Social cognition, Stress, Vigilance
2	Linguistics	2nd-language, Acquisition, Activation, Age, Awareness, Complexity, Comprehension, Context, English, Individual differences, Knowledge, Language, Language comprehensic, Learners, Lexical access, Memory, Models, Movement, Prediction, Reading, Recognition, Sentence comprehension, Sentence processing, Skills, Speech, Speed, spoken language, World paradigm, Word recognition, Word-frequency, Words, Working memory
3	Eye tracking capabilities	Accuracy, Aesthetics, Calibration, Classification, Communication, Design, Diagnosis, Experience, Eye tracker, Familiarity, Features, Gaze behavior, Gaze estimation, Gaze tracking, Identification, Interface, Visual perception, Visual search Visual-search, Visualization, Workload
4	Neuromarketing	Advertisements, Attention, Brand, Choice, Consumers, Cues, Decision making, Decision-making, Information, Processing, Judgment, Motivation, Multimedia, Learning, Strategies, Television, Text, Video, Visual Attention
5	Neurosciences	Abnormalities, Brain, Cortex, Dementia, Dysfunction, fMRI, Humans, Impairment, Responses, Schizophrenia

Figure 6 shows the distribution of keywords in each year. bibliometric analysis revealed that frequent keywords are transformed from the oldest ones indicated with dark blue into the newest ones indicated with red in the last decade.

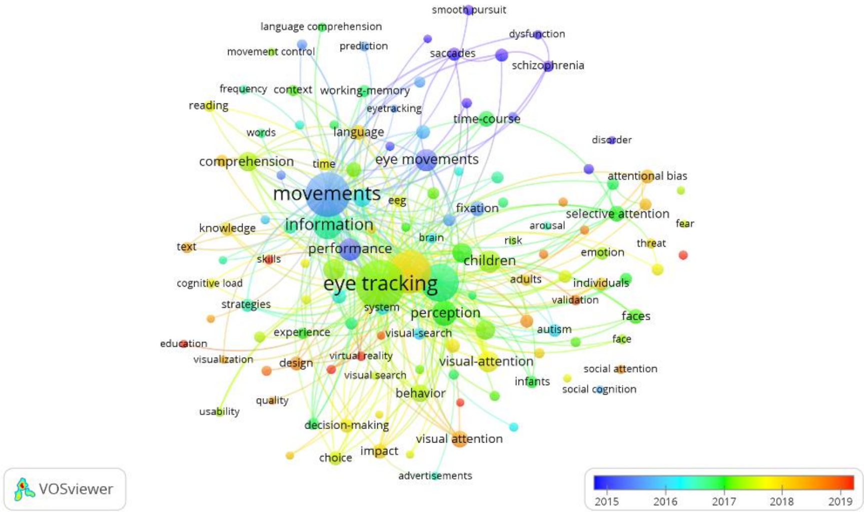

Figure 6. Distribute repetitive keywords per time period, Notes: The keyword must appear at least 20 times; Among the 3,367 keywords, 52 meet this requirement

Table 5. The process of transformation of the most frequent words based on time period

R	Color	keyword
1	Dark blue	Affective-disorders, relatives, dysfunction, movement dysfunction, abnormalities, schizophrenia, motion perception, smooth- pursuit
2	blue	Cortex, Parkinson's- diseases, prefrontal cortex, vigilance, position, feedback, kalman filter , evaluation
3	green	Hci, tracking, motion, inhibition, scale, algorism, performance, web search, color, video, perceptual span, resolution, sentences comprehension
4	yellow	Advertisement, information, multimedia learning, model, search, working- memory, decision making, communication, visual-search
5	orange	Designee, technology, education, mental work, impact, consumer behavior, visual world paradigm
6	red	Health, attention bias, meta-analysis, attitude, food choice, willingness-to-pay, inhibitory control, spectrum disorder

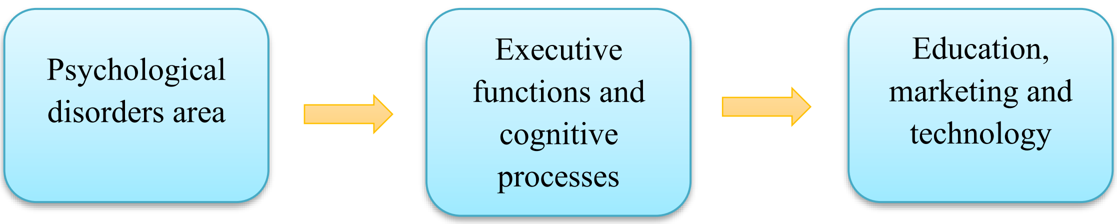

Figure 7. Keyword transformation paradigm

Regarding the trend in the transformation of the most frequently occurring keywords presented in Table 5, the terms within the **red** and **orange** clusters are primarily associated with the thematic domain of *"Education, Marketing, and Technology."* These keywords reflect an increasing scholarly interest in the application of eye-tracking methodologies within educational environments, consumer behavior studies, and human–computer interaction technologies. In contrast, the **green** and **yellow** clusters encompass terms related to *"Executive Functions and Cognitive Processes,"* indicating the central role of eye-tracking research in advancing our understanding of attention, working memory, and decision-making mechanisms. Furthermore, the **blue** cluster is mainly composed of keywords pertaining to the *"Psychological Disorders"* domain, representing the use of eye movement analysis as a diagnostic and investigative tool in the study of mental health conditions such as anxiety, depression, and schizophrenia.

Figure 7 provides a visual representation of the temporal evolution and thematic transition of these keyword clusters, highlighting how research priorities have shifted over time and how interdisciplinary applications of eye-tracking have emerged and expanded across diverse scientific fields.

Discussion and Conclusion

This article presents A bibliometric analysis of Eye Tracking research published between 1938 and 2020 based on data retrieved from the Web of Science (WoS). While previous studies have explored various experimental and technical aspects of eye-tracking, this research aims to provide a broader and more integrated view of the global research landscape in this domain. Through the analysis of publication trends, influential authors, institutions, and thematic evolution, the study offers a comprehensive understanding of the development and structure of the field over time.

The results of the study indicate that scientific publications on eye movement tracking began appearing in WoS-indexed journals approximately 12 years ago and have continued to grow steadily. As shown in Figure 3, the number of publications remained under 20 articles annually until 1970, after which a gradual increase is observed. A notable surge in publication volume is evident from 2010 onwards. However, due to the retrieval date being mid-January 2022, the decline in 2022 is likely due to the incomplete indexing of articles published in late 2021 and early 2022. The citation trend followed a similar trajectory, with moderate growth until 2007, followed by a substantial rise in the last decade. These findings suggest that the field of eye tracking remains dynamic and holds significant potential for future exploration and application, particularly as it intersects with emerging technologies and behavioral sciences.

In examining the most influential contributions, the article titled *"Tracking the time course of spoken word recognition using eye movements: Evidence for continuous mapping models"* by Allopenna, Magnuson, and Tanenhaus (1998) stands out with 883 citations in WoS. This work is notable for advancing theoretical models of spoken language processing using real-time eye movement data, which has had a lasting impact on both psycholinguistics and eye-tracking methodology. Similarly, foundational works such as Rashbass (1961), which examined the relationship between saccadic and smooth tracking eye movements, have contributed core physiological insights that continue to inform present-day studies.

A closer analysis of scholarly productivity revealed that Iacono WG, affiliated with the University of Minnesota System, is the most prolific author with 25 publications, while Holzman PS from McLean Hospital in the United States holds the highest citation count (2158). These patterns reflect both sustained engagement and deep influence in specific subfields, such as psychopathology and neurocognitive assessment.

From an institutional and geographic perspective, the United States leads in terms of total publications, reflecting strong institutional support and long-standing interest in eye-tracking research. Notably, the League of European Research Universities (Belgium) has also demonstrated significant output, with 339 publications, 6709 citations, and the highest h-index (41), indicating both quantity and quality of research impact.

Beyond quantitative indicators, this study also investigated keyword trends to understand thematic shifts within the field. Early research focused heavily on clinical and diagnostic applications, particularly in relation to psychological disorders such as schizophrenia and depression. Over time, the focus gradually shifted to broader cognitive processes and executive functions, and more recently, towards education, marketing, and technology applications. This shift reflects the interdisciplinary expansion of eye-tracking research and its growing relevance in applied behavioral sciences and user experience design.

As Hasse & Bruder (2020) suggest, the broadening scope of keywords and applications may not merely indicate a mature field but also underscore the need for further exploration and theoretical development. Eye-tracking has become increasingly integrated into studies of decision-making, learning behavior, and human–computer interaction, making it a valuable methodological tool across diverse research domains.

In conclusion, while the quantitative growth of the field is evident, this research also highlights the evolving qualitative nature of eye-tracking applications—from foundational physiological studies to sophisticated behavioral analytics—pointing to its pivotal role in the future of cognitive science, education, and technology-enhanced environments.

In this study, the main limitation lies in the exclusive reliance on the Web of Science (WoS) Core Collection database for data retrieval and analysis. While WoS is a reputable and widely used academic database, its coverage is not comprehensive. Relying solely on WoS may introduce a selection bias, as it may overlook relevant publications indexed in other databases such as Scopus, PubMed, or IEEE Xplore. Consequently, some significant studies, especially those published in non-English or region-specific journals, may have been excluded, potentially affecting the representativeness and completeness of the data set.

Another limitation is the limited depth in theoretical and conceptual elaboration regarding the field of Eye Tracking. As a quantitative bibliometric analysis, this study primarily focused on identifying publication patterns, citation metrics, and keyword trends. Thus, it does not provide an in-depth discussion of theoretical frameworks, methodological diversity, or the qualitative nuances of the content within the field.

Despite these limitations, the findings present a generalizable overview of global research trends, particularly from a macro-level perspective. However, to gain a more comprehensive understanding of the scientific landscape, future studies are recommended to combine bibliometric approaches with content analysis or systematic reviews.

Furthermore, it is suggested that future research explore specific clusters or thematic areas identified in this study—for example, the transition from clinical and cognitive applications of Eye Tracking to educational and marketing contexts. Comparative studies using multiple databases or longitudinal analyses of specific subdomains (e.g., Eye Tracking in learning analytics or consumer behavior) could also provide deeper insights. Additionally, employing mixed-method approaches that integrate bibliometric data with expert interviews or qualitative content analysis may offer a more nuanced understanding of emerging research fronts and practical applications in this evolving field.

Ethical Considerations

This study was conducted using data extracted from the Web of Science database; therefore, no human participants were directly involved, and ethical approval was not required.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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