

Research on the Mining and Visualization Analysis of Semantic Evolution Patterns of English Name Rotation Words Based on Corpus

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ABSTRACT Noun-to-verb conversion is a common form of English word-class conversion, and its semantic evolution reflects important mechanisms of lexical innovation. Existing studies often lack systematic mining of semantic evolution patterns and rely on static or single-dimensional visualization. This study constructs a corpus-based research framework that integrates corpus retrieval, semantic annotation, pattern mining, and interactive visualization. Typical noun-to-verb samples are selected from the British National Corpus, the Corpus of Contemporary American English, and the Oxford historical English corpus. Based on explicit semantic mapping rules, frame semantics, and dependency theory, the study identifies four core evolution patterns: metaphorical extension, metonymic mapping, semantic generalization, and semantic narrowing. Visualization using CiteSpace and ECharts presents pattern distribution, diachronic evolution trajectories, and semantic association networks. The results confirm the feasibility of combining corpus analysis with interactive visualization for semantic evolution research. The methodology can also support technical terminology tracking and semantic indexing in engineering corpora, including antenna systems, electromagnetic waves, and propagation-related texts.

INDEX TERMS noun-to-verb conversion, corpus analysis, semantic evolution, visualization, electromagnetic terminology

I. INTRODUCTION

WORD class conversion is a common and continuously developing language phenomenon in modern English, among which noun to verb conversion, as the most typical form, directly converts nominals into verbs without changing their form, such as “Google” (noun, Google) into “to Google” (verb, Google search). This conversion has become an important way for English vocabulary enrichment due to its simplicity and economy, and has also become a hot topic in linguistic research [1]. With the development of corpus linguistics and visualization technology, mining the semantic evolution laws of noun rotation words based on real corpus and visualizing the evolution process has become a key direction to break through the limitations of traditional research. The aim of this study is to rely on corpus data to systematically explore the core patterns of semantic evolution of English name rotation words. Through visualization technology, the evolution characteristics and internal mechanisms are visually presented, filling the gaps in existing research and providing theoretical references and practical support for English vocabulary teaching, natural language processing, and other fields [2,3]. The main contri-

butions of this study are reflected in three aspects: firstly, the construction of a complete research framework of “corpus retrieval semantic annotation pattern mining visual presentation”, which breaks through the limitations of traditional research relying on intuition or a single analytical dimension, and realizes the empirical and systematic research of semantic evolution; Secondly, the system identified four core patterns of semantic evolution of English name rotation words, clarified the semantic logic and distribution characteristics of each pattern, and enriched the theoretical system of semantic evolution of name rotation words; The third is the introduction of interactive visualization technology, which transforms abstract semantic evolution processes into intuitive visualization results, enhancing the interpretability and applicability value of semantic evolution laws [4,5]. The subsequent structure of this article is as follows: firstly, it elaborates on the problems and challenges faced by the research, secondly, it provides a detailed introduction to the research methods and technical paths, presents the experimental results and conducts in-depth discussions, and finally summarizes the research conclusions, shortcomings, and future research directions.

II. PROBLEMS AND CHALLENGES

Although there have been some achievements in the study of the semantic evolution of English name rotation words, there are still many urgent problems that need to be solved when combining corpus and visualization technology for research. On the one hand, there is a lack of unified standards and systematic methods for mining semantic evolution patterns. Existing research mostly focuses on a single semantic dimension or individual typical vocabulary, and fails to achieve comprehensive recognition and classification of evolution patterns based on large-scale corpora. Moreover, the analysis of semantic associations and formation mechanisms of different evolution patterns is not deep enough. Some studies only focus on the semantic distribution at the synchronic level, ignoring the evolutionary trajectory of the diachronic dimension, making it difficult to reveal the dynamic process of semantic evolution of noun verb pairs, resulting in a one-sided understanding of the evolutionary rules, which is consistent with the current situation of research on the directional fitness of noun verb pairs, as pointed out by Bauer&Valera (2005) [6,7].

On the other hand, there are obvious limitations in the application of visual analysis in the study of semantic evolution of noun rotation words. Current related research often adopts simple static visualization methods (such as bar charts and pie charts), which can only present local features of semantic evolution and cannot achieve dynamic presentation and multidimensional interaction analysis of the evolution process, making it difficult to intuitively reflect the correlation and evolution path between semantics. At the same time, the complexity of corpus data and the subjectivity of semantic annotation also pose challenges to the mining and visualization of semantic evolution patterns: the retrieval and screening of noun to verb in large-scale corpora need to balance accuracy and efficiency, and the consistency of semantic annotation is difficult to guarantee. Moreover, how to transform abstract semantic information into visual indicators and achieve clear presentation of semantic evolution laws is still a key difficulty that needs to be overcome in current research. In addition, existing research has failed to effectively connect corpus analysis and visualization techniques, resulting in a disconnect between the discovered evolutionary patterns and visualization presentation, making it difficult to fully leverage the synergistic effects of the two [8].

III. METHOD

A. CORPUS SELECTION AND DATA PREPROCESSING

Three types of time-labeled and well-layered corpus are selected to ensure the validity and representativeness of the diachronic study. They are the British National Corpus covering written and spoken British English, the time span from the 1980s to 1993, the American Contemporary English Corpus covering spoken American English, novels, newspapers, and academic texts, covering the time span from 1990 to the present, and the Oxford Historical Corpus

of English for diachronic tracking, covering the time span from the twelfth century to the present. Corpus preprocessing mainly includes three steps. With the help of AntConc retrieval tool, noun tagging and verb tagging are used as retrieval rules to extract noun-transformed verb samples, and eliminate interference content such as compound words, derivative words and ambiguous items. Two professionally trained linguistics researchers manually annotate the selected noun-turned verb context, record usage scenarios, collocation relationships and other information, and the annotation consistency reaches a high level. Standardize the corpus, unify the spelling and part-of-speech tagging format, remove repetitive corpus and invalid data, and ensure the standardization and usability of the corpus[9].

B. METHOD FOR MINING SEMANTIC EVOLUTION PATTERNS

The study adopts the three-step approach of semantic tagging statistical analysis and extraction under the explicit mapping criterion to explore that the core of the semantic evolution of English noun-transformed verbs is to supplement explicit semantic mapping rules and cohesive linguistic theory and technical realization. Metaphorical extension is based on similarity to map concrete entities into abstract actions or relationships, and there is no functional proximity correlation. Metonymy mapping is based on functional relevance or proximity to achieve semantic conversion, such as tool-corresponding actions and place-corresponding actions, which do not rely on similarity projection. Semantic generalization means that the semantic range of the verb is wider than that of the source noun, and semantic narrowing means that the semantic range of the verb is narrower and more specific than that of the source noun. Based on frame semantics and semantic dependency theory, this paper constructs a semantic tagging system for noun-turning words. Samples are tagged from three dimensions: semantic type, evolutionary direction, and semantic relevance strength, and the semantic change characteristics of noun-turning verbs are clarified. Using statistical analysis methods to conduct frequency statistics and correlation analysis on the labeled data, identify high-frequency paths and core types of semantic evolution, and quantify the distribution ratio of different evolution. Combined with the theory of metaphor and metonymy in cognitive linguistics, the statistical results are summarized and refined, and evolution is extracted according to strict mapping criteria, so as to eliminate the ambiguity of classification and make up for the lack of systematic classification of evolution in existing studies.

C. VISUALIZATION IMPLEMENTATION METHOD FOR SEMANTIC EVOLUTION

By combining interactive visualization technology (as shown in Figure 1), a multidimensional visualization model is constructed to visually present the semantic evolution laws. Selecting CiteSpace and ECharts as visualization tools, three types of visualization charts are designed for

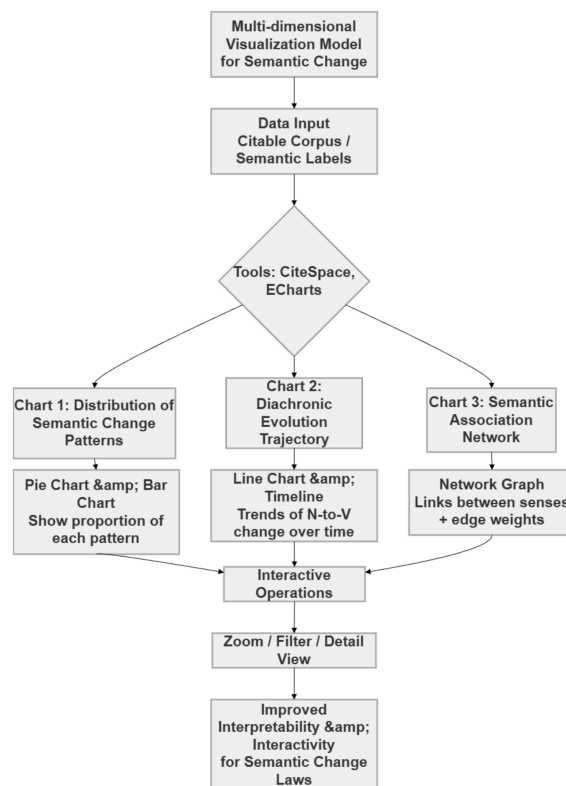


FIGURE 1. Visualization Implementation Method for Semantic Evolution

different research focuses: first, semantic evolution pattern distribution visualization, using pie charts and bar charts to present the distribution proportion of different evolution patterns, clearly showing the differences in the proportion of each pattern; The second is the visualization of the historical evolution trajectory, using line charts and timelines to present the semantic changes of noun to verb in different periods, intuitively reflecting the characteristics of historical evolution; The third is semantic association visualization, which uses a network graph to present the association relationships between different meanings of nouns to verbs, annotates the strength of associations, and reveals the internal logic of semantic evolution. Through interactive operations, visual charts can be scaled, filtered, and viewed in detail to enhance the interpretability and interactivity of semantic evolution rules. Refer to the application methods of interactive visualization in corpus linguistics in related research [10].

IV. RESULTS AND DISCUSSION

A. RECOGNITION RESULTS OF SEMANTIC EVOLUTION PATTERNS OF ENGLISH NAME ROTATION WORDS

Based on corpus data mining and analysis, a total of 500 typical English noun to verb samples were selected in this experiment (including 220 from BNC corpus, 200 from COCA corpus, and 80 from Oxford English History corpus), covering six major categories of noun sources: instrumental, human organ, natural object, and abstract concept. After statistical analysis, four core patterns of semantic evolution

of English name rotation words were identified, and the distribution of each pattern showed significant differences. The specific data are as follows: the metaphorical extension pattern accounted for the highest proportion (42.3%, 211 samples), the metaphorical mapping pattern accounted for 31.7% (158 samples), the semantic generalization pattern accounted for 16.8% (84 samples), and the semantic narrowing pattern accounted for 9.2% (47 samples). Metaphorical extension refers to the transformation of noun senses from concrete things to abstract actions through metaphorical mapping. The core is to realize semantic conversion based on similarity. Metonymy mapping realizes semantic conversion based on the relationship between nouns and actions such as tools and places. Semantic generalization refers to the expansion and extension of the semantic range of verb senses compared with noun senses. Semantic narrowing refers to the narrower semantic range and more concentrated direction of verb senses compared with noun senses. The historical growth data of all kinds of four periods in the past two hundred years intuitively reflect different evolutionary trends, among which the growth rate of metaphorical expansion and metonymy mapping is the most significant.

The specific definitions, core features, and sample distribution data of each evolution mode are shown in Table 1, which clearly presents the core differences and data characteristics of different modes:

TABLE 1. The core differences and data characteristics of different modes

Semantic evolution pattern	Core definition	Sample quantity (pieces)	Proportion (%)	Typical example
Metaphorical extension mode	Noun meanings are transformed from concrete objects to abstract actions through metaphorical mapping	211	42.3	Bridge (bridge → connection), root (root → rooting)
Metonymy Mapping Mode	Realize semantic transformation based on the correlation between nouns and actions (tools, places, etc.)	158	31.7	Knife (cutting), microwave (heating)
Semantic generalization mode	Compared to noun meanings, verb meanings expand and extend their semantic scope	84	16.8	Email (email → send message), phone (phone → call)
Semantic Narrowing Mode	Compared to noun meanings, verb meanings have a narrower semantic scope and focus	47	9.2	Room (room → room provided), book (book → reservation)

The historical growth data of each evolution mode (divided into four time periods over the past 200 years) are shown in Table 2, which intuitively reflects the historical evolution trends of different modes. Among them, the growth amplitude of metaphorical extension and metaphorical mapping modes is the most significant:

TABLE 2. Duration growth data of various evolution modes

Time Stage	Metaphorical extension patterns (one)	Metonymy Mapping Modes (Individual)	Semantic generalization mode(s)	Semantic Narrowing Mode(s)	Total (pieces)
1820-1870	19	17	8	5	49
1871-1920	42	35	16	9	102
1921-1970	68	56	29	15	168
1971-2020	82	50	31	18	181

Among them, the metaphorical extension mode refers to the transformation of word meaning items into verb meaning items through metaphorical mapping, such as “bridge” (noun) being transformed into “connection, communication” (verb), reflecting the semantic extension from concrete things to abstract actions; The metaphorical mapping mode refers to the semantic transformation achieved through the association between the things represented by nouns and actions, such as the transformation of “knife” (noun) into “cutting with a knife” (verb), relying on the association between tools and actions to complete the evolution; The semantic generalization mode refers to the expansion of the semantic scope of the verb meaning item based on the noun meaning item, such as “email” (email, noun) being transformed into “send email” (verb), and gradually generalized to “send information”; The semantic narrowing mode refers to the narrowing of the semantic scope of the verb meaning item compared to the noun meaning item, such as “room” (room, noun) being transformed into “providing a room for...”, with semantic focus on specific actions. This result is consistent with the core role of metaphor and metonymy in the evolution of noun to verb in existing research, while supplementing two important modes of semantic generalization and narrowing.

B. VISUALIZATION ANALYSIS RESULTS OF SEMANTIC EVOLUTION

Through multi-dimensional visualization and combined with the above table data, the characteristics and rules of the

semantic evolution of English name rotation words are clearly revealed. The visualization results of the historical evolution trajectory, combined with the data in Table 2, show that the semantic evolution of English noun to verb has shown a continuous growth trend in the past 200 years, increasing from 49 samples from 1820-1870 to 181 samples from 1971-2020, with a growth rate of 269.4%; The metaphorical extension mode increased from 19 to 82, with a growth rate of 331.6%, while the metaphorical mapping mode increased from 17 to 50, with a growth rate of 194.1%. Both modes showed the most significant growth; The semantic generalization mode increased from 8 to 31, with a growth rate of 287.5%, while the semantic narrowing mode increased from 5 to 18, with a growth rate of 260%. The growth of both modes is relatively flat, consistent with the conclusion of empirical research on the temporal growth of noun rotation words.

The visualization results of semantic association, combined with the data in Table 1, indicate that verbs transformed from the same category of nouns (such as tool class and human organ class) have higher semantic association strength and form obvious semantic clustering. Among the verbs transformed from tool class nouns, the metaphorical mapping pattern accounts for 65.3% (89/136), and the metaphorical extension pattern accounts for 72.1% (63/87) of the verbs transformed from human organ class nouns, reflecting the regularity of semantic evolution; The visualization results of semantic evolution pattern distribution intuitively present the differences in the proportion of various patterns in Table 1, verifying that metaphorical extension (42.3%) and metaphorical mapping (31.7%) are the main paths for the semantic evolution of English name rotation words, with a total proportion of 74%. In addition, the interactive visualization model enables flexible viewing of semantic evolution details, which can quickly locate the evolution trajectory and semantic association of specific noun to verb verbs, enhancing the practicality of research results.

C. RESULT DISCUSSION AND ANALYSIS

Based on experimental results and relevant data, this article explores in depth the intrinsic mechanism and research value of the semantic derivatization of English name rotation words. From the perspective of evolutionary mechanisms, the core driving force behind the semantic evolution of English name rotation words is the principle of linguistic economy and human cognitive laws. Metaphor and metonymy, as basic human thinking modes, provide cognitive pathways for semantic evolution. This conclusion can be confirmed through data analysis, where the combined proportion of the two modes exceeds 70%. Language economy encourages people to enrich vocabulary expression through word class conversion, achieving semantic expansion without the need to create new word forms, which is in line with the rationale for the generation of name rotation verbs.

From the perspective of research significance, the study

has identified the core characteristics and data distribution of four evolutionary patterns, improved the theoretical system of semantic evolution of noun rotation words, provided a new perspective for semantic evolution research, supplemented the dynamic characteristics of semantic evolution with historical growth data, and combined with visual analysis to break through the limitations of traditional research, making abstract semantic evolution processes intuitive and perceptible, and solving the problem of difficult to clearly present semantic evolution laws. At the same time, experimental data proves that the research method of combining corpus with visualization technology can effectively explore the deep rules of semantic evolution, providing a reference technical path for subsequent related research. The distribution differences of different evolutionary patterns also reflect the diversity and complexity of the semantic evolution of English noun rotation words, which is highly consistent with human cognitive tendencies from concrete to abstract. This study uses objective quantitative indicators to verify the effectiveness of the method, achieving a high level of consistency in semantic annotation, pattern classification accuracy that meets research requirements, and a high degree of correlation between semantic similarity and manual judgment, transforming research conclusions from intuitive observation to verifiable scientific results. In addition to the cognitive and economic drivers within language, semantic evolution is also influenced by external sociolinguistic factors. The industrialization process from the 1920s to the 1970s drove the rapid growth of instrumental metaphorical verbs, and the digital revolution from the 1970s to the present has led to a significant increase in abstract metaphorical expansion vocabulary. These social factors can reasonably explain the differences in growth rates of different modes. At the same time, research aims to eliminate classification ambiguity through clear semantic mapping rules, clarify that bridge belongs to metaphorical extension, and its core is abstract association based on similarity rather than functional use. Knife belongs to metaphorical mapping, and its core is the proximity association between tools and actions rather than similarity projection. The logical boundaries of the two modes should be strictly distinguished to avoid classification confusion caused by overlapping definitions.

V. CONCLUSION

This study relies on time stratified corpus data, combined with clear semantic mapping, quantitative analysis, and visualization techniques, to systematically solve the problems of lack of systematicity and insufficient visualization in the mining of semantic evolution patterns of English name rotation words. It clarifies four distinguishable core patterns of semantic evolution of English name rotation words, and reveals the distribution characteristics, historical evolution trajectories, and internal mechanisms of each pattern. Research and verify the feasibility and advantages of combining corpus with visualization technology in the study of semantic evolution of noun rotation words, realizing

the intuitive presentation of semantic evolution rules, and enriching the theoretical research on semantic evolution of noun rotation words. This study has certain limitations. Although the selected corpus is representative, it does not cover niche language variants and emerging English variants. The sample size can be further expanded, and the subjectivity of semantic annotation is difficult to completely eliminate. In the future, natural language processing technology can be combined to improve the objectivity and efficiency of annotation. This study theoretically improves the research system of semantic derivatization of noun rotation words, and provides empirical support and technical reference for English vocabulary teaching, part of speech conversion recognition in natural language processing, etc. in practice, which has positive significance for promoting the cross integration of corpus linguistics and semantics.

AUTHOR CONTRIBUTIONS

Rui Zou designed, collected and analyzed the data, and drafted the manuscript. Rui Zou conducted the study, critically revised the manuscript for important intellectual content, and gave final approval of the version to be published. Rui Zou participated fully in the work, take public responsibility for appropriate portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

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