Analysis of the Current Situation and Trend of Eye Movement Research in Second Language Reading

Wang Yanlin, Wu Yuxin, Huang Ling*

University of Electronic Science and Technology of China, Chengdu, China

*Corresponding Authors

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Abstract: This paper reviews 148 L2 related eye-tracking literature from 2002 to 2022 retrieved from Web of Science (WOS) core collection, and uses the software Citespace and its mapping knowledge domains method to sort out the research hotspots of eye-tracking technology of second language reading. It is found that eye-tracking research in second language reading was in its developing stage and showed obvious characteristics of multi-disciplinary cross-integration. Through the analysis of keyword frequency and co-occurrence, it was found that the thematic hotspots of this period were the impact of input of learning materials and learner factors on second language reading and high- and low-level processing in second language reading. At the same time, keyword burstiness analysis shows that the research frontiers in the past five years are mainly in two aspects: the influence of different factors on the text comprehension of second language reading and the incidental vocabulary acquisition in second language reading. However, it is expected that there will be more academic outcomes in the research field.

1. Introduction

Second language reading has always been an important aspect of second language learning as well as an important indicator of second language learners' learning ability and academic performance. Early studies on Second language reading can be traced back to the 1870s and previous studies have shown that second language reading involves such low-level processing as phonology, grammar, orthography, syntax and semantics, and such high-level processing as passage inference and pattern activation. It is hence that L2 reading is a more dynamic and complex process than L1 reading (Nassaji, 2011). Traditional research on Second language reading mainly focuses on reading skills, strategies, and reading instructions while some scholars study the cognitive process of second language reading from the perspective of cognitive psychology. However, its early research depended on such methods as questionnaires, diaries, and observations, lacking scientific and objective technical means to quantify the cognitive processing of second language reading.

Eye-tracking technology can deeply explore cognitive processing, making it widely used in educational psychology and the second language reading research and providing researchers and L2 teachers with a new research perspective and teaching guidance. However, there is still a lack of effective quantification and review of related research progress so far. Based on the method of mapping knowledge domains, this paper analyzes the application of eye-tracking technology in L2 reading research in the past two decades and explores the research hotspots and trends in the field, hoping to provide suggestions for the future study of second language reading from the perspective of cognitive psychology.

2. Research methods and data sources

In this paper, the WOS core database is selected as the data source for analysis, and the search terms are TS= (L2 read* OR second language read* OR foreign language read* OR “SL read* OR

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FL read* OR ESL read* OR EFL read* AND eye-tracking), the time span was set from 2002-01-01 to 2022-03-31, and the types of literatures were limited to articles, online publications and reviews. After removing irrelevant literatures, 148 articles were finally obtained. This paper selects the node types as "category" and "Keyword", and analyzes the literatures from the perspectives of annual publication, subject distribution, and topic research hotspots with the help of software CiteSpace.

3. Data results and analysis

3.1 Annual publication analysis

The paper uses Citespace to conduct statistics on overseas eye movement research of second language reading from 2002 to 2022, as shown in Figure 1. The research in this period can be divided into three stages: 2004-2012 was the embryonic stage, and only one or two papers were published each year, indicating that the academic circles did not pay enough attention to the cognitive processing research of second language reading. The period from 2013 to 2016 was the exploratory stage, the number of papers showed a trend of increasing year by year, and it can be clearly seen that scholars gradually shifted their research focus to the cognitive process of second language reading. 2017-2022 was the development stage, the number of documents has increased significantly, and the growth rate has accelerated significantly. The number of published papers is about 20, which shows that eye-tracking research from second language reading has received more and more attention from the international academic community and achieved effective results.

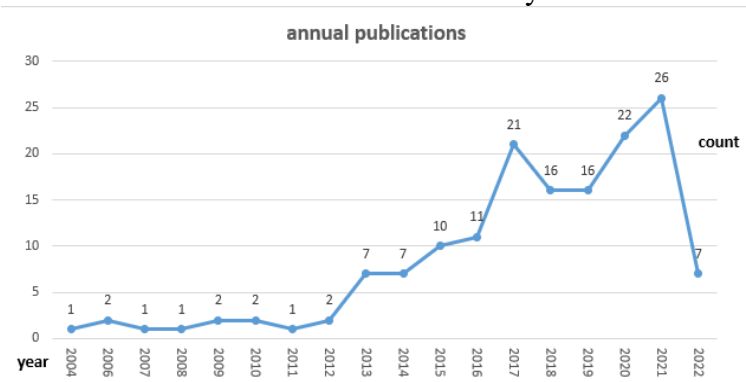

Figure 1: Distribution map of annual publication.

3.2 The distribution of literature category

By choosing the node type of “category”, the co-occurrence map of the category distribution is formed, as shown in Figure 2. It can be found that the research in the subject area during this period was mainly concentrated on linguistics, psychology, education and educational research, social sciences, behavioral sciences, computer sciences, and arts, indicating that the research scope of eye movement studies on second language reading is gradually becoming wider and showing the characteristics of multidisciplinary.

Figure 2: Distribution map of category.

The research hotspots of eye-tracking studies in the field of second language reading can be explored through the analysis of the citation frequency of high-frequency keywords and the co-occurrence analysis of keywords. Combined with Table 1 and Figure 3, it is found that the research hotspots of eye-tracking technology applied to the field of second language reading are as following aspects.

Table 1: High-frequency keywords table.

number	keywoed	frequency	number	keyword	frequency
1	comprehension	42	11	context	14
2	eye movement	34	12	children	14
3	eye tracking	32	13	frequency	14
4	movement	31	14	knowledge	13
5	information	26	15	model	10
6	2nd language	26	16	activation	10
7	language	24	17	working memory	9
8	acquisition	24	18	proficiency	9
9	individual difference	19	19	reading comprehension	9
10	attention	15	20	english	9

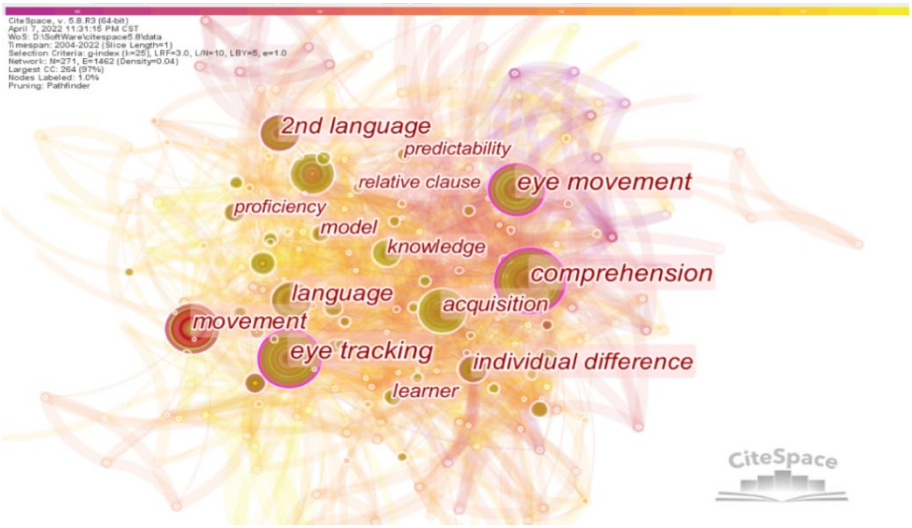

Figure 3: Map of keywords co-occurrence.

3.2.1 To study the impact of learning material input on second language reading

It is concluded that keywords such as "comprehension", "language" and "acquisition" have the highest word frequency through keyword co-occurrence analysis, reflecting that one of the hot topics of the research is to study the impact of learning material input on second language reading and learning. Boers (2017) et al. found picture annotations attracted more learners' attention and promoted learners' vocabulary learning and reading comprehension. Pellicer–Sánchez et al. (2021) found that auditory input contributes to the integrative processing of readers and improves the ability of reading comprehension. Empirical studies have shown the effectiveness of optimizing the input of learning materials for L2 reading, but it is still unknown how to design and select the most beneficial material for learners to understand and how readers interact with learning materials needs more studies.

3.2.2 To study the influence of learner factors on second language reading

Using eye-tracking technology to explore the influence of learner factors on L2 reading from the perspective of learners is another hot topic in L2 reading research. The corresponding keywords are individual difference, proficiency, working memory, etc. Researchers in this field have explored the influence of learners' language proficiency, cognitive style, and working memory capacity on second language learners' reading process and learning outcomes. Zufferey et al. (2015) found that high ability second language learners can identify cohesion words as accurately as native speakers, which to some extent explains the reason why high proficiency learners perform better at reading comprehension. However, the diversity of differences in learner factors leaves more room for future

research to explore.

3.2.3 Research on high- and low-level processing in second language reading

Combined with chart analysis, it is found that many scholars pay attention to the high- and low-level processing of second language reading, and the corresponding keywords include context, knowledge, sub-lexical orthographic, sentence comprehension, etc. Koda (2005) pointed out that there is a lack of effective research on second language reading from the perspective of cognitive psychology and cognitive process for most studies mainly focus on reading tests, while the study of second language reading from the perspective of high- and low-level processing can reveal the cognitive process of second language reading more specifically. However, since both low-level processing and high-level processing occur in working memory, how individual differences in working memory affect L2 reading performance is still a hot topic in future research.

4. Research trend analysis

In this paper, the recent change of research hotspots is shown in Figure 4, which is obtained through the keyword burstiness analysis. It can be seen that the research hotspots in the past five years have changed compared with the previous years. The corresponding keywords are reading comprehension, acquisition, cognitive load, learner and frequency. Analyzing in combination literature content, it is found that the research hotspots in the past five years are mainly in two aspects: the influence of different factors on the text comprehension of second language reading and the incidental vocabulary acquisition in second language reading.

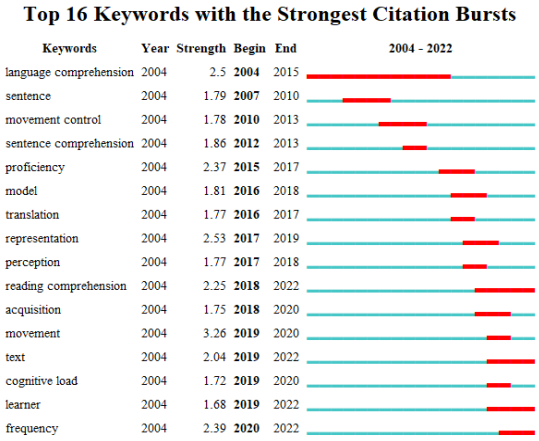

Figure 4: Map of keyword burstiness.

4.1 The influence of different factors on text comprehension in second language reading

In recent years, the study of different factors in the second language learners' reading comprehension process and learning outcomes has become an important trend in the field of second language reading research. From 2018 to 2022, it was found that the keyword "reading comprehension" has always been a research hotspot. The learners' vocabulary knowledge, the vocabulary frequency in the text, cognitive load, and other factors will affect the cognitive processes and outcomes of the second language reading comprehension. Although the eye movement processing of text reading is more complex than that of sentences, it can also reveal the L2 learners' cognitive reading processing in a more effective way, which is useful for improving second language reading research and teaching instruction.

4.2 Incidental vocabulary acquisition in second language reading

Contrary to intentional learning, incidental vocabulary learning is an unconscious way of vocabulary acquisition by which learners learn vocabulary through reading. Hulstijn (2001) suggested that incidental vocabulary acquisition is a natural way of language learning and vocabulary acquisition. Compared with the traditional way of vocabulary learning, incidental

vocabulary acquisition is more interesting and effective, so it has gradually attracted the attention of researchers. Eye movement data can effectively track learners' visual attention to text and vocabulary during reading, to discover the impact of these intricate factors on learners' reading processing and vocabulary acquisition, which is of great significance to the improvement of reading comprehension and vocabulary learning.

5. Prospects for future research

Based on the method of mapping knowledge domains, it is found that overseas studies on eye movement research of second language reading are in their developing stage, showing obvious characteristics of multi-disciplinary cross-integration. The integration of multi-disciplinary domain knowledge will be an important trend in eye movement research in second language reading. In terms of research content, exploring the influence of learner factors and learning materials input on L2 reading and vocabulary acquisition is still one of the research hotspots. In the future, eye movement data can be used to reveal internal processing strategies such as learners' reading strategies and skills while revealing the interactive effects of more different factors and second language reading. In terms of research methods, the combination of eye-movement technology with various brain imaging techniques such as ERP, EEG, and fMRI, and the combination of multiple cognitive processing tools can reflect the cognitive processing of second language reading in a more effective way, which is an important method to bring breakthrough progress in future second language reading research.

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