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Literature Review: Impact of Noise on Cognitive Performance Using Electroencephalography

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Abstract. One of the environmental factors that can influence the onset of fatigue is noise exposure. Besides noise has a negative impact on everything from cognitive processes to mental and physical health. Noise's impact can be measured using brain activity and the waves it generates. This article's main objective is to review electroencephalography as a method for assessing the effects of noise on cognitive function. The purpose of this literature review was to identify any knowledge gaps in studies on the quantitative effects of noise on employees' mental health. The method is carried out by combining literature studies of the Scopus database and snowball search methods based on the stages of bibliometric analysis. Analysis research was done by observing trends in journals, authors, and keywords. The results are visualized with VOSviewer. The findings revealed that of the 30 articles examined, 28 used the experimental design method with continuous noise, and 10 used the time-frequency domain for feature extraction. According to the results of the study, there seems to be an increase in the use of EEG for performance measurements, such as mental fatigue, mental workload, working memory, attention, stress, and the presence of noise factors that influence cognitive performance. Overall this study identified a gap that shows the direction of future research that can still be developed to determine the impact of work environment factors on the cognitive aspects of workers.

Introduction

Workplace safety is essential in keeping workers safe. Human factors and ergonomics disciplines look at how people interact with their environment, technology, and work equipment, ensuring that human limitations and capabilities are considered making abilities [1]. Noise is one environmental factor that has an impact on job safety. In many workplaces, noise can be an issue. People's emotional and physical health, and ability to think clearly can all be negatively impacted by noise. The impact of noise on the brain and performance is frequently disregarded [2]. Non-auditory effects of noise exposure include perceived disorder, impairment, cognitive impairment, cardiovascular disruption, and sleep disturbance [3]. Long-term noise exposure is closely linked of several detrimental side effects, such as decreased productivity, stuttering, hearing loss, poor work performance, elevated levels of attention, lower hazard identification, and even higher risk of accidents [2]. Several studies have argued that noise has a negative impact on safety due to increased work errors and interruptions in safety communication [4,5]. Performance accuracy and working memory performance suffer suffered from noise, but not performance speed. Cognitive and mental functions reaction time, attention, memory, intelligence, and focus. Cognitive function changes cause human error, which raises the risk of accidents. Over time, this can result in decreased performance and productivity [6].

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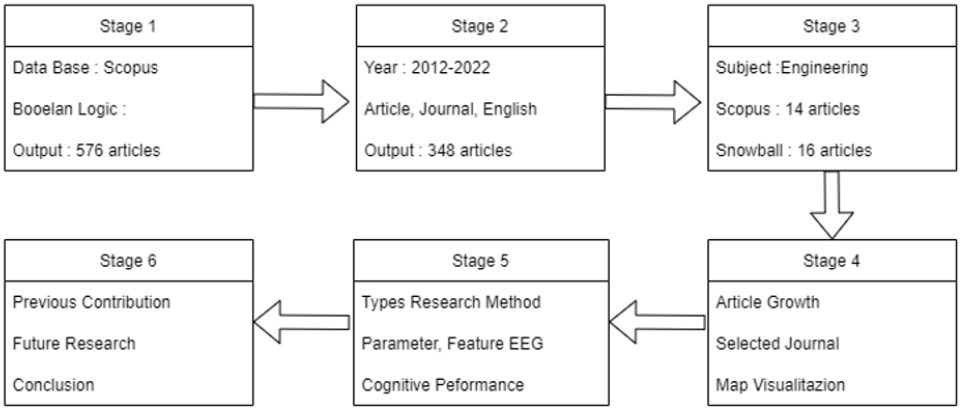
Performance throughout various cognitive activities, including perception, memory, retrieval, judgment, and decision-making, is referred to as cognitive performance [7]. Cognitive changes decrease perception and speed of response and decision-making. Changes in emotions and behavior can be in the form of increased stress, reduced patience, and motivation [8]. Recent advancements in artificial intelligence, autonomous systems, and industrial automation, collectively known as "Industry 4.0," have made it necessary for human operators to collaborate in challenging and rapidly evolving technical contexts. In these situations, high levels of cognitive and perceptual abilities are necessary [9,10]. Consequently, a greater understanding of human performance is necessary consider how the human brain works. Cognitive ergonomics is concerned with the mental processes of perception, information processing, and decision-making [11]. More than 100 billion neurons make up the human brain, which integrates all physical functions and controls every aspect of the body [12].Electrical signals that flow to form an electric current and a wave pattern called "brain signal" are used by neurons to communicate with one another. Several waves with various frequency ranges will be created from the EEG input. These waves are theta (4 to 8 Hz), alpha (8 to 13 Hz), beta (0 to 4 Hz), and delta (0 to 4 Hz) (13 – 35 Hz). Brain activity and the waves that result from it can be used to measure the impact of noise. An electroencephalogram (EEG) is typically used to record brain wave activity. The electrical signals that the brain generates in reaction to stimuli are recorded using a device called EEG [6] . According to cognitive theory, the brain plays a significant role in emotion. Primary emotions are distinct from the brain's electrical and metabolic processes in that they employ certain cortical and subcortical systems. As a result, the EEG is one of the best and most often used techniques for brain imaging the brain's activity in response to stress, including noise [13]. EEG offers benefits and drawbacks when compared to other neuroimaging techniques, making it both helpful and challenging neuro-ergonomic applications. EEG has several benefits, including high temporal resolution [14], mobility for use in practical situations, and affordability [15]. But the EEG approach has three significant flaws: (1) poor spatial resolution[16], (2) undesired non-brain signals or "artifacts" [17,18], and (3) a drawn-out preparatory procedures [17] .The types of EEG analysis techniques are time domain, frequency domain, time-frequency domain, and nonlinear techniques. Using the EEG index, irregular brain activity may be precisely measured. In this regard, it is vital to examine how noise affects cognitive performance using EEG.

The literature review reported in [19] focused on the methods used to study the effects of noise on cognitive performance qualitatively reviewed. Literature review discussed the classification of the use of EEG [20]. Meanwhile, this literature study was carried out on the influence of noise aspects on workers' cognition by paying attention to the type of noise and noise level using EEG. This article's primary goals are to comprehend the present state of knowledge based on related articles, to look at how EEG can be used to measure the effects of noise on cognitive function, and to comprehend research-related discoveries that are still relevant for further study.

Materials and Method

The literature review is one of the most important elements in research to map and review relevant literature and identify research gaps that will help strengthen further research that researchers can carry out. The analysis was carried out on libraries from the Scopus database and snowball search methods. The research method used is described in Fig. 1.



(TITTLE-ABS-KEY (**electroencephalography**) AND TITTLE-ABS-KEY (**noise**) AND TITTLE-ABS-KEY (**cognitive AND performance**) OR TITTLE-ABS-KEY (**cognitive AND taks**) OR TITTLE-ABS-KEY (**cognitive and work**) OR TITTLE-ABS-KEY (**mental AND states**)) AND (EXCLUDE (PUBYEAR, **2011**) OR EXCLUDE (PUBYEAR, **2010**) OR EXCLUDE (PUBYEAR, **2009**), OR EXCLUDE (PUBYEAR, **2008**) OR EXCLUDE (PUBYEAR, **2007**) OR EXCLUDE (PUBYEAR, **2006**) OR EXCLUDE (PUBYEAR, **2005**) OR EXCLUDE (PUBYEAR, **2004**) OR EXCLUDE (PUBYEAR, **2003**) OR EXCLUDE (PUBYEAR, **2002**) OR EXCLUDE (PUBYEAR, **2001**) OR EXCLUDE (PUBYEAR, **2000**) OR EXCLUDE (PUBYEAR, **1999**) OR EXCLUDE (PUBYEAR, **1997**) OR EXCLUDE (PUBYEAR, **1996**) OR EXCLUDE (PUBYEAR, **1995**) OR EXCLUDE (PUBYEAR, **1994**) OR EXCLUDE (PUBYEAR, **1993**) OR EXCLUDE (PUBYEAR, **1990**) OR EXCLUDE (PUBYEAR, **1989**) OR EXCLUDE (PUBYEAR, **1984**) OR EXCLUDE (PUBYEAR, **1982**) OR EXCLUDE (PUBYEAR, **1977**) OR EXCLUDE (PUBYEAR, **1974**) OR EXCLUDE (PUBYEAR, **1968**) AND (EXCLUDE (DOCTYPE, "**cp**") OR EXCLUDE (DOCTYPE,"**re**") OR EXCLUDE (DOCTYPE, "**ch**") OR EXCLUDE (DOCTYPE, "**ed**") AND (EXCLUDE(LANGUAGE, "**Chinese**") OR EXCLUDE (LANGUAGE, "**Russian**") OR EXCLUDE (LANGUAGE, "**Persian**") OR EXCLUDE (LANGUAGE, "**Spanish**") AND (LIMIT-TO (SUBJAREA, "**ENGI**") AND (EXCLUDE (SUBJAREA, "**NEUR**") OR (EXCLUDE (SUBJAREA, "**NEUR**") OR (EXCLUDE (SUBJAREA, "**COMP**") OR (EXCLUDE (SUBJAREA, "**MEDI**") OR (EXCLUDE (SUBJAREA, "**BIOC**") OR EXCLUDE (SUBJAREA, "**PHYS**") OR EXCLUDE (SUBJAREA, "**CHEM**") OR EXCLUDE (SUBJAREA, "**CENG**") OR EXCLUDE (SUBJAREA, "**HEAL**") OR EXCLUDE (SUBJAREA, "**MATE**") OR EXCLUDE (SUBJAREA, "**ENER**") OR EXCLUD'E (SUBJAREA, "**MATH**") OR EXCLUDE (SUBJAREA, "**ENVI**") OR EXCLUDE (SUBJAREA, "**SOCI**") AND EXCLUDE (SUBJAREA, "**BUSI**))

Fig. 1. Stages of Noise Impact Blibiometric Analysis Against Cognitive Performance using EEG

First Stage (Initial)., The Scopus database was used independently to conduct a thorough library search. The first of these studies applies searches using Boolean logic: "electroencephalography" AND "noise" AND "cognitive performance" OR "task cognitive" OR "work cognitive" OR "mental states." In the search column "Article Title, Abstract, Keyword" in the Scopus database. The document type at this stage is selected "All" (including articles, conference papers, books, book chapters, reviews, letters, notes, etc.), publication year "All years" and access type "All" (including open access). Initial search efforts yielded 576 articles from 1968 to 2022.

Second Search Stage., Of the 576 articles from the initial screening, many papers appeared in several categories, from the existing categories only the document type "article" was selected (not including conference papers, books, book chapters, reviews, letters, notes, etc.), the year of publication was selected 10 last year" 2012–2022" and source type "journal" and language "English." There is a total of 348 articles in this second search stage.

Third Quest Stage., In the last refinement, a search was carried out and selected in the subject field "Engineering" a total of 14 articles were found. Then the search stage was also carried out based on the snowball search method, which obtained 16 articles.

Result

Blibiometric Analysis., A useful tool for doing a quantitative analysis of a particular research subject is provided by bibliometrics, This research method takes into account the bibliometric properties of a research publication.

Article Growth and Trend Analysis, From 2012 to 2022, there will be an increase in the number of articles in the annual publications on the use of EEG to research cognitive performance. As shown in Fig. 2, the data indicate a rising trend in using of the EEG index to measure cognitive function, with 2021 seeing the maximum number of publications. This shows that there is increasing and accelerating interest in this research.

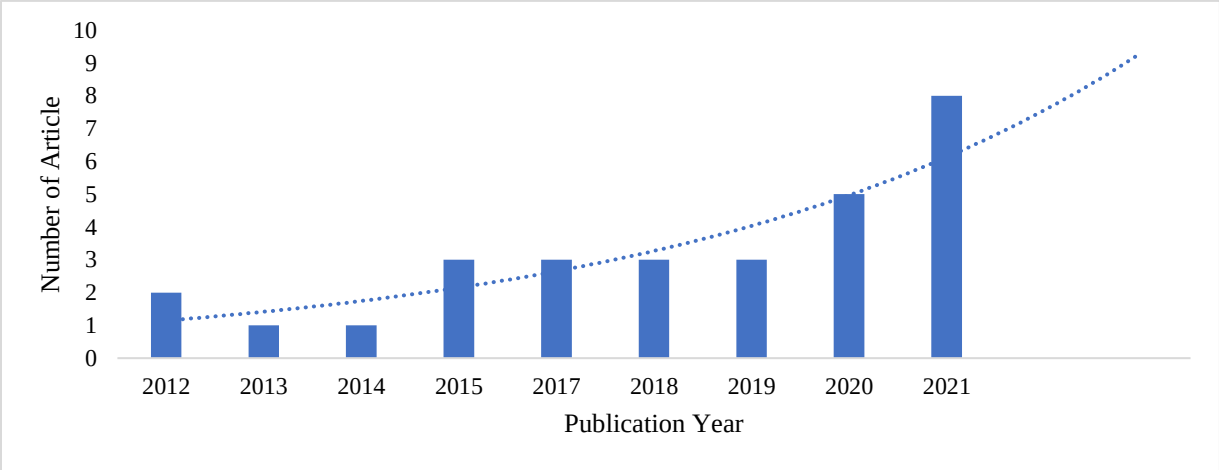


Fig. 2. Trends in Cognitive Performance Studies Using EEG

Selected Articles from Journals Published from 2012 to 2022, The 30 studies published in international journals and seminar proceedings were chosen to study the effects of noise on cognitive performance using EEG. Several articles published in the same journal, namely the Journal of Automation in Construction Automation in Construction, contained 3 articles, in the IEEE Transactions on Biomedical Engineering, there were 3 articles and 2 articles in the Journal of Mechanics in Medicine and Biology. Table 1 presents selected journal names and the number of articles from 2012 to 2022.

Table 1. Selected articles from emerging topics on the impact of noise on cognitive performance using EEG

No	Authors	Title	Research Method	EEG Parameter	EEG Feature Method	Noise	Cognitive Performance
1	Tseng LH, Cheng MT, Chen ST, Hwang JF, Chen CJ, Chou CY (2013)	An EEG Investigation of The Impact of Noise on Attention	Design Experiment	Alpha 1, Alpha 2, Beta, Theta, Delta	Fast Fourier Transform	50, 85 dB	Attention Demand Task
2	Zarjam P, Epps J, Lovell NH (2015)	Beyond Subjective Self-Rating: EEG Signal Classification of Cognitive Workload	Design Experiment	32 Electrode Delta, Theta	Wavelet Transform	X	Mental Workload (Delta, Theta)
3	Yoshida Y, Kawana T, Hoshino E, Minagawa Y, Miki N (2020)	Capturing Human Perceptual and Cognitive Activities Via Event-Related Potentials Measured with Candle-Like Dry Microneedle Electrodes	Design Experiment	4-Electrode EEG NIRS 22 Electrode	Wave-form Event-Related Potentials (ERP)	X	Oddball Task
4	Puthankattil SD, Joseph PK (2012)	Classification of EEG Signals in Normal and Depression Conditions by ANN Using RWE and Signal Entropy	Design Experiment	Alpha Beta Theta Delta Gamma	Relative Wavelet Energy, Artificial Neural Network	X	X

Table 1. Selected articles from emerging topics on the impact of noise on cognitive performance using EEG (continued)

No	Authors	Title	Research Method	EEG Parameter	EEG Feature Method	Noise	Cognitive Performance
5	Arsalan A, Majid M, Butt AR, Anwar SM (2019)	Classification of Perceived Mental Stress Using a Commercially Available EEG Headband	Design Experiment	4 Channel Gamma Delta Theta Alpha Beta	FFT, Power Spectral Density	X	PSS Questionnaire + Specific Presentation
6	Abbasi AM, Motamedzade M, Aliabadi M, Golmohammadi R, Tapak L (2020)	Combined Effects of Noise and Air Temperature on Human Neurophysiological Responses in A Simulated Indoor Environment	Design Experiment	20 Electrode Alpha, Theta, Beta	Power Band	55 dBA, 75 dBA	Working Memory
7	Kästle JL, Anvari B, Krol J, Wurdemann HA (2021)	Correlation Between Situational Awareness and EEG Signals	Design Experiment	32 Electrodes Beta Gamma	Power Spectrum Density	X	Situation Awarennes
8	Iqbal MU, Srinivasan B, Srinivasan R (2020)	Dynamic Assessment of Control Room Operator's Cognitive Workload Using Electroencephalography (EEG)	Design Experiment	14 Electrode Theta Signal	Spectral Density	X	Mental Workload
9	Jun G, Smitha KG (2017)	EEG-Based Stress Level Identification	Design Experiment	14 Electrodes Alpha Beta Signal	Discrete FT and FFT with Ham-ming Window	X	Mental stress level with 2 triggers
10	Wang F, Zhang X, Fu R, Sun G (2018)	EEG Characteristic Analysis of Coach Bus Drivers Based on Brain Connectivity as Revealed: Via A Graph Theoretical Network	Design Experiment	14 Channels, Theta, Beta, 36-44Hz Rhythms	Wavelet Packet Decomposition (WPD)	X	X
11	Qin X, Deng J, Wang M, Wang P, Wang L, Zhang Y (2017)	EEG Feature Extraction and Recognition with Different Mental States Based on Wavelet Transform and ACCLN Network	Design Experiment	FP 1, A 1 Alpha Beta Theta Delta	DWT and FFT ACCLN for Signal Recognition	X	X

Table 1. Selected articles from emerging topics on the impact of noise on cognitive performance using EEG (continued)

No	Authors	Title	Research Method	EEG Parameter	EEG Feature Method	Noise	Cognitive Performance
12	Putman P, Verkuil B, Arias Garcia E, Pantazi I, Van Schie C (2014)	EEG Theta/ Beta Ratio as a Potential Biomarker for Attentional Control and Resilience Against Deleterious Effects of Stress on Attention	Design Experiment	9 Electrode Theta Beta	Fast Fourier Transform	X	Attention (VAS), Stress (theta, Beta, Frontal, Central, Parietal
13	Jebelli H, Hwang S, Lee SH (2018)	EEG-Based Workers' Stress Recognition at Construction Sites	Design Experiment	14 Electrode, Alpha, Beta, Delta, Theta	(PCA and t-SNE)	X	Worker stress on construction site
14	Sadeghian M, Yazdanirad S, Mousavi SM, Jafari MJ, Khavanin A, Khodakarim S, Jafarpishe AS (2021)	Effect of Tonal Noise and Task Difficulty on Electroence-phalography and Cognitive Performance	Design Experiment	15 Electrodes Alpha, Theta, Beta Signal	Fast Fourier Transform and Band Power	55 dBA and 500 Hz	Subjective response, (Nasa TLX)
15	Daud SS, Sudirman R (2015)	Effect of White Noise Stimulation and Visual Working Memory Task on Brain Signal	Design Experiment	17 Electrodes	Wavelet Trans-form	50-51 dB	Attention memory
16	Shao S, Wang T, Song C, Su Y U, Wang Y, Yao C (2021)	Fine-Grained and Multi-Scale Motif Features for Cross-Subject Mental Workload Assessment Using BI-LSTM	Design Experiment	Public Dataset, Unexplained	FGMSM ICEEMDAN	X	X
17	Sintotskiy G, Hinrichs H (2020)	In-Ear-EEG–A Portable Platform for Home Monitoring	Design Experiment	2 Channel Alpha	X	X	X
18	Sadeghian M, Mohammadi Z, Mousavi SM (2021)	Investigation of Electroencephalography Variations of Mental Workload in The Exposure of The Psychoacoustic in Both Male and Female Groups	Design Experiment	19 Electrode, Alpha Theta	Fourier Transform	40 dB,	Nasa TLX

Table 1. Selected articles from emerging topics on the impact of noise on cognitive performance using EEG (continued)

No	Authors	Title	Research Method	EEG Parameter	EEG Feature Method	Noise	Cognitive Performance
19	Ke J, Zhang M, Luo X, Chen J (2021)	Monitoring Distraction of Construction Workers Caused by Noise Using A Wearable Electroencephalography (EEG) Device	Design Experiment	14 Beta Electrode, Gamma	FFT	80 dBA	Attention (beta, Gamma)
20	Kato K, Yasukawa S, Suzuki K, Ishikawa A (2017)	Oscillatory Neural Activity During Performance of a Cognitive Task in The Presence of Fluctuating Ambient Noise	Design Experiment	60 Electrodes Alpha Beta Theta	ERS & ERD	X	N-back task (3-back task)
21	Tamesue T, Kamijo H, Itoh K (2012)	Quantitative Evaluation Using EEG for Influence of Meaningful or Meaningless Noise on Participants During Mental Tasks	Design Experiment	7 Electrodes, Amplitude N100, Amplitude P300	Odd-ball paradigm, Waveform Event-related potentials (ERP)	60 dB, continuous	Task performance under noise condition
22	Mullen TR, Kothe CA, Chi YM, Ojeda A, Kerth T, Makeig S, Jung TP, Cauwenberghs G (2015)	Real-Time Neuroimaging and Cognitive Monitoring Using Wearable Dry EEG	Design Experiment	64 Electrodes	ERP and dual-spectral regularized logistic regression (DSRL)	X	Ericksen Flanker Test
23	Abbasi AM, Motamedzade M, Aliabadi M, Golmohammadi R, Tapak L (2018)	Study of The Physiological and Mental Health Effects Caused by Exposure to Low-Frequency Noise in A Simulated Control Room	Design Experiment	20 Theta Alpha Electrodes	Power Band	55,65, 70, dan 75 dBA	Mental Workload (FVAS)
24	Ke J, Du J, Luo X (2021)	The Effect of Noise Content and Level on Cognitive Performance Measured by Electroencephalography (EEG)	Design Experiment	8 Electrodes	Wavelet Decomposition	60, 70, dan80 dB	Attention, stress, Mental workload

Table 1. Selected articles from emerging topics on the impact of noise on cognitive performance using EEG (continued)

No	Authors	Title	Research Method	EEG Parameter	EEG Feature Method	Noise	Cognitive Performance
25	Jafari MJ, Khosrowabadi R, Khodakarim S, Mohammadian F (2019)	The Effect of Noise Exposure on Cognitive Performance and Brain Activity Patterns	Design Experiment	16 Electrode Beta Signal	Fast Fourier Transform	75, 85, and 95dBA	Mental Workload (Nasa TLX)
26	Huda LN, Salsabila C, Nasution I (2021)	The Effect of Noise on Average Beta EEG Signal	Design Experiment	4 Beta Signal Electrodes	Power Band	45 and 85 dBA	Tochemeci
27	Tokhmechi B, Fazel-Rezai R, Bamdad M (2020)	The Effects of Explosion Sound on The Brain Based on Electroencephalogram Signals	Design Experiment	8 Delta Signal Electrodes	Wavelet	X	Reaction Timedelta Signal
28	Pieper K, Spang RP, Prietz P, Möller S, Paajanen E, Vaalgamaa M, Voigt-Antons JN (2021)	Working with Environmental Noise and Noise-Cancelation: A Workload Assessment with EEG and Subjective Measures	Design Experiment	16 Electrodes, Signal Theta, Alpha, Beta, Gamma	Power Band	70 dB and 76 dB,	NASA-TLX, SAM and Subjective Rating Scale
29	Safavi SM, Lopour B, Chou PH (2018)	Reducing the Computa-tional Complexity of EEG Source Localization with Cortical Patch Decompo-sition and Optimal Electrode Selection	Modelling and Simulation Study	59, 79, 107, 123 Electrode	Multiple Signal Classifi-cation (MUSIC) + Monte Carlo Simulation	X	X
30	Bore JC, Yi C, Li P, Li F, Harmah DJ, Si Y, Guo D, Yao D, Wan F, Xu P (2019)	Sparse EEG Source Localization Using LAPPS: Least Absolute l-P ($0<p<1$) Penalized Solution	Modelling and Simulation Study	64 Electrodes, P300	WMNE solution, LI solution, LAPPS solution, FOCUSS solution, Sloreta SOLUTION	-10 dB, -5 dB, 0 dB, 5 dB, 10 dB	EEG source imaging, Fields of cognitive neuroscience and brain imaging

Analysis of Keyword Visualization from The Author, Keywords represent certain characteristics or fields of related study documents in an information system. The terms in the data are split into two categories: author and index. The Scopus database system generates the index keyword, while the author keyword is generated by the author in the journal system. Fig. 3 presents the articles in journals published from 2012 to 2022.

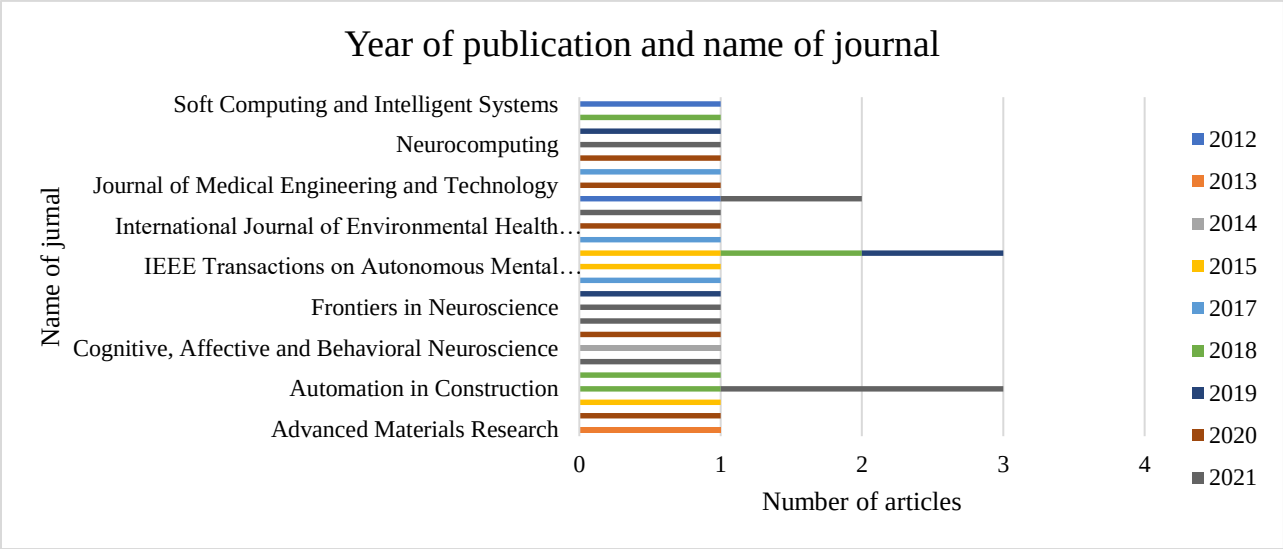


Fig. 3. Articles in Journals Published from 2012 to 2022

Fig. 4 depicts the most common author terms in the chosen articles, which are grouped into circles. The analysis indicates that 112 distinct keywords are present throughout 30 articles. The number of occurrences in the circle shows the term network. The number of articles found with the main keyword is indicated by the size of the circle in each cluster, and the clusters are shown in the colors yellow, blue, green, red, orange, brown, purple, and pink. The top five author keywords were "electroencephalography" which appeared 16 times," cognitive performance" 4 times, "mental workload" 3 times, "noise" 3 times, and "cognitive workload" 2 times.

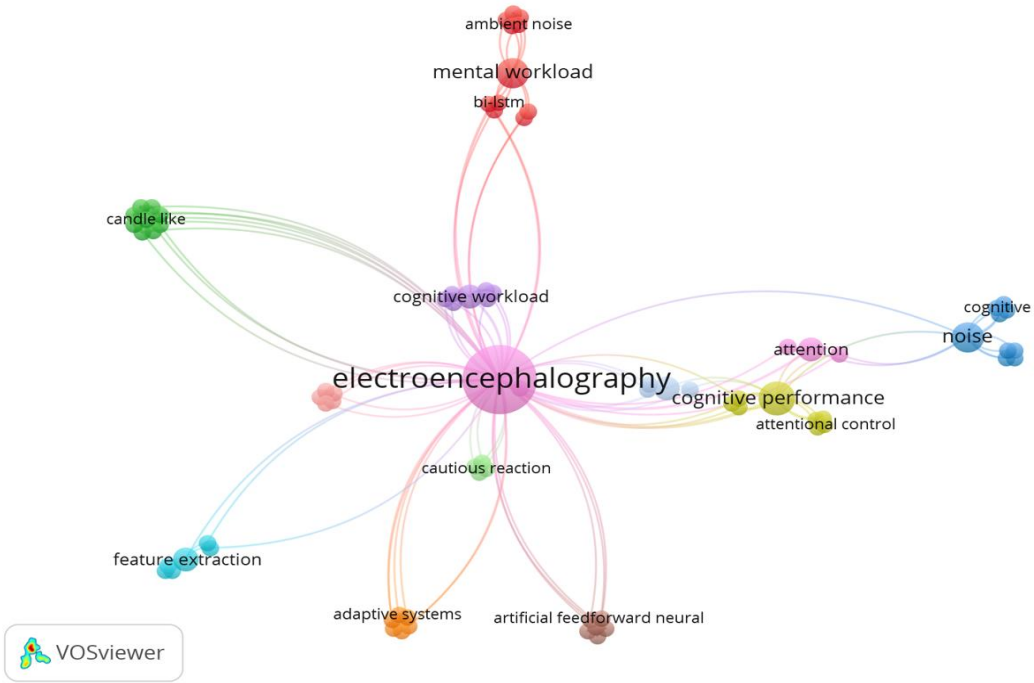


Fig. 4. Keyword Visualization Map from the Author

Analysis and Visualization of Research Capabilities Based on Text Data, Clusters are groups of keywords that appear frequently and are close to one another on the map. Three clusters are depicted in the figure: Cluster 1, Cluster 2, and Cluster 3, respectively. In cluster 1 there are 7 keywords, namely electroencephalography, EEG signal, stress, subject, paper, feature, and signal. In cluster 2 there are 5 keywords, namely noise, performance, participant, attention, and cognitive performance. In cluster 3 there are 4 keywords, namely effect, level, exposure, and alpha. Fig. 5 presents the clusters of titles and keywords abstract.

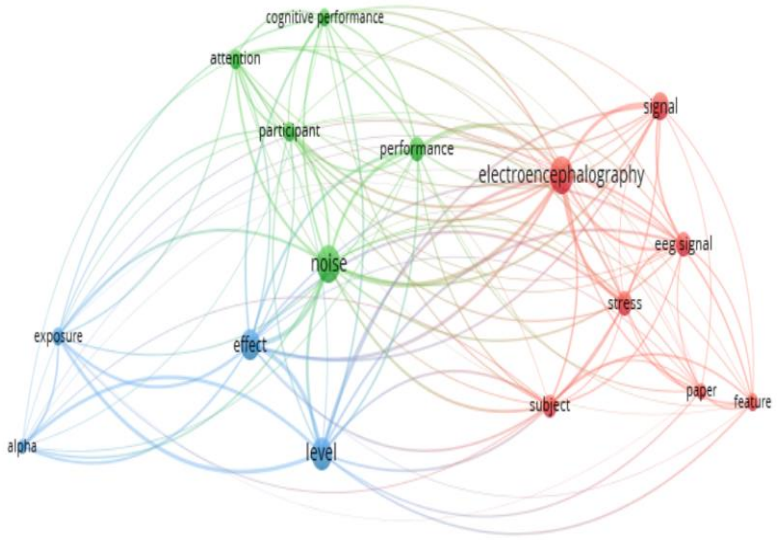


Fig. 5. Map of co-occurrence network visualization of titles and keywords abstract

Fig. 6 shows high-frequency keyword density, where lighter colors (i.e., closer to yellow) indicate higher occurrences of key terms. The core keywords of the articles reviewed included “Electroencephalography”, “Noise”, and “Performance”. Performance measures that attracted widespread attention included “cognitive performance,” with the related key terms “attention,” “participant”; “Electroencephalography” with the key terms related “signal”, “EEG signal”, “stress”, “subject”, “paper” and “feature”. The maps show that noise density and related key terms like "effect," "level," "exposure," and "alpha" have frequently been used as EEG indices for analyzing EEG data.

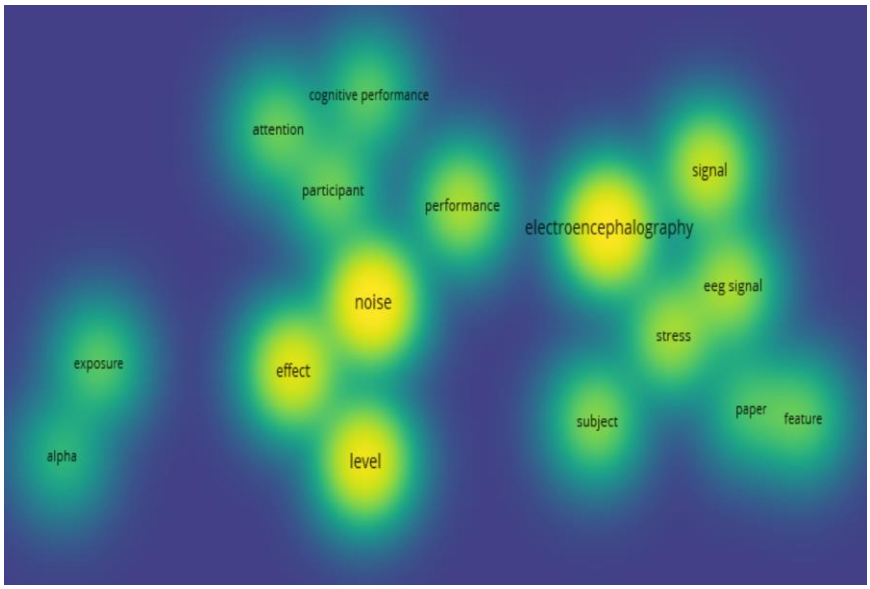


Fig. 6. Map of the network visualization of the appearance of the title and abstract keywords

A timeline-based depiction of the numerous highlighted phrases is shown in Fig. 7. The time slot is represented by the color of the circle; the more recent the term, the lighter the circle. The creation of high-frequency keywords enables academics to identify the main developments in cognitive science. Fig. 7's visualization map illustrates how frequently "Electroencephalography" is used in 2018. In 2019, "Cognitive Performance" is frequently utilized.

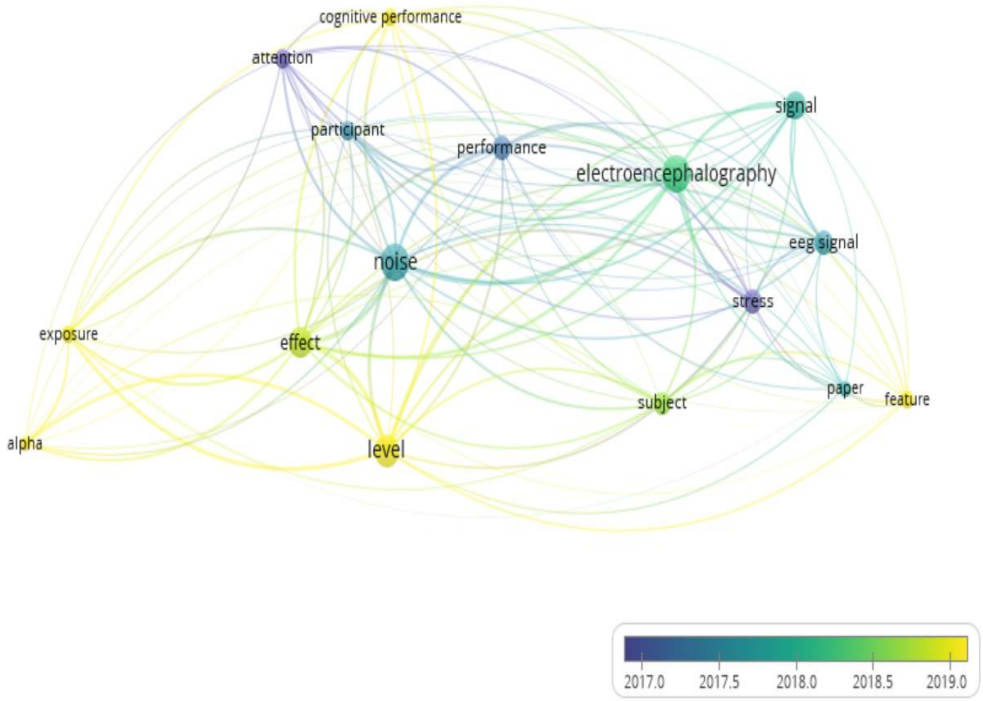


Fig. 7. Visualization map of keyword frequency evolution over time

Content Analysis

Types of Research Methods, the research method is a method used in science to gather data for a particular use. There are two types of research methods: qualitative and quantitative. In this literature review, of the 30 selected articles, 28 articles conducted research using experimental design methods, and 2 articles used modeling simulation. Experimental design methods and modeling simulations are research methods carried out in the laboratory [21]. The experimental research method is used to find the effects of certain treatments on others under controlled conditions. Of the 28 articles that were selected using a two-factor factorial experiment, the influencing factors and response variables were studied, including the influencing factors in the form of noise levels and noise sources and the observed response variables in the form of changes in the EEG signal on attention, mental workload and stress[22,6,23].Studies using EEG to examine how noise affects cognitive function. Because it is necessary to control a number of elements and variables in order to gather reliable data, experimental design is the best research methodology.

The EEG Parameters Used, the parameters used in analyzing the EEG signal from 30 articles in this literature review are different, namely related to the number of electrode channels, and the observed waves. An EEG electrode will only record activity from the area of the brain that is attached below it. Even so, the electrodes received activity from thousands of neurons. 1 mm2 of cortex contains more than 100,000 neurons. A straightforward periodic waveform of the EEG is represented by input from a location that is time-synchronized with electrical activity that is occurring at the same time. EEG investigations have employed electrode channels with somewhere between 4 and 64 electrodes[24,25].The observed waveform is yet another EEG characteristic. The following frequencies make up the most widely used taxonomy for brain signals [26], which is based on brain wave frequencies measured in hertz (Hz): delta (: 0.5–4 Hz), theta (: 4–8 Hz), alpha (: 8–13 Hz), beta (: 13–30 Hz), and gamma (: 30-150 Hz) [15].

Feature Method, feature extraction is the process of transforming raw data into data with reduced variables [27], this term generally appears in studies of signal analysis, machine learning, pattern recognition, to image processing. EEG and EMG data processing is included in signal analysis. The essence of feature extraction is to find certain patterns or features from data for further analysis, in the context of EEG these features are associated with behavior, mental processes, or brain activity.

whereas in the context of EMG it is associated with muscle strength There are various ways to perform feature extraction [28]. The feature extraction method used in the selected articles can be classified into time-domain and frequency-domain. The most commonly used feature extraction method is time-domain analysis. This method looks at the basic characteristics of the EEG signal with a calculation based on time. Research using Event-related Potential or Evoked Response Potential is included in the feature extraction method in the time domain [29,30,31]. While in the EMG signal analysis, study reported [32] used the root mean square time domain to determine the most dominant muscle strength. The frequency of brain waves that manifest under specific conditions is the foundation of the frequency-domain feature extraction technique. The Power Spectrum Density approach, which is used in the article's frequency domain feature extraction, is a research technique [33,34,35],Band Power technique [36,24,37]. The analytical method that combines time-domain and frequency-domain research is known as time-frequency analysis [28]. The article uses the Wavelet approach [38,39,22,40,41] and the Fast Fourier Transform method [42,43,44,6,34] for feature extraction via time-frequency analysis. Fig. 8 presents the classification of types of EEG feature extraction methods.

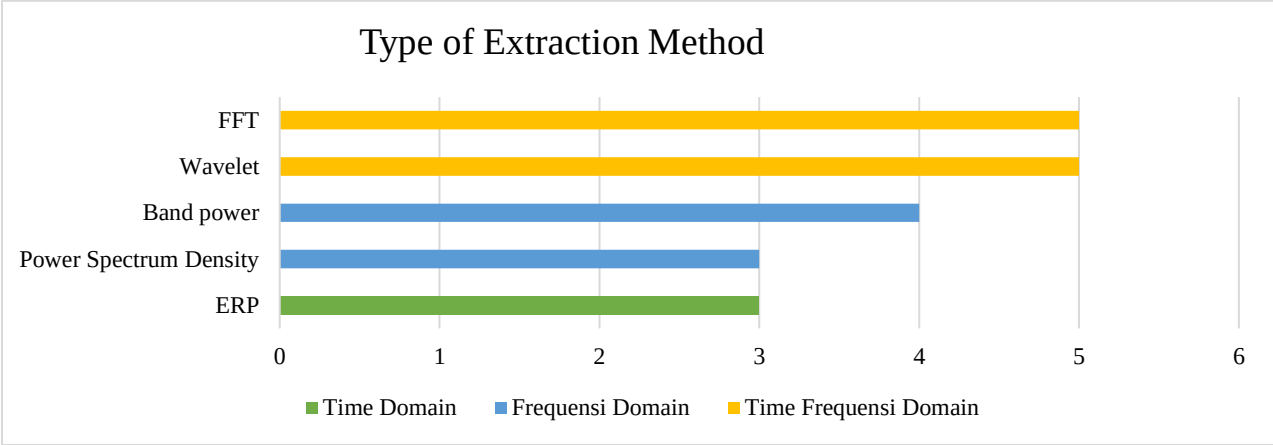


Fig. 8. Classification of types of EEG Feature Extraction methods

Noise Type, unwanted noise that interferes with work has been defined as noise [22]. Noise characteristics and noise intensity are the factors that determine how noise impacts cognitive function and brain signals [6]. This article describes the types of noise sources and the noise level used as a factor in various experimental designs. There are two types of noise, namely continuous and intermittent noise, while the noise sources used are music sounds, mechanical sounds, conversation sounds [22]; mechanical and office sounds [6,23]. The noise level used in the experimental design in this article also varies, namely levels of 40 dBA [45], levels of 45 and 85 dBA [24], levels of 75 dBA, 85 dBA and 95 dBA [6], Levels 60,70 and 80 dBA [22]. Of the 30 articles, the majority use the continuous noise type. The type of intermittent noise has not been widely studied for its effect on workers.

Cognitive Performance, cognitive performance is the sum of performance across a range of cognitive tasks, including as perception, memory, retrieval, judgment, and decision-making [7]. Electroencephalography (EEG), a technology that records electrical signals produced by the brain as an action and reaction to the stimulus received by a person, can be used to assess cognitive performance [13]. In this article, the cognitive functions studied vary, each researcher examines one cognitive aspect, but some combine more than one cognitive aspect. The cognitive aspects studied by the researchers are "Attention"[42,43,40,22,24], “Stress”[46,47,22], “Mental Workload” [41,23,34,6,35,48,37], “Situation Awareness”[48,33], “Task Performance” [30,31,45], "Working Memory" [49,36,40],“Reaction Time” [39]. In the era of digitization and automation with the increasing use of digital systems, the focus should shift to studying cognitive aspects. Huge dependence on the use of technology causes high cognitive activity and load. These inguiries have

been studied the most, while researchers have not widely studied other cognitive aspects. Fig. 9 presents 30 research articles related to cognitive performance in the mental workload field.

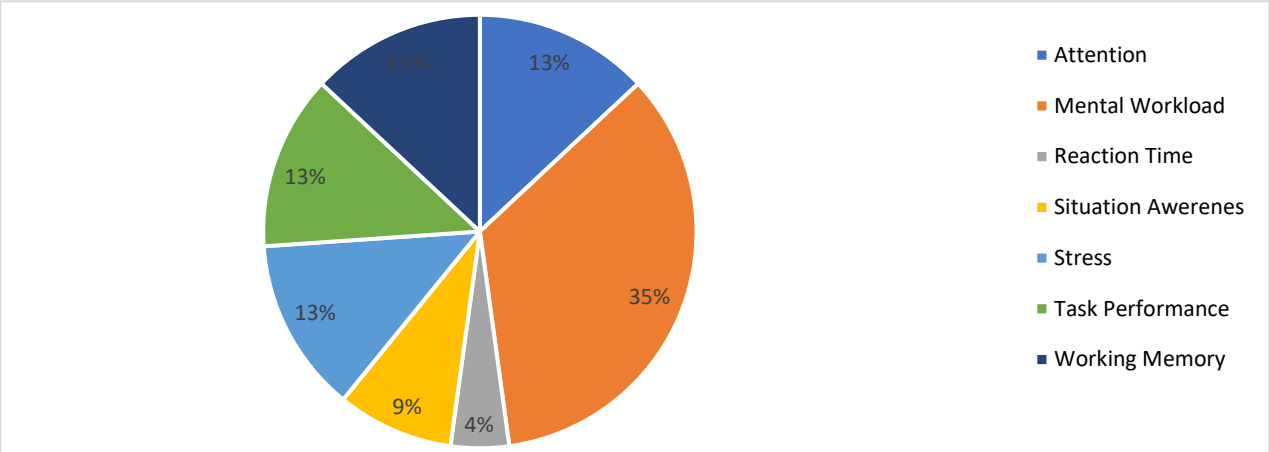


Fig. 9. Percentage of cognitive aspect studies from 30 articles

To determine how noise levels and exposure times affect field behaviors, numerous experimental investigations and surveys have been carried out. Additionally, numerous research have confirmed the direct inverse association between noise levels and performance [50]. The most important parameter, noise levels, tend to be higher noise levels rather than a wide range. Existing research focuses on high noise levels, because high noise has a noticeable influence on the physicality of workers, namely the presence of hearing loss. A previous study [51] showed that noise levels are being rarely discussed. For example, workers who are in the office may often be exposed to moderate noise, while moderate noise levels are considered harmless to workers, this is what needs more research related to the influence of noise on office workers who use more cognitive aspects in getting their work done.

Increased noise levels have been associated in several studies to reduced cognitive function. [6]. Additionally, the effects of noise may have an impact on cognitive and behavioral functioning. Performance throughout a variety of cognitive activities, including perception, memory, retrieval, judgment, and decision-making, is referred to as cognitive performance [7]. A dynamic cognitive state is linked to cognitive performance. The majority of papers have focused on how noise directly affects things like external performance and error rates [50]. However, the data is not strong enough to establish the impacts of noise on cognitive performance, which can be measured by cognitive states like stress levels, attention levels, cognitive loads, disorders, etc. There are less studies on the effects of noise on mental workload and stress, and the concept of mental workload is broader than that of working memory load [41].

Mapping Analysis

Previous Research Contribution, this article maps out the contributions of previous research related to the study of cognitive performance using EEG. Table 1 lists the characteristics and parameters used in the study of the impact of noise on cognitive performance using EEG. There are various studies among the 30 papers listed in table 1 that use techniques or experimental designs to try to ascertain how noise affects cognitive performance. Experimental design plays an important role in creating cognitive performance indicators that mark fatigue so that observation results can be evaluated. Because of this, it's important to take into account the key elements that are directly linked to the development of weariness while working on tasks while evaluating cognitive performance. Numerous research on the impact of noise on cognitive function take into account the room's acoustics, the noise source, the noise level, and individual characteristics. Experimental research produces results that are just as strong as non-experimental research in terms of their ability to

demonstrate the existence or absence of cause-and-effect relationships. Experimental research constrained variables are solely brought about by free variables and not by other factors. The majority of the cognitive trials covered in the study only took place in lab settings. In a study that used EEG for this reason, the analysis used digital signal processing, the type of parameter used from this literature study was known to have used 4 to 64 electrodes in his experiments to observe the signals produced by the human brain. The EEG signal preprocesses carried out are generally the identification of artifacts on the data, correction of data from artifacts and cutting data according to experimental conditions.The independent variables used in the experiment using EEG are focused on the type and level of noise, it is known from the results of this literature study that not many researchers have used these 2 variables, out of 30 studies there are only 11 researchers who use noise variables with different types and levels of noise. There have been no studies that examine the types of continuous and intermittent noise simultaneously their effect on cognitive aspects. Research related to cognitive performance using EEG is also still a little bit developed, the measurement of cognitive performance that is often done by researchers so far is more qualitatively using questionnaires. The most common challenge faced in studies using EEG is how to get "clean" data, but EEG also has the advantage of having a high temporal resolution, relatively cheaper and flexible than other brain imaging methods. Research on the influence of noise at the moderate level on workers from the cognitive aspect using EEG (quantitative) will provide knowledge to the public about the existence of the impact of noise from the mental aspect even though the noise received is in the moderate category.

Future Research Directions, this review explores the feasibility of using the EEG index to measure human performance against noise exposure to various cognitive performances. The findings of a review of 30 papers point to a chance to use EEG to investigate the impact of noise exposure on cognitive elements, which many researchers have not yet done. Both the effects of mental moods on cognitive function and the different types of intermittent noise have not been properly examined. The fact that the ideal EEG index is currently unidentified is one drawback. Computational techniques that take into consideration the dynamic and non-stationary nature of EEG data should be the main focus of future study. This method might make it simpler to create automatic adaptive systems and tiredness recognition systems. Finally, EEG data must be used to describe and forecast human performance in order to get over the current constraints. Research in the field of neuro-ergonomics is still possible to be developed. Neuro ergonomics is the study of human performance using recorded brain signals that combines neuroscience and ergonomics.

Conclusion

This review examines the effects of noise on human cognitive function using an EEG index based on a bibliometric analysis of a few articles published between 2012 and 2022. Based on a review of 30 papers taken from the Scopus database and snowball search, it is becoming more common to utilize EEG to evaluate certain performance metrics, such as mental fatigue, mental effort, working memory, attention, stress, and noise issues. This review offers a thorough examination of the most recent developments in cognitive neuro-ergonomic future research. Over the previous ten years, this field has seen an increase in publications, with 2021 being the highest volume. Most studies employ EEG as a linear approach to evaluate people's cognitive abilities.

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