

# Bibliometric Analysis of Research on Ergonomic Traffic Sign Comprehension

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**Abstract:** Traffic signs are a message to road users and have an important role in ensuring the safety and efficiency of the transportation system. From an ergonomics perspective, a good comprehension of traffic signs is key to accomplish these goals. This study is to analyze the research on the impact of ergonomics on traffic sign comprehension by using bibliometric analysis method that can identify the current research trends and the main focus of previous studies. The information and data in this study were taken from the Scopus database through the Publish or Perish application. In the last 20 years, there are 13 related research publications. These publications have been screened from a total of 177 research publications. The analysis results indicate that research with a focus on the theme of Ergonomic Traffic Sign Comprehension is still relatively limited, especially in Indonesia.

**Keywords:** Bibliometric Analysis, Ergonomics, Traffic Signs Comprehension

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## 1. Introduction

A traffic accident is an unpredictable incident, and the effect of the accident is material and non-material damages to the person who suffered it. According to the Global Status Report on Road Safety (WHO) [1], over 50 million people suffer significant injuries in traffic accidents each year, and more than 1.25 million people worldwide are dead. 90% of these incidents occur in developing countries, where the total number of registered cars is only 54% of the global total. In the next 20 years, 25 million lives will be lost if society doesn't do anything about it.

The use of road traffic signs as a tool for controlling, warning, and informing road users is widely regarded now as a strategy for maintaining road safety in public land transportation systems [2].

Traffic signs are a sign of traffic control that can deliver a message to the road users [3]. Traffic signs are very important to adhere the principles of ergonomics for a better comprehension of spatial compatibility, conceptual compatibility, physical representation, familiarity and standardization [4], [5], [6], [7]. Therefore, the recent study shows that traffic signs according to these principles are easier to understand [3]. The comprehension of drivers is an obvious indicator of the efficiency of road warning signs in the field of traffic engineering and cognitive ergonomics [8].

In terms of ergonomics, traffic signs comprehension is important to ensure safety and efficiency of transportation systems. The role of ergonomics in traffic sign comprehension is very important. A number of research studies have examined the level of comprehension of various traffic signs in different countries and the ergonomic principles that can affect the level of observed comprehension [9]. Ergonomics is the study of the

interaction between humans and their work environment, including in this context, the road environment and traffic sign systems. Traffic signs are one of the instruments of traffic regulation.

The purpose of this study is to provide a bibliometric overview of the current research on the effect of ergonomics on driver traffic comprehension. The application of bibliometric methods can help identify recent research trends and the main focus of previous studies on the ergonomics of traffic sign comprehension.

## 2. Method

This research used a method of literature review with a bibliometric approach. A literature review is a systematic, explicit and developable method [10][11]. According to Donthu et. al, bibliometric analysis is a method of assessing the development of a field of science from a research domain, including topics and authors, based on the social, intellectual, and conceptual structure of a field of science [12].

The bibliometric analysis method in this study is used with five steps introduced by Fahimnia et al (2015) [13]. Those five steps are defining search keyword, initial search result, refinement of the search results, compiling statistics on initial data, and data analysis.

### 1. Defining Search Keyword

The literature review was conducted in August 2023, using PoP Software and the database from Scopus as the primary search engine to identify relevant keywords. The literature review specifically focused on the keywords "Traffic Sign Comprehension". The initial search in the Scopus database yielded 180 articles published between 1971 and 2023.

### 2. Initial Search Result

The list of top 10 articles identified by PoP are presented in Table 1.

Table 1. The articles are identified by PoP

Author	Title	Cited by
D. Shinar[6]	Traffic sign symbol comprehension: A cross-cultural study	112
T. Ben-Bassat[4]	Ergonomic guidelines for traffic sign design increase sign comprehension	111
H. Al-Madani[14]	Assessment of drivers' comprehension of traffic signs based on their traffic, personal and social characteristics	93
A. Ng[5]	The effects of driver factors and sign design features on the comprehensibility of traffic signs	92
D. Shinar[7]	Comprehension of traffic signs with symbolic versus text displays	85
G.H. Walker[15]	Cognitive compatibility of motorcyclists and car drivers	84
H. Al-Madani[16]	Role of drivers' personal characteristics in understanding traffic sign symbols	82
T.J.B. Kline[17]	Visibility distance of highway signs among young, middle-aged, and older observers: Icons are better than text	82
A. Dutta[18]	Use of a driving simulator to evaluate and optimize factors affecting understandability of variable message signs	73
R. Ma[19]	Situation awareness and driving performance in a simulated navigation task	73

### 3. Refinement of The Search Results

From the results that were obtained, keyword refinement was made for ergonomics-related articles. The search keyword is "Ergonomic Traffic Sign Comprehension", from the Scopus database resulting in 13 qualified articles. Table 2 shows the comparison of metric data from the initial search and search after screening.

Table 2. Comparison Matrix

Data Matrix	Initial Search	Refinement Search
Keyword	<i>Traffic Sign Comprehension</i>	<i>Ergonomic Traffic Sign Comprehension</i>
Source	Scopus	Scopus
Article	177	13
Citation	2407	442
Cites/Year	52.33	22.10
Cites/Article	13.60	34.00
Author/Article	0.99	1.00

4. Compiling Statics on Initial Data

The results of the search were imported in RIS format and saved in the Mendeley application to include all important information related to the paper, such as its title, author names, abstract, keywords, and journal specifications.

5. Data Analysis

In this paper presents a bibliometric analysis for the keyword 'Traffic Sign Comprehension', and the search was refined to the Ergonomics domain from the Scopus database. The initial search of the Scopus database returned 177 articles with 2407 citations. The refinement of the search results with the keyword 'Ergonomic Traffic Sign Comprehension' resulted in 14 articles with 442 citations. These results decreased by 92.65%.

**3. Results and Discussion**

The results from the article search show that the article written by Shinar with the title 'Traffic sign symbol comprehension: A cross-cultural study' is the most cited article with a total of 112 citations in Ergonomic Traffic Sign research trends. The second most cited article is Ben-Bassat's 'Ergonomic guidelines for traffic sign design increase sign comprehension' with a total of 111 citations.

After considering how often citations were used and other parameters, the results of the PoP application were evaluated using the VOSviewer application. The purpose of this evaluation was to identify the most common countries, authors, and keywords appearing in related research. The VOSviewer application was used to display bibliometric maps through three different types of visualizations, namely network visualization, overlay visualization, and density visualization. The following are the results of the analysis using the VOSviewer application for research on 'Ergonomic Traffic Sign Comprehension'.

The articles that were discovered through keyword searches in Scopus indicated the 10 most productive countries in publishing Ergonomic Traffic Sign Comprehension articles shown in Figure 1. The articles came from various countries, with the largest number of documents published by Israel with 5 articles, Canada, Finland, India, Netherland, Poland, and United States with 2 articles, while China, Colombia, and Indonesia with 1 relevant article.

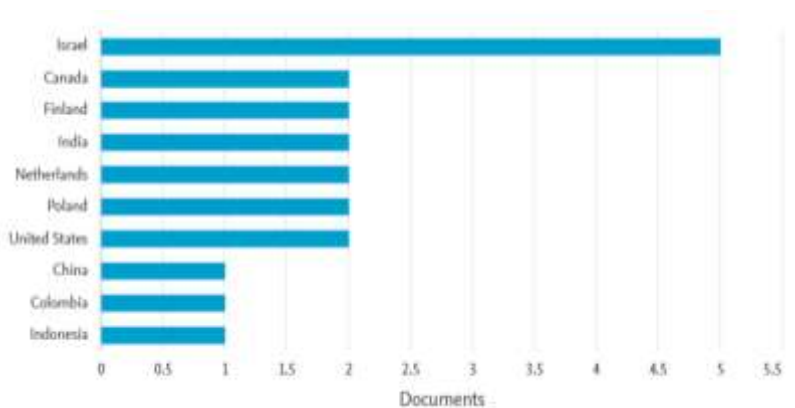


Figure 1. Article based on Countries

On Figure 2 is the result of analysis from the VOSviewer application which presents 9 authors who are productive in Ergonomic Traffic Sign Comprehension related research with an average publication period with a time period represented by the term color. The color of this term is based on the average year of publication, where the dark blue color represents the older time, while the yellow color represents the more recent time.

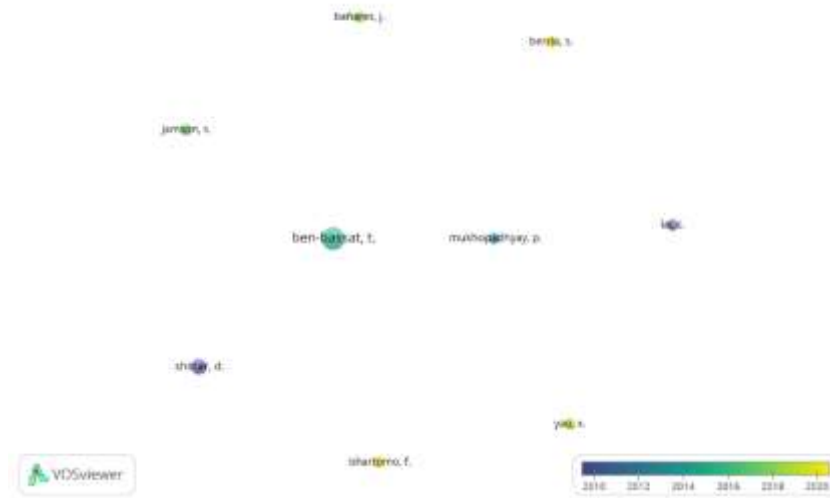


Figure 2. Overlay Visualization by Author

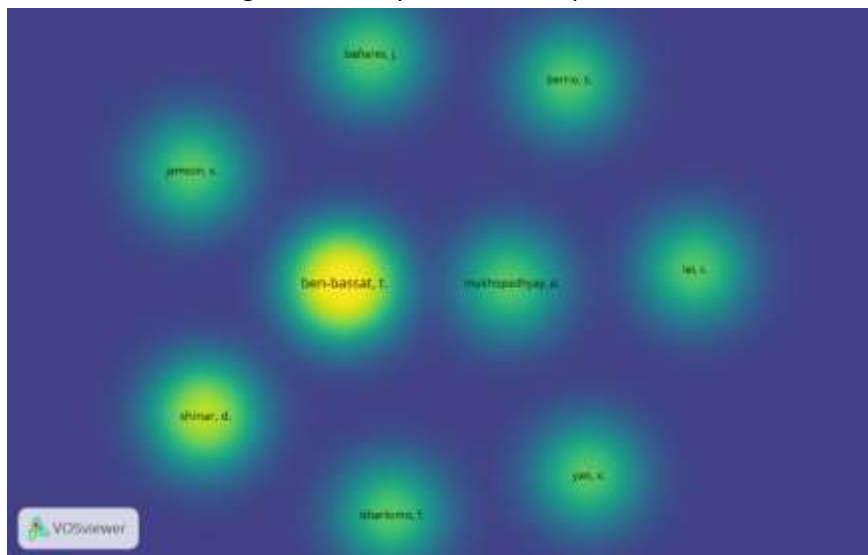


Figure 3. Density Visualization By Author

In Figure 3 visualizes the density of research authors which is the result of the VOSviewer application, 9 clusters are obtained, where Ben-Bassat is the author who published research on the theme of Ergonomic Traffic Sign Comprehension with the largest number of papers, namely 4 papers in the 2010 to 2020 time span. In addition, there are 8 other authors mentioned in Table 3.

Table 3. List of Authors Who Published Research of Ergonomic Traffic Sign Comprehension

Cluster	Author	Document
1	Banares, J.	1
2	Ben-Bassat, T.	4
3	Berrio, S.	1
4	Ishartomo, F.	1
5	Jamson, S.	1

6	Lai, C.	1
7	Mukhopadhyay, P.	1
8	Shinar, D.	2
9	Yao, X.	1

In addition to analyzing the authors, the analysis was also carried out for keywords which resulted in two keyword clusters with a time span of 2012 to 2018, which are visualized in Figure 4. In the first cluster there are Comprehension, Traffic Sign, and Effect with occurrences values of 8, 4, and 2; and the second cluster is Ergonomic Principle with a occurrences value of 2.



Figure 4. Research Trend Overlay Visualization

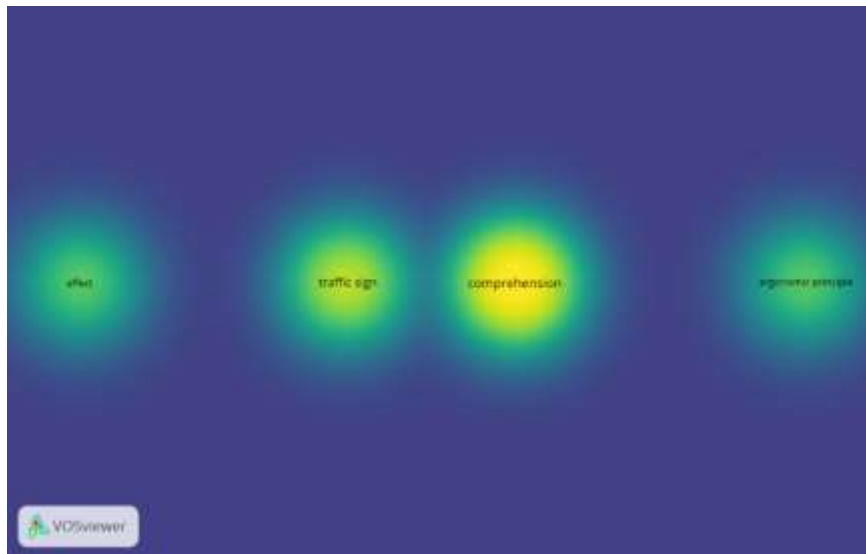


Figure 5. Destiny Visualization of Research trends

#### 4. Conclusion and Limitations

This research focuses on the overview of research in the Ergonomics field with the theme of Ergonomic Traffic Sign Comprehension. There are 13 related research publications in the last 20 years collected from the Scopus database using PoP software and a screening process has been carried out from 177 research publications. Based on the analysis, it shows that there is still quite limited research with the theme of Ergonomic Traffic Sign Comprehension, especially in Indonesia.

The gaps identified in this study provide directions for future research into traffic sign comprehension research, particularly in the field of ergonomics. This research topic may experience increasing trends and requires a special focus on further collaboration both between authors and between sub-topics. Overall, this bibliometric

analysis shows the authors and the variety of research that has been published on the topic in different parts of the world.

This study has two limitations. First, it is based on a limited set of keywords and may be affected by the database used to collect published research. Secondly, in this study, formal tools such as PoP, VOSviewer, and Mendeley were used, but the interpretation of the results could still be affected by the subjective viewpoint of the researcher, potentially leading to misinterpretation.

Future research can be improved by using a larger sample, by expanding the variety of keywords used, and accessing a wider database.

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