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# Analysis of Scientific Knowledge Atlas of Reading Eye Movement Research in China From 1992 to 2017 Based on Citespace III

Qin Xu <sup>a</sup>, Lili Yan

School of Foreign Language, Henan University of Technology, Zhengzhou 450001, China

<sup>a</sup>1803691705@qq.com

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## Abstract

This paper uses the information measurement visualization tool CiteSpace III to carry out dynamic knowledge map analysis for 330 CSSCI journals (1992-2017) related to reading eye-movement research in the CNKI journal database, from the angles such as research scholars, research institutions, research hotspots, research frontier and so on. It aims to sort out the development context of the field of eye movement research in China during the past 25 years, and to provide innovative thinking and multiple inspiration for scholars engaged in the study of reading eye movement in China.

## Keywords

CiteSpaceIII ; Eye movement; reading; Research Frontiers and Hot Spots.

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## 1. Introduction

Understanding cognitive activities in the reading process is of great importance for improving reading efficiency, promoting reading instruction, and solving problems with reading disabilities (Hucy, 1908). Western countries have studied eye movement in reading for more than 100 years. The domestic study of reading eye movements really began in the early 1980s. This paper objectively describes the achievements, development status, authors, institutions, research contents, research methods, research trends, and research hotspots of reading eye movements from 1992 to 2017, and discusses current problems in the research field.

## 2. Research Design

### 2.1 Sources of Data

The research data originates from CNKI database and retrieved CSSCI journals from 1992 to 2017 in the direction of “reading eye movements” (1992 is the starting year that CNKI included reading eye movement research core CSSCI journals). After excluding irrelevant literature, the paper obtains 330 actual valid documents. The data retrieval time is February 6, 2018.

### 2.2 Research Tools

The tools used in this paper are the CNKI measurement visualization tool and CiteSpace III. The search method is to import 330 papers retrieved from CNKI into CiteSpace III, and set the relevant parameters in CiteSpace III.

### 3. Analysis of Research Results

#### 3.1 Reading Eye Movement Research Literature Features

##### 3.1.1 Read Eye Movement Research Literature Distribution Trend

The number of domestic reading eye movement studies has generally risen from 1992 to 2017, which can be divided into two phases: 1) The initial period of reading eye movement research is from 1992 to 2005 and the number of published papers has been in the interval of [1,10] (paper). Internal; 2) the rapid development period of domestic eye-movement study of readings is from 2006 to 2017. The number of published papers rose rapidly and was in the interval of [10,30]. According to the trend of the number of papers issued, it is expected that the results of reading eye movement research will continue to rise. The trends can be specifically shown in Figure 1.



Figure 1. publishing Trends of Reading Eye Movement Research Documents

##### 3.1.2. Journal Distribution of Publishing Reading Eye Movement Research Papers

As can be seen from Figure 2, in the 330 CSSCI core journals, "Psychology Science" ranks first with a total of 61 papers accounting for 22.9% of the total. The journals followed by are "Psychology Journal", "Psychological Science Progress", "Psychology and Behavior Research", "Exploring New Psychology." All of them are psychology journals accounting for about 66% of the total number of journals. While, other foreign language, Chinese, and education core journals have a relatively small number of papers, which is relatively small, and their research on the field of reading eye movements is relatively backward.

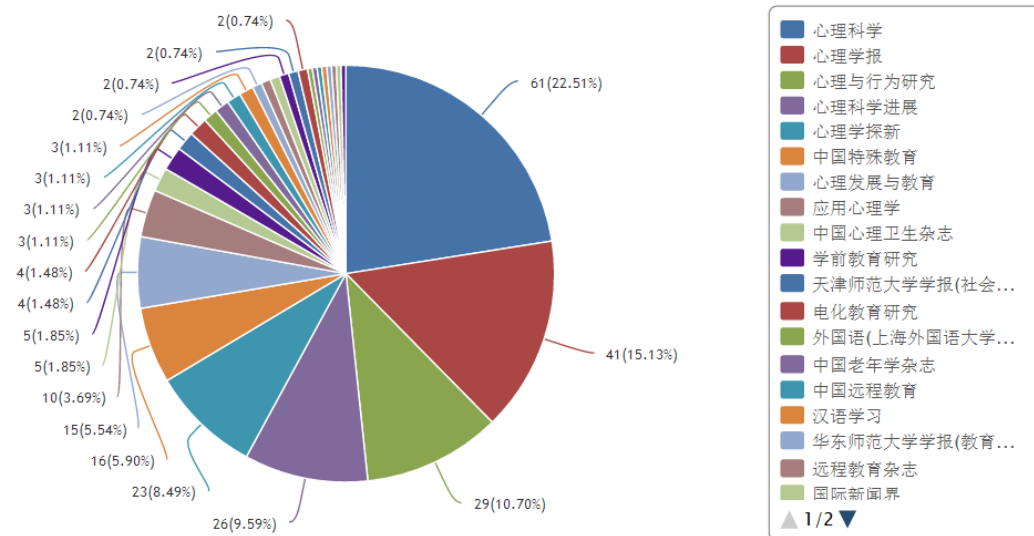


Figure 2. Distribution of reading eye movement research journals

##### 3.1.3 Reading Eye Movement Research Literature Authors and Institutions

Figure 3 is the author and institutional coupling diagram of CSSCI core journals published the reading eye movement research by CiteSpaceIII during the 25 years from 1992 to 2017. The co-occurrence of authors and institutions can reflect the strength of cooperation and mutual relations between core

authors and their agencies in a particular research field (Hu Zewen, Sun Jianjun, 2013). As can be seen from Figure 3, Professor Yan Guoli and Bai Xuejun, professors at Tianjin Normal University, are the best in reading eye movement research field. Among the research institutes, Tianjin Normal University is the scientific research center of reading eye movement research, which forms a co-occurrence network with Tianjin Normal University as the center. And Tianjin Normal University is the domestic leading research institution.

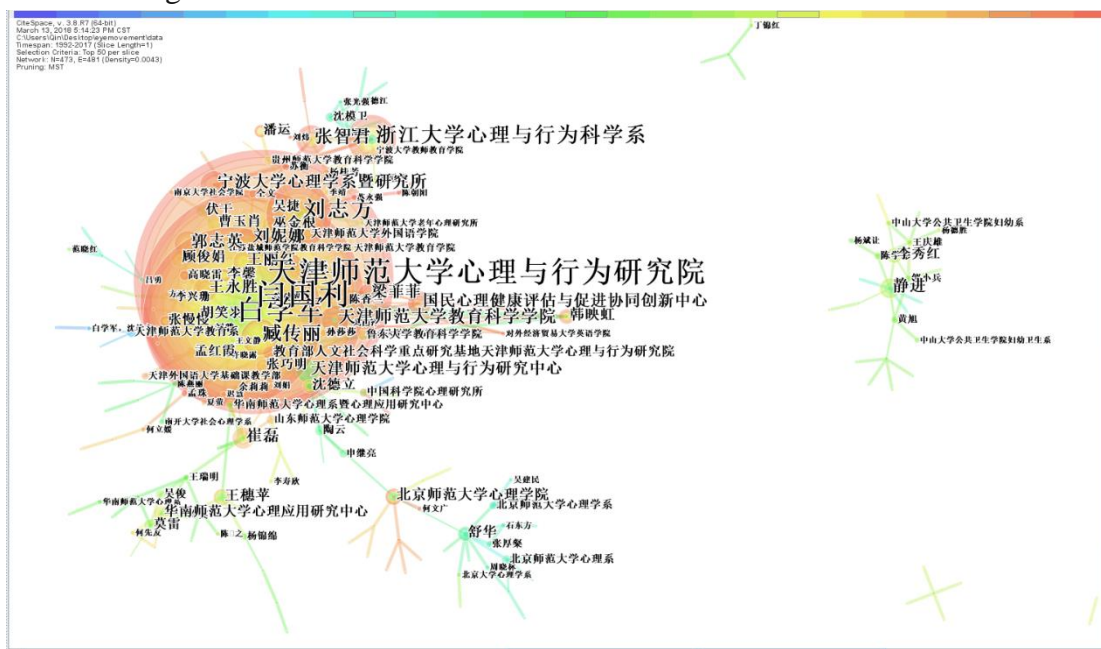


Figure 3. Reading eye movement research author and research institute coupling diagram

From Table 1, it can see that from 1992 to 2017, the top 10 in the field of reading eye movement research were Tianjin Normal University, Zhejiang University, East China Normal University, Beijing Normal University, Ningbo University, Liaoning Normal University, and South China Normal University. Nanjing Normal University, Institute of Psychology, Chinese Academy of Sciences, Capital Normal University. Among them, Tianjin Normal University publishes 114 papers that accounted for 34.5% of the total number of papers issued, which is five times ahead of second place Zhejiang University. But, the last 8 institutions published over 20 papers in 25 years, which shows that the gap is huge. With the exception of Tianjin Normal University, other institutions are still in a slow development stage in the field of eye movement research. Various researchers and research institutions should strengthen cooperation.

Table 1. Reading Eye Movement Research institute Issuing sorting Form

| sorting | institute Name                | Number of papers issued |
|---------|-------------------------------|-------------------------|
| 1       | Tianjin Normal University     | 114                     |
| 2       | Zhejiang University           | 24                      |
| 3       | East China Normal University  | 20                      |
| 4       | Beijing Normal University     | 18                      |
| 5       | Ningbo University             | 17                      |
| 6       | Liaoning Normal University    | 16                      |
| 7       | South China Normal University | 14                      |
| 8       | Nanjing Normal University     | 9                       |
| 9       | Institute of Psychology       | 8                       |
| 10      | Capital Normal University     | 7                       |

### 3.1.4 High Cited Documents

Highly cited documents are basic documents in the field of research (Cheng bo, 2017). Table 2 shows the top 20 most cited papers in the field of reading eye movements. These key documents together lay the knowledge base for reading eye movement studies. From Table 2, it can see that the highest cited frequency is Yan Guoli and Xiong Jianping's "Review of major eye movement indicators in reading research", which has been cited 178 times. This paper explains in detail the problems such as the classification of eye movement indicators, the deletion criteria of raw data, the problems with the selection of eye movement indicators and so on (Yan Guoli, Xiong Jianping, 2013).

Table 2. Highly cited documents of reading eye movements research

| Sorting | Citations | Name of Cited Paper  | Author                    | Source Journal                          | Year |
|---------|-----------|--|---------------------------|---|------|
| 1       | 178       | <i>The Main Eyemovement Index in Reading Study</i>   | Yan Guoli;Xiong Jianping  | Advances In Psychological Science       | 2013 |
| 2       | 138       | <i>The Study of Junior High School Students' Eyemovement Process of Reading Book with and without Illustration</i> | Shen Deli;Tao Yun         | Psychological Science                   | 2001 |
| 3       | 90        | <i>A Comparative Study of Eyemovement Characteristics of Primary Readers and Proficient Readers</i>                | Bai Xuejun;Shen Deli      | Psychological Development and Education | 1995 |
| 4       | 88        | <i>A Study of the Effects of Word Segmentation on Beginner's Sentence Reading</i>                                  | Shen Deli;Bai Xuejun      | Acta Psychologica Sinica                | 2010 |
| 5       | 71        | <i>The Study of Eyemovement in Chinese Reading Process</i>   | Yan Guoli; Bai Xuejun     | Advances In Psychological Science       | 2000 |
| 6       | 63        | <i>The Eyemovement Study of Reading Perceptual Span and Previewing Benefit in Different Grade Students</i>         | Yan Guoli; Wang Ligong    | Acta Psychologica Sinica                | 2011 |
| 7       | 63        | <i>The Application of Eyemovement Technique in Reading Research</i>  | Wu Di;Shu Hua             | Advances In Psychological Science       | 2001 |
| 8       | 59        | <i>The Eyemovement Study of Reading Technology Articles by Different Grade Students</i>                            | Yan Guoli                 | Psychological Science                   | 1999 |
| 9       | 58        | <i>The Effect of Semantic Information on Eyemovement Previewing Effect in Chinese Sentence Reading</i>             | Wang Suiping;Tong Xiuhong | Acta Psychologica Sinica                | 2009 |
| 10      | 56        | <i>An Eyemovement Study of Illustrative Effect of New Mathematics Teaching Materials in Primary School</i>         | Han Yuchang;Ren Guiqin    | Acta Psychologica Sinica                | 2003 |

## 3.2 Analysis of Research Hot Topics in Reading Eye Movement

### 3.2.1 High Frequency Keywords of Reading Eye Movement Research

In CiteSpace software, high-frequency keywords are used to determine the research hotspots in a field (Lin Deming, Chen Chaomei, Liu Zeyuan, 2011). Figure 5 shows the high frequency keywords that appear in the CiteSpace keyword co-occurrence analysis. According to Figure 5, high-frequency keywords are mainly related to topics such as eye movement studies, Chinese-Chinese reading, reading disorders, perceived breadth, cognitive processing, eye movement indicators and so on .

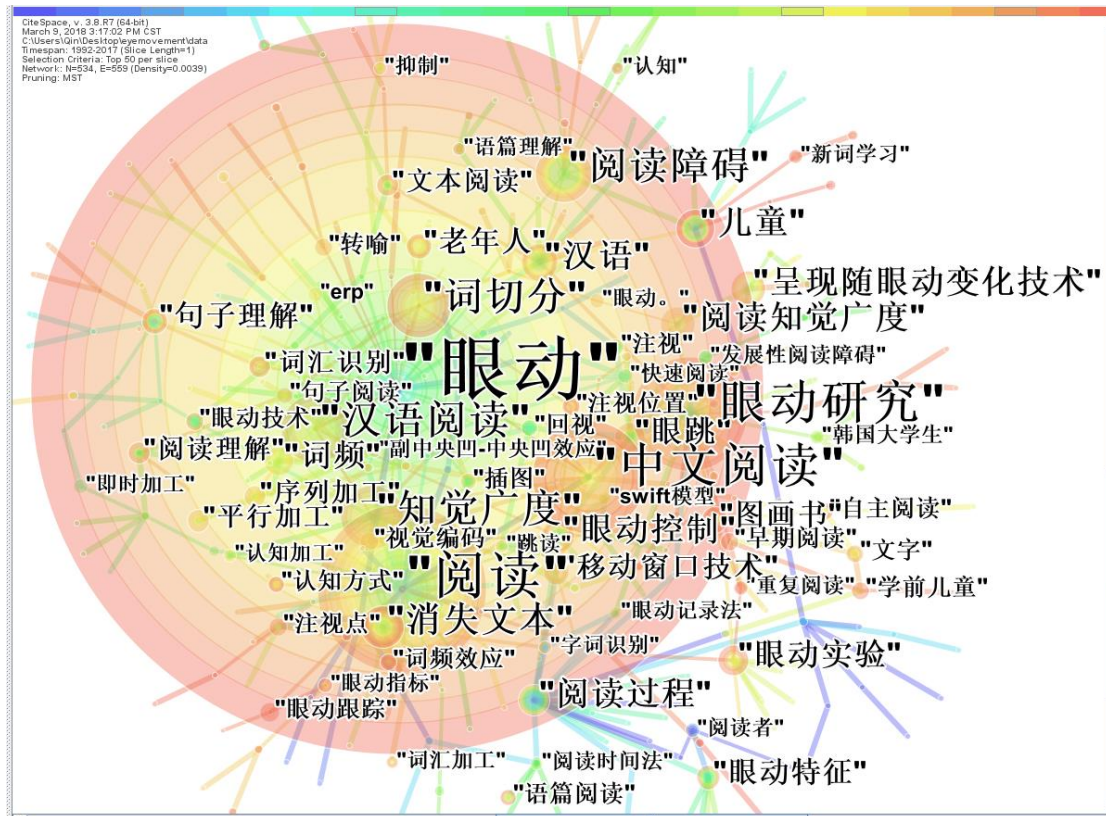


Figure 4. Reading Eye Movements Keywords Co-occurrence Map

### 3.2.2 Reading Eye Movement Research Keyword Clustering

Co-word clustering is based on the analysis of co-words and uses the frequency of co-words as the analysis object. Using clustering statistical methods, the co-word network relationship is reduced to a relatively small number of clustering processes (Zhong Weijin, Li Jia, Yang Xingju, 2008). In the past 25 years, the largest clustering nodes for reading eye movement research in China are cluster #0 word frequency, cluster #1 reading disorder, cluster #2 text, cluster #3 eyeball movement, cluster #4 reader, clustering #5 Eye movement, cluster #6 reading eye movement, cluster #7 sentence understanding, cluster #8 eye tracking, cluster #9 Chinese reading, cluster #10 psychology method.



Figure 5. reading eye movement research keyword clustering



### 3.3 Reading Eye Movement Research Frontier

References co-citation refers that two references are cited in the same document. By clustering and analysis of key nodes in a co-citation network, the knowledge structure, knowledge base, and research frontier of a research field can be revealed (Li Jie, Chen Chaomei), 2016). Through analyzing the content of frontier documents, the front-line perspectives can be explored from the basic problem discussing of reading eye movement research, the research direction of reading eye movement, and the experimental paradigm of reading eye movement research.

#### 3.3.1 Reading Eye Movement Research Foundation Problem

Reading eye movement research has been centered around two central questions: First, which factors determine the eye's gaze time; Second, which factors determine the eye's gaze position. Through research, it is found that the eye movement control in Chinese reading is different from the eye movement control in Pinyin writing. Therefore, it is an more important point and a difficult point to build an eye movement control model suitable for Chinese characteristics based on the existing eye movement control model, which will be a frontier topic in the future of eye movement research.

#### 3.3.2 Reading Eye Movement Research Direction

Rayner (2003) proposes that the emergence stage is the fourth development stage of reading eye movement research, which is focused on the eye movement control model. The most representative of this stage is the EZ reader model proposed by Reichle (1998) and others, which belongs to the newer cognition control model. But it does not fully explain the parafoveal preview effect and other eye movements in reading. Therefore, the parafoveal-foveal effect is the frontier in the field of reading eye movement research.

#### 3.3.3 Reading Eye Movement Research Experimental Paradigm

Yan Guoli (Yan Guoli, Wu Jingen, 2010) points out that there are many experimental models for reading eye movement study in China, but the combination of eye movement research paradigm and electrophysiology/brain imaging (ERP/fMRI) technology is rare and will certainly be research frontier topics in the future.

## 4. Conclusion

This study uses Citespace III software to analyze the field of reading eye movement research in the past 25 years. And the following conclusions can be got. 1. China's reading eye movement research has entered the fourth phase, scientific research results have been rising year after year, and the number of published literatures has shown a tendency of increasing year by year. From the distribution of disciplines, reading eye movement research in the past 25 years is still mainly concentrated in the field of psychology, the distribution is not balanced, to strengthen interdisciplinary, inter-agency, researcher cooperation can promote the comprehensive development of reading eye movement research. 2. Research focuses mainly focus on the eye movement studies, Chinese-Chinese reading, dyslexia, perceptual breadth, cognitive processing, and eye movement indicators. Based on its development trend, it is still the mainstream of future research. 3. To build an eye movement control model suitable for Chinese characteristics and combine eye movement technology with brain electricity (ERP/fMRI) is the frontier direction of future reading eye movement research.

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