

## *Original Paper*

# 15 Years of Research on Second Language Development in the DST Perspective in China- A Visual Analysis Based on the Literature from 2010-2024

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### ***Abstract***

*This study takes the research literature on second language development in the context of dynamic systems theory (DST) included in the China Knowledge Network (CNN) during 2010-2014 as the data source, and uses the visual analysis tool of CiteSpace to systematically sort out the research lineage in this field during the past 15 years, and to explore the research hot spots, cutting-edge themes, and their evolutionary trends. The results of the study show that the research on second language development under the perspective of DST in China has gone through the process from theoretical exploration to application expansion, and the research content has gradually extended from focusing on the theory itself to the various dimensions of second language development, including individual differences, learning environments, and instructional interventions, etc., and has shown the trend of multidisciplinary integration. The results of this research have promoted the in-depth development of second language development research under the framework of DST theory.*

### ***Keywords***

*dynamic systems theory, bilingual development, visual analysis*

## **1. Introductory**

### *1.1 Research Background*

The study of second language development as an interdisciplinary field was formed in the 1970s, and its development has benefited from the cross-fertilization of multidisciplinary theories from linguistics, psychology, and education. Traditional second language acquisition (SLA) research has been criticized by Larsen-Freeman for its focus on static analyses, who pointed out that this research paradigm is like a photographic technique that can only capture fragments of language development, but is unable to reflect its dynamic evolution (Diane Larsen-Freeman, 1997). Therefore, the introduction of Dynamic Systems Theory (DST) has brought a methodological innovation to the field, which advocates the adoption of a “camera-like” research perspective and the use of “Second Language Development (SLD)”

instead of the traditional terminology, in order to highlight the nonlinear characteristics of language development (Diane Larsen-Freeman, 2014). DST has its origins in classical mechanics, and integrates Chaos Theory and Self-Organization Theory, and its core features include system openness, dynamic adaptability, and sensitivity to initial conditions (Shen Changhong & Lu Min, 2008). Since its introduction into the field of second language research at the end of the 20th century, the theory has regarded language learners as complex dynamic systems, providing a new analytical framework for understanding language development. At the level of empirical research, scholars have used methods such as multi-case longitudinal tracking and computer modeling to systematically examine the interaction of variables within the language system (Verspoor, M., Lowie, W., & Van Dijk, M., 2008). Although domestic related research started late, in recent years it has gradually shifted from theoretical introduction to the exploration of specific application areas. Early studies focused on theoretical explanations, but in recent years, they have been expanded to vocabulary, grammar, reading and other language skills (Li Lanxia, 2011). However, there is still a significant gap compared with international studies: the theoretical level has not yet constructed a localized theoretical model, and the depth of research needs to be strengthened; the empirical level has a single research scenario, and the research methodology is still based on quantitative analysis, while the application of qualitative research paradigms, such as ethnography, action research, etc., is relatively scarce. In view of this, this study systematically combed the research results of this field in the past 15 years through bibliometric visualization analysis. The analysis shows that the current research focuses on vocabulary and grammar acquisition, while the research on pragmatic competence development is relatively weak. The visualization mapping can present the research lineage and identify the core and fringe areas in the knowledge structure, so as to point out the direction for the subsequent research. This analysis not only helps to avoid low-level repetitive research, but also promotes the internationalization of domestic research on second language development, narrowing the research gap with the international frontiers (Lei Pengfei, 2022).

### *1.2 Research Purpose*

This study aims to achieve the following objectives through the visual analysis of the research literature on second language development in the context of DST in China from 2010 to 2024: firstly, to reveal the development history and general trend of the research in this field, including the change of the number of literature, so as to grasp the development trend of the field in recent years; secondly, to identify the research hotspots and cutting-edge themes in this field and to analyze the development of the research themes and the trend in the future, through the keyword co-occurrence analysis and other methods. Through keyword co-occurrence analysis, cluster analysis and other methods, the research focus and core issues in different periods are sorted out to provide guidance and reference for the further development of the field and subsequent research.

## 2. Research Methodology

### 2.1 Research Tools

In this study, we used CiteSpace 6.4.R1 software to carry out the visualization and analysis of literature, which is mainly based on the theory of co-citation analysis and the Path-Finder algorithm to measure the literature (collection) to explore the key paths and knowledge inflection points of the evolution of disciplines and fields (Chaomei, C., 2005). The key paths and knowledge inflection points of the evolution of the field, and through a series of visual mapping to achieve the analysis of the potential power mechanism of the evolution of the discipline and the detection of the frontier of discipline development (Chaomei, C., 2005).

### 2.2 Data Sources and Processing

This study uses China Knowledge Network (CNKI) as the main data source. In the CNKI database, the search time was set from January 1, 2010 to December 31, 2024, the search subject terms were “dynamic system theory” and “bilingual development”, and the types of literature were limited to academic journal articles, doctoral dissertations and master's degree theses. D. theses and master's theses. After the initial search, a total of 115 relevant documents were obtained. Subsequently, the search results were manually screened to exclude irrelevant literature such as conference notices, book reviews, advertisements, and literature whose contents were not related to the research topic, and finally 110 valid documents were obtained as the analysis samples of this study. Visual information technology is used to analyze the annual distribution of the literature, to sort out the overall research situation of dynamic systems theory in second language development from 2010 to 2024 in terms of macro quantity; then keyword clustering co-occurrence mapping analysis is used to sort out the core areas of dynamic systems theory in second language development, and at the same time, the representative keywords of these core areas are analyzed using the LLR (Log Likelihood Ratio) algorithm in order to Then we analyze the representative keywords of these core areas using the LLR (Log Likelihood Ratio) algorithm to explore the specific research hotspots; and finally, we use the keyword emergence to predict the changes of the research hotspots over time.

## 3. Findings and Analysis

### 3.1 Annual Distribution of Literature

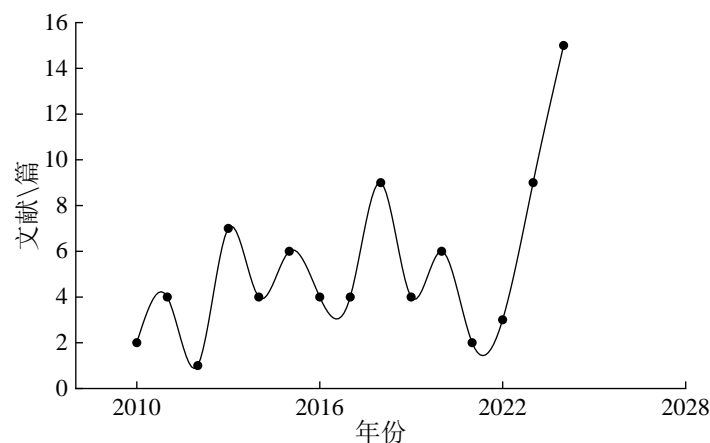


Figure 1. Annual Distribution of Literature

As can be seen through the line graph, during the period of 2010-2024, the overall trend of the number of articles published on the study of second language development under the perspective of DST in China shows a fluctuation followed by a significant increase. The total number of related literature is 76 articles. Among them, the year 2024 has the highest number of 15 articles. Further observation reveals that the development of research on second language development under the DST perspective in China can be divided into three phases: a steady fluctuation phase (2010-2012, totaling 7 articles), a slow growth phase (2013-2021, totaling 49 articles), and a rapid growth phase (2022-2024, totaling 27 articles). Overall, the attention of domestic scholars to the study of second language development under the perspective of DST is more scattered in the early stage, and then rapidly enhanced in the later stage, and the field shows good prospects for development.

### 3.2 Keyword Co-occurrence Mapping Analysis

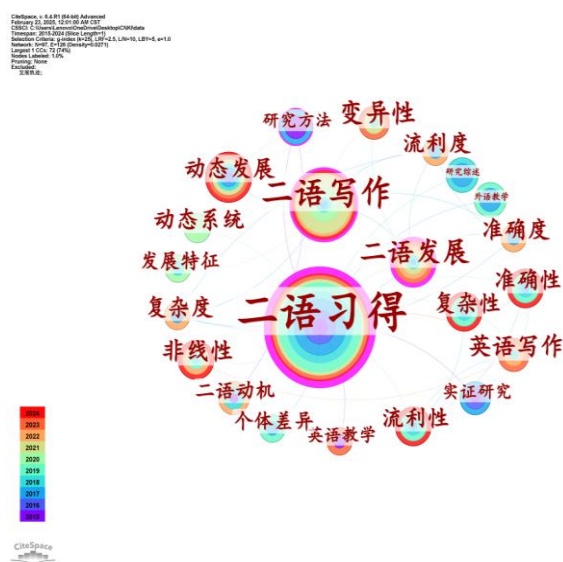


Figure 2. Keyword Co-occurrence Mapping Analysis

Keywords are a high degree of summarization of the topics in the literature, and keyword co-occurrence analysis can reveal the research hotspots and core issues in the field. In the keyword co-occurrence map generated by CiteSpace software, the size of the nodes indicates the frequency of keyword occurrence, and the thickness of the connecting lines indicates the intensity of co-occurrence between keywords. The analysis of the keyword co-occurrence graph shows that in the research of second language development in the domestic DST perspective, the keywords with higher frequency include “second language acquisition”, “variability”, “second language development”, “complexity”, “complexity”, “complexity”, “complexity”, “complexity”, “complexity”, “complexity”, “complexity”, “complexity”, “complexity”, “complexity”, “complexity”, “dynamic change”, “language development” and so on. These keywords reflect the research focus and core content of the field.

“Second language acquisition” is a hot research topic in the field of dynamic systems theory, and a wide range of research has been carried out on the process, mechanism and influencing factors of second language acquisition. “Individual differences” is also an important research hotspot, scholars pay attention to the influence of learners' individual differences in age, gender, learning styles, motivation and other aspects on second language development. The “language learning environment” has also received extensive attention, and the research includes the influence of classroom teaching environment, extracurricular learning environment and social and cultural environment on second language learning. In addition, the emergence of keywords such as “complexity”, “non-linearity”, “dynamic change” and “adaptability” emphasizes that Second language development is a complex, non-linear and dynamically changing process, and learners need to constantly adapt to changes in the environment and adjust their learning strategies.

### 3.3 Keyword Clustering Analysis

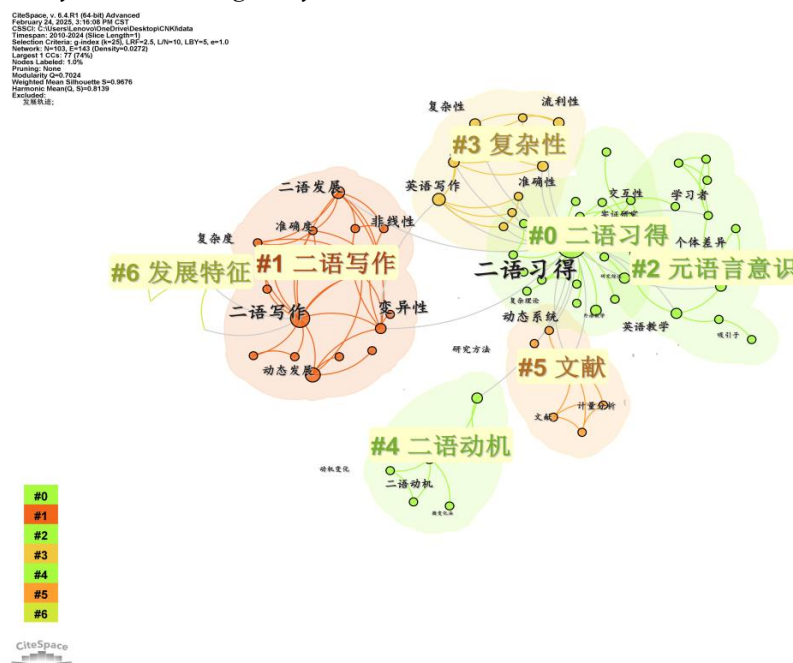


Figure 3. Keyword Clustering Analysis Mapping

Keyword co-occurrence analysis based on Citespace can reveal the knowledge structure and evolution of a specific research field. In this study, we use co-occurrence analysis to construct a visual knowledge map of dynamic systems theory in applied linguistics. The specific operation process is as follows: set the time span as 2014-2024 (time slice 1 year), choose “Keyword” as the node type, and keep the default values of other parameters. Firstly, keywords are clustered by “Find clusters” function, then “K” algorithm is used to complete the cluster naming, and finally LLR algorithm is used to generate the keyword co-occurrence knowledge graph. The analysis results show that a total of six keyword clustering networks (clusters 0-6) are formed, in which the clustering value ModularityQ is 0.7024, and the value of Silhouette, an indicator of the internal similarity of the clusters, is 0.9676, which indicates that the clustering results have a high level of internal consistency and differentiation. After bibliometric analysis, it was found that Cluster #5 (insufficient literature) and Cluster #6 (developmental feature class) were not included in the subsequent focused discussion due to small sample size and lack of representativeness. The research focuses on five core research clusters: second language acquisition (#0), second language writing (#1), meta-language awareness (#2), complexity (#3), and second language motivation (#4).

Cluster #0 is “Second Language Acquisition”. Since 2008, domestic academics have begun to gradually expand the dimensions of the application of Dynamic Systems Theory in second language acquisition research. Scholars such as Li Lanxia (2011) and Wang Tao (2010) have systematically sorted out the theoretical foundation of the theory, its core concepts and its application value in the field of second language acquisition. Since then, related studies have gradually expanded to other branches of applied linguistics. Wei Xiaobao (2012) innovatively put forward the D-C-C integration model, and by integrating dynamic systems theory, connectionism and constructive grammar theory, he explored in depth key issues such as the mechanism of second language acquisition, the frequency effect of linguistic input, developmental features and the path of acquisition. Zhao Changzhi and Yang Lianrui (2012), on the other hand, started from the cognitive-motivational interaction perspective and constructed a three-dimensional analysis framework of mindstream experience, motivational task processing and ideal second language self, which provided a new theoretical perspective for understanding the interaction between cognitive mechanisms and motivational systems in the process of language learning.

The greatest contribution of Dynamic Systems Theory to the study of second language acquisition is that it provides a framework that integrates the social and cognitive dimensions of second language acquisition and demonstrates that the interaction of these two dimensions ultimately leads to language development (Shen Changhong & Lu Min, 2008). The study of Zheng Yongbi (2011) shows that this theory provides a unique perspective for the study of second language vocabulary development, which can effectively explain the multilevel interaction mechanism between cognition and environment, the nonlinear characteristics of language development and its possible stagnation phenomenon, and at the same time take into account the complexity of factors such as the mother tongue transfer effect and learners' individual differences. Under the guidance of dynamic system theory, the dynamic model of second language acquisition constructed by Dai Yuncai and Wang Tongshun (2012) integrates the

environment, learner and language elements into a complex adaptive system, providing a theoretical tool for understanding the dynamic process of language acquisition. By examining the attentional mechanism in second language vocabulary acquisition, Wang Xiaoning (2015) found that the dynamic adaptation process between the learner and the social context has a significant effect on the allocation of attentional resources, and based on this, he put forward pedagogical suggestions to optimize the attentional mechanism. Xu Jinfen and Lei Pengfei (2017), on the other hand, revealed the application value of dynamic system theory in teaching practice by analyzing the nonlinear developmental characteristics of classroom second language acquisition. In addition, there are other scholars who have explored the construction of translation competence based on the dynamic system theory (Fang Hong & Wang Kefei, 2014). It is worth noting that the existing studies still focus on theoretical exploration and qualitative analysis, and the support of empirical data needs to be strengthened to deepen the theoretical construct in the future.

Cluster 1 is “second language writing”, in terms of domestic research, this cluster mainly applies the dynamic system theory to the research on writing, using comparative experimental control methods and relevant empirical studies. The types of studies mainly focus on three categories: the introductory theoretical introduction and elaboration by Shen Changhong and Lu Min (2008), the construction of a second language acquisition model based on the dynamic systems theory by Dai Yuncai and Wang Tongshun (2012), and the introduction of the research method based on the theory by Xu Lihua and Cai Jinting (2014). Gai Shuhua and Zhou Xiaochun (2013) conducted a follow-up study on writing under peer feedback approach and analyzed the dynamic change process of peer feedback. Only that study still used the comparative experimental control method in the research method. Later, the case study and follow-up methodology adopted by Yanjun Chen (2016) explored the study of second language writing under the DST perspective. However, further analysis showed that the existing studies were mostly theoretical and less empirical; the empirical studies were more qualitative and less quantitative. Therefore, it is suggested that future researchers should adopt feasible and practical research methods and analytical tools to expand relevant research areas, reduce repetitive studies, and provide feasible references for future empirical studies.

Cluster 2 is “Meta-Linguistic Awareness”, which mainly includes research aspects such as English teaching, individual differences and attractors. For example, through a set of self-designed vocabulary depth test combined with the audible thinking method, Zheng Yongyan (2014) found that the development of vocabulary depth knowledge under the framework of dynamic systems theory fluctuates and shows non-linear characteristics, and the language input is not proportional to the progression, which is aimed at providing theoretical basis for the development of the research on second language vocabulary under the dynamic systems theory. As well as Xu Jinfen and Lei Pengfei (2017) choose the example of classroom teaching content to control the classroom environment variables to analyze, and nearly revealed that the classroom second language acquisition presents the essence of the dynamic nonlinear development characteristics, aims to provide theoretical support and practical guidance for second

language teaching. Cluster 3 is “complexity”, which is firstly reflected in the fact that second language vocabulary includes not only lexical knowledge, but also multiple information such as phonology, morphology, collocations and language threshold. This cluster includes keywords such as English writing, accuracy, fluency, etc., which reveals that research on second language development in the DST perspective includes research on second language vocabulary as well as fluency and accuracy of oral expression. Cluster 4 is “Second Language Motivation”, which focuses on the application of theory and exploration of research methodology in the context of Dynamic Systems Theory (DST). The study aims to analyze the dynamic characteristics of second language motivation, reveal its interrelationships with the environment and individual learners' factors, and provide strong theoretical support and practical guidance for the practice of second language teaching, so as to promote the enhancement of second language learning effects.

### 3.4 Keyword Emergence and Future Trend Analysis

#### Top 9 Keywords with the Strongest Citation Bursts

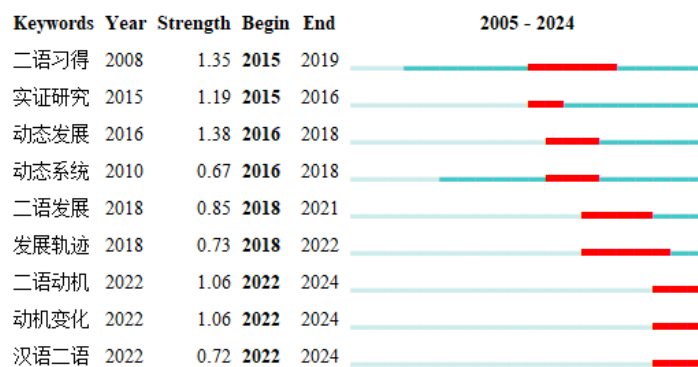


Figure 4. 2010-2024 Keyword Emergence Mapping

This keyword emergence analysis chart shows the top 9 keywords with high citation emergence intensity and their time intervals of emergence in the 2010-2024 domestic research related to second language development under the perspective of dynamic systems theory (DST). We can see that “second language acquisition” appeared in 2008, with a citation emergence intensity of 1.35 in the period of 2015-2019, indicating that in the early years of domestic research focused on second language acquisition, which is a key starting point for the field. In 2015, “empirical research” became a keyword with a citation intensity of 1.19, which lasted until 2016, indicating that from this period onwards, the emphasis on and application of empirical research methodology in the study of second language development under the perspective of DST in China gradually increased. “Dynamic development” and ‘dynamic system’ began to emerge in 2016 and 2010, respectively, and the intensity of the emergence of ‘dynamic development’ in 2016-2018 reached 1.38, indicating that with the advancement of research, the strength of the emergence of ‘dynamic development’ reached 1.38, suggesting that the

exploration of the dynamic features of second language development and the theory of dynamic systems itself becomes an important direction as the research progresses, and the emergence of “second language development” and “developmental trajectory” in 2018 shows that the focus of research in this period shifts to the exploration of the specific second language development process and trajectory. In 2018, “second language development” and “developmental trajectory” began to appear, indicating that the focus of research in this period shifted to the exploration of specific second language development processes and trajectories. 2022 “second language motivation”, “motivational change” and “Chinese second language” became keywords, indicating that the current domestic research focuses on the motivational factors in second language learning, as well as Chinese as a second language. The keywords “second language motivation”, “motivational change” and “Chinese as a second language” appear prominently, indicating that the current domestic research focuses on the motivational factors in second language learning, as well as the research on Chinese as a second language.

It can be seen that the study of second language motivation will continue to heat up in the future ‘second language motivation’ and ‘motivational change’ continue to emerge in 2022-2024 with high intensity, and it is expected that the dynamics of motivation in second language learning will continue to be studied in depth in the future. It is expected that the dynamic changes of motivation in second language learning, the influencing factors and the relationship with second language development will continue to be thoroughly studied in the future. ‘With the increase of Chinese’s international influence, the research on the learning and teaching of Chinese as a second language is likely to expand and deepen in the future under the DST perspective. It can be seen that the research on Chinese as a second language has great potential. Based on the accumulation of previous research on second language acquisition, empirical studies, dynamic development and other aspects, more comprehensive cross-disciplinary research may emerge in the future, integrating the research results of different aspects with each other, in order to understand the development of second language in a more comprehensive way.

## **4. Research Conclusion and Outlook**

### *4.1 Research Conclusions*

This study draws the following conclusions through the visual analysis of the research literature on second language development under the domestic DST perspective from 2010 to 2024: firstly, in the past 15 years, the research on second language development under the domestic DST perspective has made remarkable progress, with the number of literatures showing phased growth, the research team growing, and the content of the research becoming increasingly rich and in-depth. Secondly, the research hotspots in this field cover a variety of aspects such as second language acquisition mechanism, second language development, second language writing, application of dynamic system theory, etc., and the research hotspots have been expanding and evolving over time, showing the trend of multidisciplinary integration.

### *4.2 Research Outlook*

From the above studies, it can be seen that the research on second language development under the

perspective of dynamic systems theory in China has made rapid development in the past 15 years. In the future, bilingual motivation, Chinese bilingualism and motivational change will receive increasing attention, and it becomes an inevitable trend to explore in depth the dynamic change of motivation in bilingual learning, its influencing factors and its relationship with bilingual development. It can be expanded and deepened from the following two aspects: first, to further strengthen the theoretical research on second language development and to improve the application framework of DST theory in the study of second language development, which can be further studied and improved in depth by combining the dynamic system theory with the perspectives of motivation to learn and Chinese second language. For example, the research on classroom learning motivation under DST theory can be combined with the actual situation of second language development, and case studies and case analyses can be used to enrich the research data, refine and expand some core concepts and principles, and explore new paths for second language development.

Secondly, empirical research is strengthened to improve the scientificity and reliability of the research. At present, domestic research in this field is dominated by theoretical discussions and qualitative analyses, with relatively few empirical studies. For example, Gai Shuhua and Zhou Xiaochun (2013) conducted a tracking study on writing under peer feedback approach, without conducting a truly dynamic systematic micro-developmental study or paying special attention to the differences in individual development (Chen Yanjun, 2016). Therefore, the research on second language development under the DST perspective is expected to expand and deepen. In the future, a variety of research methods, such as experimental research, survey research, case study, etc., can be used to collect rich data and conduct in-depth research on learning motivation and motivational change of second language development under the DST perspective, to verify the theoretical assumptions and to provide more effective empirical support for the development and application of theories.

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