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Complex word formation in contemporary syntactic frameworks: scientometric investigation and its relevance to grammar pedagogy

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ABSTRACT

This study explored the evolving research landscape on complex word formation within contemporary syntactic frameworks using a scientometric approach. Employing bibliographic data of 350 journal articles (2014 – 2024) retrieved from Scopus, the study examined publication trends, author productivity, and prominent publication avenues, utilizing VOSviewer for data visualization and network analysis. Findings revealed a growing body of literature, with an average of 34 publications annually and a notable increase in recent years. Verspoor and Culbertson emerged as the leading authors within this research focus, while *Lingua* and *Languages* were identified as the most prominent journal publishers. Keyword co-occurrence analysis revealed ten thematic clusters, highlighting the nature of this research domain. Two main clusters, "word constructions" (20.4%) and "syntax" (18.5%), dominated the landscape, followed by four intermediate clusters focusing on "compounds" (15.7%), "artificial intelligence" (14.85), "syntactic complexity" (10.2%), and "verb" (6.5%). Four minor clusters explored more specialized themes such as "speech perception and recursion" (4.6%), "syntactic processing and sentence comprehension" (3.7%), "syntax, semantics, and information structure" (3.7%), and "sign language and language evolution" (1.9%). These findings, to a certain extent, offer implications for grammar pedagogy, emphasizing the need for teaching approaches that reflect the interconnected nature of complex word formation.

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INTRODUCTION

The influence of English within an increasingly interconnected global landscape presents a salient issue for studying complex word formation, particularly concerning the emergence of novel lexical items driven by cross-linguistic interaction and the need for international intelligibility. Complex word formation is the process through which languages generate new lexical units by combining existing morphemes (Booij, 2017; Plag, 2019; Schmid, 2015)has long captivated the attention of linguists and language educators alike. This fascinating phenomenon lies at the center of linguistic creativity (Aikhenvald et al., 2020; Plag, 2020), allowing languages to adapt and expand their expressive control to meet the ever-evolving communicative needs of their speakers. From the everyday compounds we encounter in our daily lives (e.g., "mailbox," "sunshine") to the more specialized technical terms found in scientific discourse (e.g., "photosynthesis," "morphosyntax"), complex words permeate our linguistic landscape, enriching our vocabulary and enabling us to convey nuanced meanings with precision. In line with Clahsen and Jessen (2020), DeVore and Verspoor (2024), Jurado (2019), and Verspoor (2024), understanding the mechanisms underlying complex word formation is crucial for unraveling the intricacies of language structure and for gaining insights into the cognitive processes that enable humans to generate and interpret novel linguistic forms.

Complex word formation encompasses the processes by which words are combined or modified to create new lexical units (Booij, 2020). This phenomenon involves the interplay of compounding, derivation, and inflection, each contributing to the nature of lexical innovation in language (Blevins, 2016; Stekauer et al., 2012). Compounding, the concatenation of two or more existing words (Hüning & Booij, 2014), results in complex words like "sun-flower" or "black-board," where the meaning of the new word is often a combination or extension of the meanings of its constituent parts. Derivation, on the other hand, involves the addition of affixes to a base word (Lieber et al., 2015), as in "un-happy" or "work-er," leading to new words with altered meanings or grammatical categories. Inflection, while not creating new lexemes (Štekauer, 2015), modifies existing words to express grammatical relations, such as "walk-ed" or "cat-s," contributing to the syntactic well-formedness of sentences.

The significance of complex word formation extends beyond theoretical linguistics (Adams, 2014; Anderson & de Saussure, 2018;

Körtvélyessy & Štekauer, 2020). For language learners, mastering the principles of complex word formation is essential for expanding vocabulary, enhancing reading comprehension, and achieving fluency in both spoken and written communication (Khezrlou & Ellis, 2017; Monaghan et al., 2021; Sun & Verspoor, 2022). In psycholinguistics, the study of complex word formation sheds light on the cognitive processes involved in word recognition, lexical access, and semantic interpretation (Hopp, 2016; Mifka-Profozic et al., 2024). Computational linguists leverage insights from complex word formation to develop algorithms and models for natural language processing, machine translation, and artificial intelligence (Shih, 2022; Zukoff, 2023). Moreover, in language education, understanding the complexities of word formation can inform pedagogical practices and contribute to the development of more effective teaching materials and strategies (Ellis, 2015; Larsen-Freeman, 2015a; Larsen-Freeman et al., 2024).

Recent years have witnessed a surge in research on complex word formation, exploring its various facets. Contemporary research delves into the interplay between morphology, phonology, syntax, and semantics. For instance, the study of morphophonological alternations (e.g., Savoia & Baldi, 2022; Zukoff, 2023). The study of complex word formation also sheds light on language acquisition, processing, and variation (e.g., Bamshadi & Ardakani, 2020; Hopp et al., 2024; Taylor, 2015). A number of studies have investigated the cross-linguistics variation in complex word formation processes (e.g., de Swart et al., 2022; Garbo et al., 2019; Wälchli, 2015, 2018). Others have focused on the cognitive mechanisms underlying complex word processing (e.g., Günther & Marelli, 2023; Rice, 2023; Spencer et al., 2023). Furthermore, there has been increasing interest in the application of computational methods to the analysis and modelling of complex word formation (e.g., Gorman, 2022; Marco & Fraser, 2020). Specifically, these computational approaches encompass machine learning algorithms for predicting novel compound formation, statistical modeling for analyzing the productivity of different morphological processes, and natural language processing tools for the automated extraction and annotation of complex words in large corpora.

Nevertheless, complex word formation holds significant importance within syntactic frameworks, offering tools to dissect internal structure and syntactic behavior of these lexical items (Carston, 2022; Lieber, 2006; Pustejovsky & Batiukova, 2019). Frameworks like Distributed Morphology (Beraldo & Araújo-Adriano, 2024; Lieber & Plag, 2022) and Lexical Functional Grammar (Davidse & Brems, 2023; Heine et al., 2016; Jansen, 2016) provide detailed accounts of morpheme combination and their interaction within sentences. Contemporary syntactic theories, notably Minimalism (Chomsky, 2004; Cipriani, 2021) and Distributed Morphology (Embick, 2013; Harley, 2014), posit that complex word formation transcends mere morpheme

concatenation, involving syntactic operations like Merge and Move in a hierarchical and rule-governed fashion. These frameworks underscore the crucial role of syntactic structures in determining the interpretation and well-formedness of complex words, highlighting the morphology-syntax interface (Chomsky, 2021). The concept of "head movement" in Minimalism elucidate affix placement, while Distributed Morphology clarifies the timing of morphological operations, proposing both lexical and syntactic assembly of complex words (Hathout & Namer, 2019). This syntactic perspective emphasizes the interplay between morphological rules and syntactic constraints in forming and interpreting complex lexical units.

Shifting from micro-level analysis, complex word formation bridges micro and macro linguistics, offering insights into language variation (Cabezas-García & Chambó, 2021), change (Beavers et al., 2021), and contact (Adamou et al., 2021). Borrowing studies illuminate language contact and cultural exchange (e.g., Gibson & Marten, 2019; Tat, 2022), while neologism and productivity analyses reveal mechanisms of language change and lexical innovation (Al-Dala'ien et al., 2022; Kim, 2021). In applied linguistics, complex word formation is vital for language assessment (Uzun, 2021), teaching (Lun et al., 2023), and lexicography (Fendel, 2024). Learner corpus analysis of derivation reveals vocabulary acquisition stages and learner challenges, informing assessment design.

Moreover, grammar pedagogy, the study of teaching grammar, has long engaged with complex word formation, employing diverse methodologies from rule-based to communicative approaches emphasizing meaning and authentic use (Larsen-Freeman et al., 2024). A focus on meaning-making and communicative competence underscores effective grammar instruction (Ellis, 2021; Larsen-Freeman, 2015b). Research indicates that integrating grammar with authentic tasks enhances engagement and deepens structural understanding (Hopp et al., 2024; Murphy, 2023). Recognizing varied learning needs, differentiated instruction is increasingly vital (Hsieh, 2024; H. Wang et al., 2024). Consequently, grammar pedagogy is crucial for fostering proficiency and communicative skills (Panahi et al., 2024), holding particular significance in complex word formation, which bolsters vocabulary and morphological awareness (Larsen-Freeman, 2010).

Despite these advancements, there remains a need for a data-driven overview of the current research on complex word formation, particularly within the context of contemporary syntactic frameworks. While valuable, the existing body of literature lacks a systematic, large-scale analysis of the key trends and emerging themes, hindering our ability to synthesize current knowledge and identify promising avenues for future investigations. The present study aims to fill this critical gap by providing a data-driven overview of the field, enabling researchers to build upon a more robust foundation of

knowledge. The present study addresses this gap by conducting a scientometric investigation. Specifically, we aim to address the following research questions:

(1) What are the prevalent trends in research on complex word formation within contemporary syntactic frameworks, and what are the key themes and research foci within this domain?
(2) How do these research themes relate to different aspects of grammar pedagogy, and what are the implications for language teaching and learning?

METHOD

Research Design

This study employed a scientometric approach to investigate the research landscape of complex word formation within contemporary syntactic frameworks (*see* Figure 1). Scientometrics, as defined by Hood and Wilson (2001) and van Eck and Waltman (2010), involves quantitatively analyzing scientific literature to identify patterns and trends in research activity. This methodology allows for a data-driven and objective assessment of a given field of research, providing insights into its evolution, key themes, and influential contributors. In this study, scientometric analysis was used to examine publication trends, prominent authors and institutions, and the intellectual structure of the field through keyword co-occurrence analysis. The choice of scientometrics for this study was motivated by several factors. Firstly, scientometrics offers a broader scope of analysis, encompassing not only thematic aspects but also the intellectual structures of the research field. This perspective aligns with the aims of this study, which aim to provide a comprehensive overview of the research landscape. Secondly, scientometrics provides a methodological framework for analyzing large-scale datasets and visualizing complex relationships between research entities, such as authors, keywords, and publications. This capacity was crucial for this study, which involved the analysis of a substantial corpus of publications and identifying intricate thematic clusters. Finally, while scientometrics has traditionally been associated with the natural sciences, its application in the humanities and social sciences is increasingly recognized. This application for revealing the "big picture" of research activity is crucial for understanding the complex and evolving landscape of complex word formation studies.

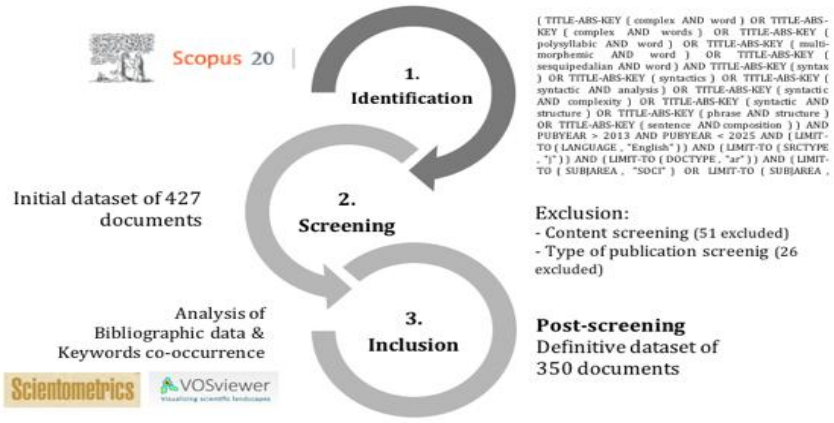

Figure 1. Chronological step of this scientometric study.

Materials

The materials for this study consisted of 350 documents retrieved from the Scopus database (https://www.scopus.com/), spanning the years 2014 to 2024. The selection of 350 documents aimed to establish a robust yet manageable dataset for a comprehensive investigation, balancing breadth and analytical depth following initial scoping searches in Scopus. Incorporating publications from 2014 to 2024 was crucial for establishing a diachronic understanding of the field's evolution and trends over the past decade, enabling the identification of foundational studies and shifts in research focus, thus providing essential context for interpreting current findings. As in excerpt (1), the search query was carefully constructed to ensure relevance to the research topic, incorporating keywords related to complex word formation and syntactic frameworks. Inclusion criteria stipulated that documents must be peer-reviewed journal articles published in English and indexed in Scopus under the subject areas of "Social Science" or "Arts and Humanities." Documents not meeting these criteria, such as conference papers, book chapters, and publications in languages other than English, were excluded (77 documents excluded).

(1) Excerpt 1

"(TITLE-ABS-KEY (complex AND word) OR TITLE-ABS-KEY (complex AND words) OR TITLE-ABS-KEY (polysyllabic AND word) OR TITLE-ABS-KEY (multi-morphemic AND word) OR TITLE-ABS-KEY (sesquipedalian AND word) AND TITLE-ABS-KEY (syntax) OR TITLE-ABS-KEY (syntactics) OR TITLE-ABS-KEY (syntactic AND analysis) OR TITLE-ABS-KEY (syntactic AND complexity) OR TITLE-ABS-KEY (syntactic AND structure) OR TITLE-ABS-KEY (phrase AND structure) OR TITLE-ABS-KEY (sentence AND composition)) AND PUBYEAR > 2013 AND PUBYEAR < 2025 AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "ARTS")) AND (LIMIT-TO (PUBSTAGE , "final"))"

Data Analysis Procedures

Data analysis was conducted using VOSviewer (1.6.20), a software tool designed for bibliographic mapping and visualization (van Eck & Waltman, 2023). Bibliographic data, including author keywords, index terms, and abstract, were extracted from the Scopus records as *.csv files and analyzed for co-occurrence patterns. A co-occurrence map was generated to visualize the relationships between keywords and identify clusters of related terms. The analysis parameters were set as follows: type of analysis: complete counting; and minimum number of occurrences of a keyword: 3 (three). Of the initial 1,814 keywords identified, 131 met the threshold. After a second refinement process, the definitive keywords consisted of 108 items. For each keyword, the total strength of co-occurrence links with other keywords was algorithmically calculated, and the keywords with the greatest total link strength were selected for visualization in the co-occurrence map as the most visible thematic cluster within the analyzed research topic.

FINDINGS

This section presents the findings of the scientometric analysis conducted on a corpus of 350 documents about complex word formation within a syntactic framework, retrieved from the Scopus database and spanning the period from 2014 to 2024. The analysis involves important dimensions, including annual publication frequency, the contributions of prominent publishers and notable authors, the distribution of documents by affiliation and country, the role of funding sponsors, the classification of documents by subject area, and the thematic clustering of keywords.

Annual Publication Frequency

The annual publication frequency concerning complex word formation within contemporary syntactic frameworks, as depicted in Figure 2, exhibits a notable upward trend over the 11-year period from 2014 to 2024. While the initial years (2014 – 2017) show some fluctuation, with a slight dip in 2016 (17 publications) followed by a minor peak in 2017 (24 publications), a clear and consistent increase in scholarly output is observed from 2018 onwards. This period is marked by a steep rise in publications, culminating in a peak of 47 publications in 2021. Despite a subsequent dip in 2023 (34 publications), the overall trend remains positive, with a strong resurgence in 2024 (45 publications). This suggests a growing interest in the complexities of word formation processes within the context of evolving syntactic theories.

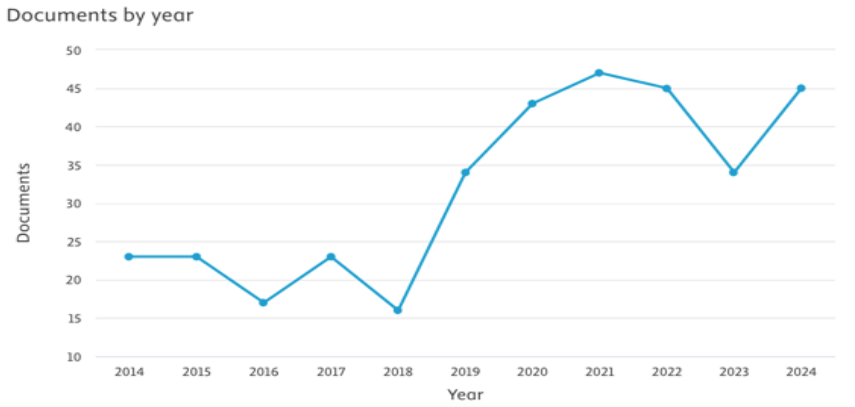

Figure 2. Annual Publication Frequency.

Furthermore, a statistical analysis of the data reveals a mean annual publication rate of 33.82 or rounded as 34 (SD = 9.77), indicating a considerable degree of variability in research output across the investigated period. However, the pronounced upward trend, particularly evident from 2018 onwards, suggests an accelerating momentum in this field of linguistic inquiry. This surge in scholarly activity may be attributed to several factors, including the development of new theoretical models in syntax, the increasing availability of large-scale linguistic datasets, and a growing recognition of the importance of complex word formation in understanding language structure and acquisition.

Preeminent Publishing Firm

Analysis of the leading publication venues for research on complex word formation within contemporary syntactic frameworks, spanning 2014 to 2024, reveals a diverse and dynamic landscape (*see* Figure 3). While no single journal exhibits absolute dominance, *Lingua* (Q1 | SJR: 0.5) emerged as a prominent platform, demonstrating a consistently strong presence throughout the investigated period. Notably, *Lingua* exhibits a peak in 2014 with 5 publications, followed by a gradual decline, yet maintains a steady contribution to the field. *Languages* (Q1 | SJR: 0.4) also demonstrates a noteworthy upward trajectory, with a surge in publications in 2022, reaching a peak of 3 publications. This suggests a growing recognition of this journal as a significant venue for disseminating research on complex word formation.

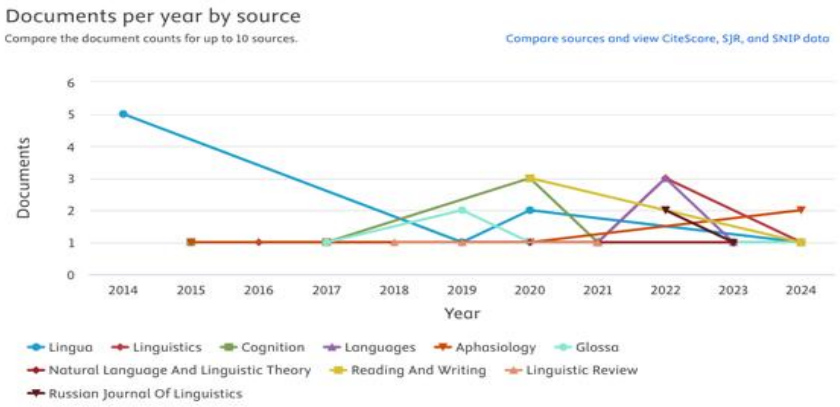

Figure 3. Preeminent Publishing Firm.

Further examination reveals that journals such as *Cognition* (Q1 | SJR: 1.59), *Natural Language and Linguistic Theory* (Q1 | SJR: 1.22), and *Reading and Writing* (Q1 | SJR: 1.14) exhibit sporadic contributions, indicating their occasional engagement with this specific area of linguistic inquiry. Interestingly, several journals, including *Aphasiology* (Q1 | SJR: 0.83), *Glossa* (Q1 | SJR: 0.69), *Linguistic Review* (Q1 | SJR: 0.45), and the *Russian Journal of Linguistics* (Q1 | SJR: 0.6), demonstrate a late entry into the topic, with their publications concentrated towards the latter part of the analyzed period. This observation may reflect an increasing diversification of research interests within these journals or a growing awareness of the importance of complex word formation across different linguistic subfields. Overall, the publication landscape showcases a healthy distribution of research across various journals, fostering an in-depth and comprehensive exploration of complex word formation within contemporary syntactic theory.

Recognized Authorship

An analysis of authorship patterns in research on complex word formation within contemporary syntactic frameworks from 2014 to 2024, as illustrated in Figure 4, reveals a diverse yet concentrated landscape. While many scholars contribute to the field, specific individuals emerge as particularly prolific. Verspooor, M. leads with the highest number of publications (4), followed closely by Culbertson, J. and Liu, H. with three publications each. This suggests that these researchers have made significant and sustained contributions to advancing knowledge in this domain, potentially establishing themselves as key figures in the topic.

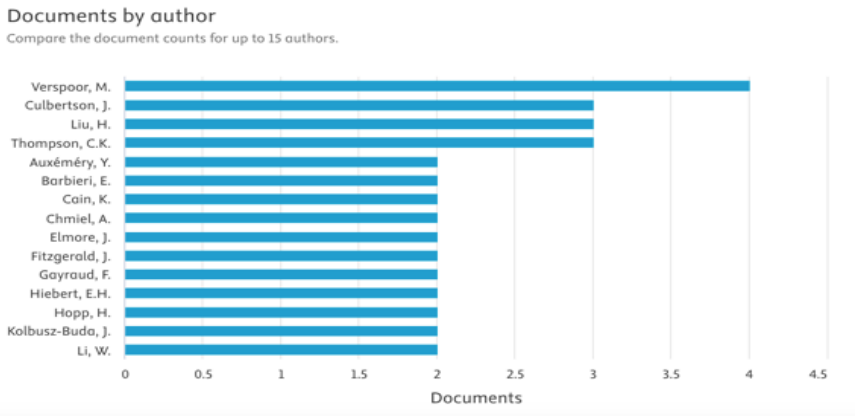

Figure 4. Recognized Authorship.

However, it is crucial to acknowledge that most authors (11 out of 15) have contributed two publications each. This indicates a relatively even distribution of research activity among a substantial portion of the scholarly community. This observation suggests a healthy level of engagement and a lack of excessive dominance by a small number of individuals, fostering a more inclusive and dynamic research environment. At least, this observation provides an empirical depiction of the intellectual influences shaping the complex word formation research topic.

Documents by Institution

An analysis of institutional contributions to the research on complex word formation within contemporary syntactic frameworks from 2014 to 2024, as depicted in Figure 5, reveals a geographically diverse and multi-institutional landscape. While no single institution overwhelmingly dominates the field, *CNRS Centre National de la Recherche Scientifique* emerges as a leading contributor with 10 publications, highlighting its significant role in advancing this area of linguistic inquiry. *The University of Edinburgh*, *Charles University Prague,* and *Russian Academy of Sciences* also demonstrate noteworthy contributions, with 8.5, and 5 publications, , indicating their active engagement in this domain.

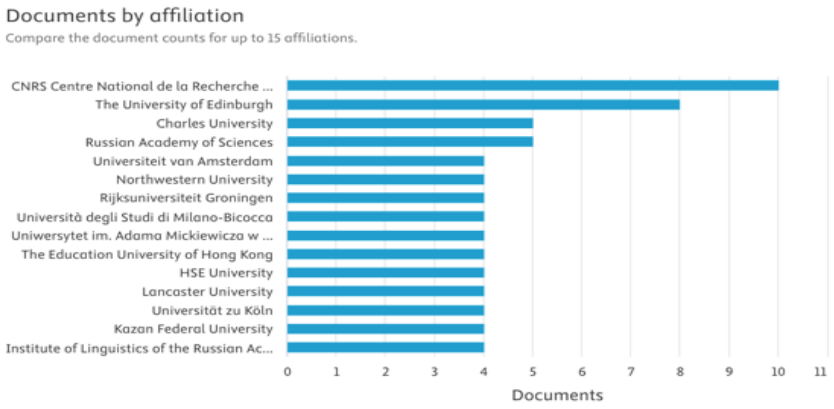

Figure 5. Institutional Sources.

Interestingly, the remaining institutions exhibit a relatively even distribution of research output, each contributing four publications. This observation suggests a healthy decentralization of research activity, with contributions emanating from a wide range of universities and research centers across the globe. This diversity of institutional sources fosters a notable exploration of complex word formation, drawing upon various theoretical perspectives and methodological approaches. This distribution also indicates that the investigation of complex word formation is not confined to a select few elite institutions but rather thrives on the contributions of a diverse range of universities and research centers globally. At the very least, this analysis of institutional sources sheds light on the external factors driving research productivity and the sources factors facilitating knowledge dissemination in this domain.

Publications by Country

An analysis of the geographic distribution of research on complex word formation within contemporary syntactic frameworks from 2014 to 2024, as presented in Figure 6, reveals a pronounced concentration of scholarly activity in the United States. With a total of 86 publications, the U.S. emerges as the dominant force in this domain, underscoring the significant contribution of American institutions and researchers to the advancement of knowledge in this research domain. This is followed by the United Kingdom with 36 publications and Germany with 33 publications, indicating a strong research presence in these countries as well.

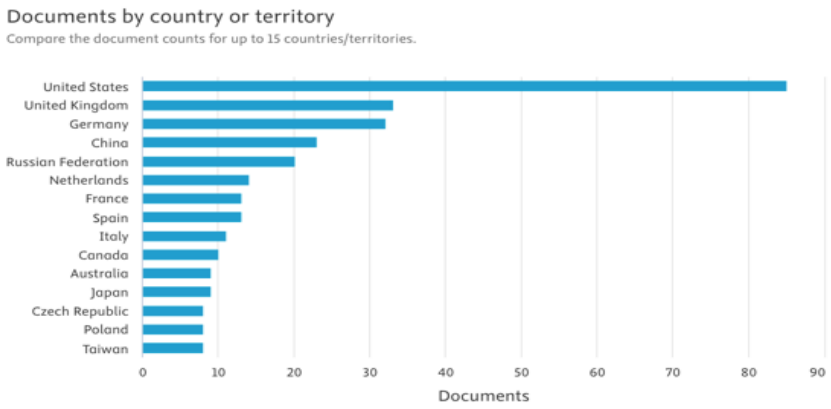

Figure 6. Country Origin.

However, the landscape is not entirely homogenous. While the top three countries account for a substantial portion of the research output, many publications originate from other parts of the world, including China, Russia, the Netherlands, and France. This suggests a growing global interest in complex word formation and a diversification of research perspectives. Furthermore, the presence of publications from countries like Spain, Italy, Canada, and Australia, albeit in smaller numbers, highlights the increasing internationalization of this field of linguistic inquiry. This geographic distribution underscores the importance of cross-cultural collaboration and knowledge exchange to foster a comprehensive understanding of complex word formation across diverse linguistic contexts.

Sponsor-categorized Works

An analysis of funding supporting research on the under-analyzed research topic, as shown in Figure 7, reveals a diverse range of sponsors contributing to the advancement of this research area. *The Deutsche Forschungsgemeinschaft* emerges as the leading funding body, with 13 documented support instances, highlighting its substantial investment in linguistic research. This is followed closely by the *National Institutes of Health* with 12 instances, indicating a strong commitment to supporting research with potential implications for cognition. Notably, several other prominent organizations, including the *National Office for Philosophy and Social Sciences,* the *European Commission,* and the *Japan Society for the promotion of Science*, demonstrate significant contributions, each with eight documented funding instances.

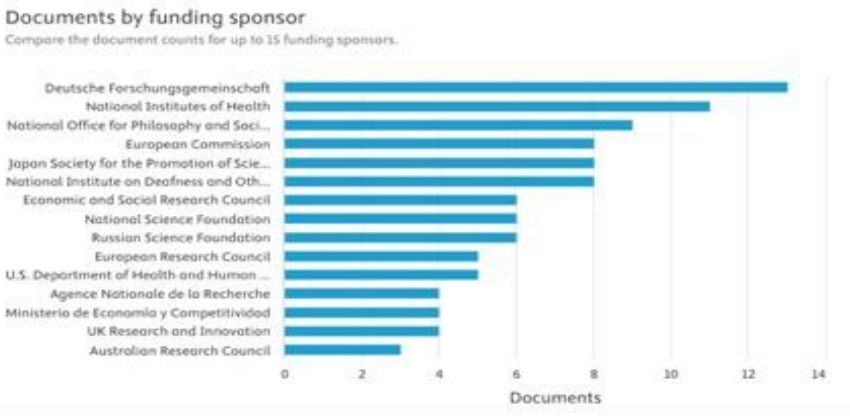

Figure 7. Funding of the Research.

This funding distribution across various national and international organizations suggests a broad recognition of the importance of research on complex word formation. The involvement of diverse sponsors, including those focused on health, social sciences, and the humanities, underscores the disciplinary nature of this research topic and its potential to contribute to a broader understanding of language, cognition, and human communication. Furthermore, funding from organizations like the *National Science Foundation,* the *Russian Science Foundation,* and the *European Research Council* highlights the global reach of this research area and the collaborative efforts undertaken to advance knowledge in this domain.

Subject Area of the Publications

As illustrated in Figure 8, an examination of the subject areas associated with research on complex word formation within contemporary syntactic frameworks from 2014 to 2024 reveals a strong inclination toward the *Social Sciences,* which account for 40% of the publications. This finding underscores the significant relevance of complex word formation to disciplines such as linguistics, sociolinguistics, and psycholinguistics, where the study of language structure and its social and psychological implications are central. Furthermore, *Arts and Humanities* represent a substantial portion of the subject areas, contributing 34% of the publications. This highlights the importance of complex word formation in fields like literature, philosophy, and cultural studies, where analyzing language use and meaning is crucial.

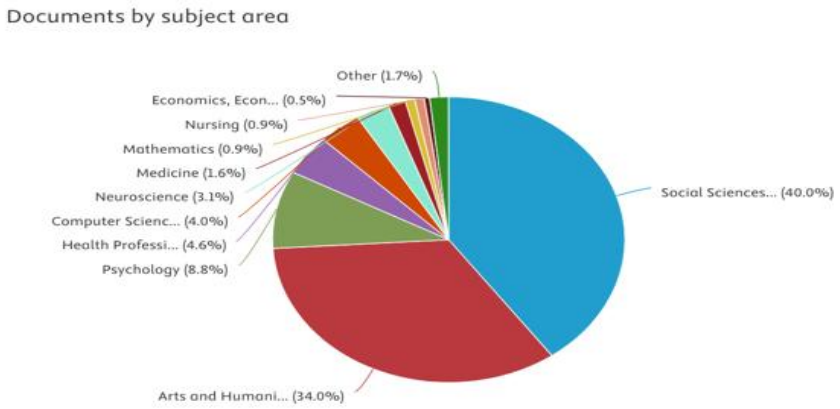

Figure 8. Subject Area of the Research Publication.

While *Social Sciences* and *Arts and Humanities* dominate the landscape, the remaining publications are distributed across a variety of disciplines, including Psychology (8.8%), Health Professions (4.6%), Computer Science (4.0%), Neuroscience (3.1%), Medicine (1.6%), Mathematics (0.9%), Nursing (0.9%), Economics, Econometrics and Finance (0.5%), and other areas (1.7%). This distribution reflects the slightly interdisciplinary nature of research on complex word constructions, with its relevance extending to fields concerned with cognition, language processing, artificial intelligence, and even clinical applications. This diversity of subject areas emphasizes the broad implications of understanding how complex words are formed and processed, and its potential to contribute to a broader range of academic disciplines.

Keyword Classification

The network visualization of prominent keywords in research on complex word formation within contemporary syntactic frameworks from 2014 to 2024, as depicted in Figure 9, reveals an interconnected landscape of research themes. The analysis identified ten distinct clusters, each representing a specific thematic focus within the broader field. The most prominent cluster, represented in red (N=22, 20.4%), revolves around the concept of "word construction," with strong connections to "syntax," "speech," "narrative," and "language development." This cluster highlights the centrality of word construction as a core object of inquiry and the exploration of complex word formation within various linguistic contexts. The second largest cluster, depicted in green (N=20, 18.5%), focuses on "syntax" and its interrelations with "word order," "noun phrase," "verb," and "word." This cluster emphasizes the significant role of syntactic theory in understanding complex word formation and investigating specific syntactic structures and the processes involved. The blue cluster (N=17, 15.7%) centers on "compounds" and their connections to "reading comprehension," "lexical semantics," and

"typing," indicating a focus on the cognitive and psycholinguistic aspects of complex word processing. The yellow cluster (N=16, 14.8%) revolves around "artificial intelligence" and its links to "natural language processing," "deep learning," and "machine translation," highlighting the growing importance of computational approaches in analyzing and modeling complex word formation. The remaining clusters, though smaller in size represent diverse themes such as "syntactic complexity" (purple, N=11, 10.2%), "lexical semantics" (sky blue, N=7, 6.5%), "speech perception" (orange, N=6, 4.6%), "language" (brown, N=4, 3.7%), "complex sentence" (fuchsia, N=4, 3.7%), and "language evolution" (pale purple, N=2, 1.9%).

Table 1 presents a list of comprehensive keywords associated with Cluster 1. This cluster, representing 20.4% of the total keywords identified in the network visualization, encompasses various terms reflecting the nature of language study on complex word formation. The keywords within this cluster can be broadly categorized into those on language structure and those related to language use and development. Keywords such as "word construction," "syntax," "speech," and "complex syntax" fall within the former category, highlighting the importance of understanding the grammatical and structural aspects of language concerning complex word formation. Conversely, terms like "language development," "child language," "narrative," and verbal communication emphasize the developmental and communicative aspects of language, suggesting an interest in how complex words are acquired, processed, and used in different contexts.

Table 1
Classification of the Notable Keywords.

Cluster	N	(%)	Color in Figure 9	Itemization
1	22	20.4%	Red	word construction; writing; vocabulary; verbal communication; syntactic development; speech analysis; speech; psychology; psycholinguistics; narrative; narration; major clinical study; language tests; language tests; language disability; language development disorder; language development; hearing impairment; hearing; developmental language disorder; complex syntax; child language
2	20	18.5%	Green	word order; word formation; word complexity; text complexity; reading comprehension; prominence; poetry; perception; noun phrase; nominalization; negation; language contact; German; French;

Cluster	N	(%)	Color in Figure 9	Itemization
				eye-tracking; English; compounding; comparative study; bilingualism; argument structure
3	17	15.7%	Blue	wording structure; task performance; reading; reaction time; phrase structure; multi-word construction; memory; language ability; discourse; comprehension; cognitive; cognition; assessment of language; assessment; aphasia; agrammatism
4	16	14.8%	Yellow	syntactics; syntactic structure; procedures of phrasing; performance; natural language processing system; natural language processing; linguistics; linguistic features; language processing; information retrieval; extraction; deep learning; complex networks; classification of information; artificial intelligence; algorithm
5	11	10.2%	Purple	syntactic complexity; second language writing; machine translation; lexical complexity; grammaticalization; genre; corpus linguistics; corpus; complexity; adjectives; academic writing
6	7	6.5%	Sky Blue	verb; typology; morphology; lexical semantics; incorporation; grammar; compounds
7	5	4.6%	Orange	speech perception; recursion; prosody; phonetics; learning
8	4	3.7%	Brown	syntactic processing; sentence comprehension; working memory; language
9	4	3.7%	Fuchsia	syntax; semantics; information structure; complex sentence
10	2	1.9%	Pale Purple	sign language; language evolution

Further examination of the keywords in Cluster 1 reveals several sub-clusters reflecting more specific focus areas within the theme of word constructions. Firstly, a prominent sub-cluster (C1-1) emerges around the core concept of "word construction," encompassing related terms such as "writing," "vocabulary," and "verbal communication." This sub-cluster emphasizes the role of word construction in language production, both written and spoken, and its contribution to effective communication. Secondly, a sub-cluster (C1-2) focusing on language development is evident, including keywords like "syntactic development," "language development," and "child language." This sub-cluster highlights the importance of investigating how complex word formation unfolds in language acquisition. Thirdly, a sub-cluster related to language processing and comprehension can

be identified, encompassing terms such as "speech analysis," "reading comprehension," and "cognitive." This sub-cluster underscores the cognitive mechanisms underlying complex word formation and their implications for language understanding. Finally, a smaller sub-cluster (C1-3) focusing on clinical aspects of language is apparent, including keywords like "speech," "hearing," "hearing impairment," and "major clinical study."

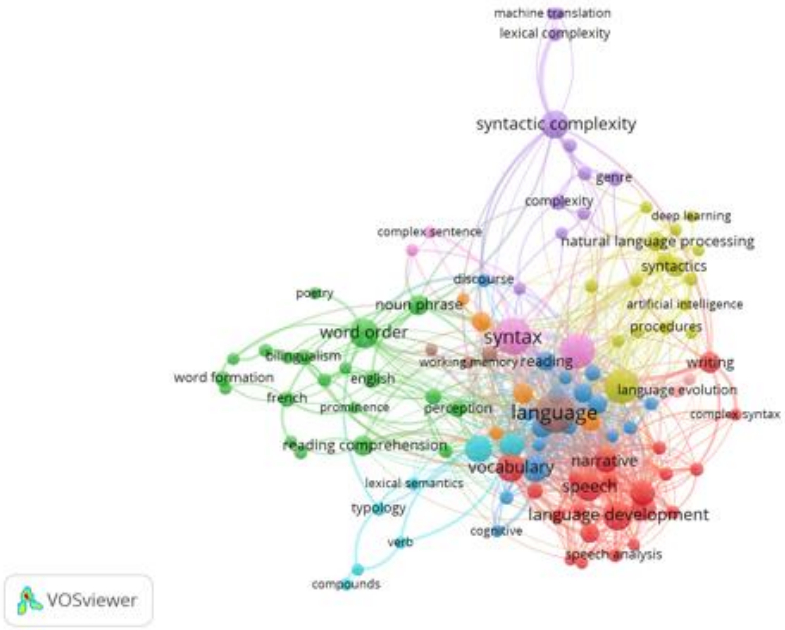

Figure 9. Network Visualization of the Notable Keywords.

In addition to Cluster 1, Table 1 also provides a comprehensive overview of the keywords constituting Cluster 2, which revolves around the theme of "syntax" within the research landscape of complex word formation in contemporary syntactic frameworks (2014 – 2024). This cluster encompasses 20 keywords, representing 18.5% of the total keywords identified in the network visualization. The keywords within this cluster highlight the pivotal role of syntactic theory and analysis in understanding the intricacies of complex word formation. They encompass of various concepts, from fundamental syntactic structures like word order and noun phrases to more specialized topics such as nominalization, negation, and argument structure. This thematic scope reflects the nature of syntactic inquiry and its contribution to the research on word formation processes.

A closer examination of the keywords in Cluster 2 allows us to identify several distinct sub-clusters, each representing a specific area of focus within the theme of "syntax." One prominent sub-cluster (C2-1) centers on the core concepts of "word order" and "word formation," encompassing related terms such as "word complexity," "text complexity," and "argument structure."

This sub-cluster emphasizes the interplay between syntactic structure and word formation, highlighting how the arrangement of words within a sentence can influence the interpretation and processing of complex words. Another sub-cluster (C2-2) focuses on the cognitive and perceptual aspects of syntactic processing, including keywords like "reading comprehension," "prominence," "poetry," and "perception." This sub-cluster suggests a growing interest in understanding how language users process and interpret complex syntactic structures. Additionally, a sub-cluster (C2-3) related to cross-linguistic and comparative studies is evident, encompassing terms such as "language contact," "German," "French," "English," "comparative study," and "bilingualism." This sub-cluster underscores the importance of investigating complex word formation across different languages and language families to better understand universal and language-specific properties. Finally, a smaller sub-cluster (C2-4) focusing on specific syntactic phenomena can be identified, including keywords like "noun phrase," "nominalization," and "negation."

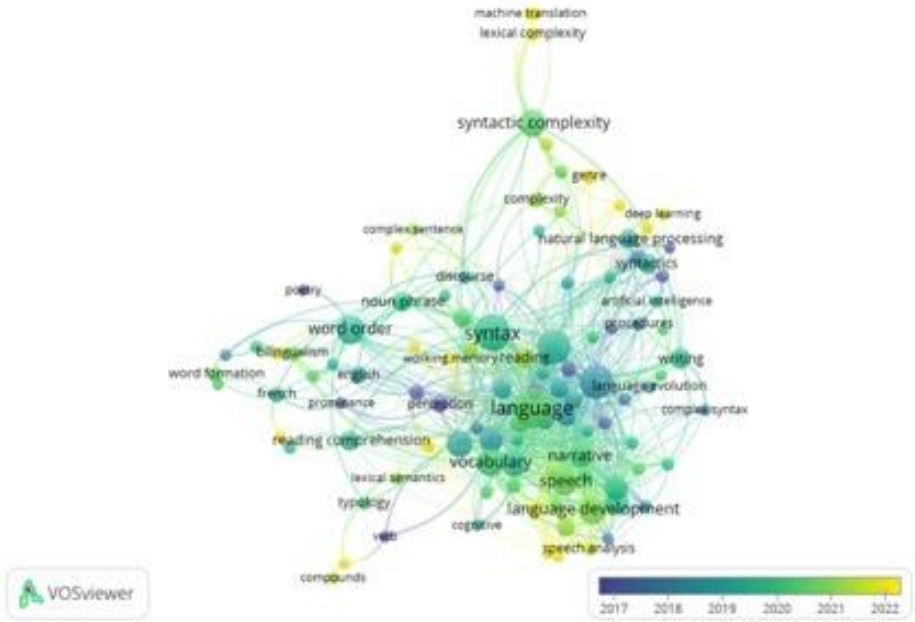

Figure 10. Overlay Visualization of the Notable Keywords.

In addition to the significant clusters, the network visualization also presents the keywords associated with Cluster 3 ("compounds") and Cluster 4 ("artificial intelligence"), offering insights into the variative themes explored within these research areas. Cluster 3, comprising 17 keywords (15.7%), delves into the cognitive and linguistic aspects of compound word processing. The keywords within this cluster highlight the nature of compound comprehension, encompassing factors such as reading ability,

processing speed ("reaction time"), and cognitive resources ("memory," "cognitive," "cognition"). Furthermore, including terms like "aphasia" and "agrammatism" suggests an interest in understanding how compound processing is affected in individuals with language impairments. Within Cluster 3, distinct sub-clusters emerge, reflecting specific areas of focus. One sub-cluster (C3-1) centers on the structural aspects of compounds ("wording structure," "phrase structure," "multi-word construction"), while another (C3-2) emphasizes the cognitive processes involved in compound comprehension ("reading," "comprehension," "cognitive"). Additionally, a sub-cluster focusing on language assessment and disorders is evident (C3-3) ("assessment of language," "assessment," "aphasia", "agrammatism").

Cluster 4, encompassing 16 keywords (14.8%), explores the intersection of complex word formation and artificial intelligence. The keywords within this cluster emphasize the computational approaches used to analyze and model complex word structures. Terms like "natural language processing," "deep learning," and "algorithm" highlight the growing role of machine learning and computational linguistics in understanding and generating complex words. Moreover, the inclusion of keywords like "syntactics," "syntactic structure," and "procedures of phrasing" suggests an interest in applying computational methods to analyze the syntactic properties of complex words. Within Cluster 4, distinct sub-clusters can be identified. One sub-cluster (C4-1) centers on the core concepts of natural language processing ("natural language processing system," "natural language processing," "language processing"), while another (C4-2) focuses on the methodologies and techniques employed in this field ("information retrieval," "extraction," "deep learning," "complex networks," "classification of information"). Additionally, a sub-cluster (C4-3) related to artificial intelligence and its applications is evident ("artificial intelligence," "algorithm").

Moreover, Table 1 also presents the keywords associated with Cluster 5 ("syntactic complexity") and Cluster 6 ("verb"), offering further insights into the diverse research landscape of complex word formation. Cluster 5, comprising 11 keywords (10.2%), delves into the nature of syntactic complexity and its connection to some linguistic phenomena. The keywords within this cluster highlight the interplay between syntactic complexity and areas such as second language writing, machine translation, and lexical complexity. The inclusion of terms like "grammaticalization" and "genre" suggests an interest in understanding how syntactic complexity evolves and varies across different communicative contexts. Moreover, the presence of keywords like "corpus linguistics" and "corpus" indicates a reliance on empirical data and quantitative methods to investigate syntactic complexity. Within Cluster 5, although distinct sub-clusters are not readily apparent, the keywords collectively point towards a research focus on the factors

contributing to syntactic complexity, its measurement and assessment, and its implications for language processing and acquisition.

In addition, Cluster 6, encompassing seven keywords (6.5%), explores the role of verbs in complex word formation. The keywords within this cluster emphasize the interplay between verbal morphology, lexical semantics, and syntactic structures. The inclusion of terms like "typology" and "incorporation" suggests a cross-linguistic perspective and an interest in understanding how verbs are integrated into complex word structures across different languages. Moreover, the presence of keywords like "lexical semantics" and "grammar" highlights the importance of considering both the meaning and grammatical properties of verbs in complex word formation. Within Cluster 6, while distinct sub-clusters are not readily apparent, the keywords collectively point towards a research focus on the specific contributions of verbs to the formation of complex words.

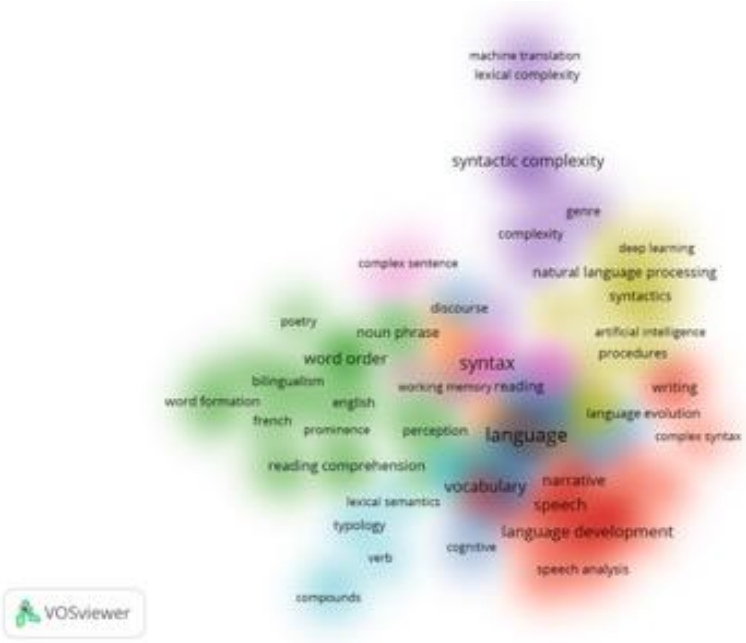

Figure 11. Density Visualization of the Notable Keywords.

In addition to the leading and intermediate clusters, Table 1 presents the keywords associated with Clusters 7, 8, 9, and 10, which, while smaller in size, offer valued insights into specific niches within the broader research landscape of complex word formation. Cluster 7, encompassing five keywords (4.6%), focuses on the perceptual and cognitive aspects of language processing, emphasizing speech perception and the role of recursion in language learning. The keywords within this cluster, including "speech perception," "recursion," "prosody," "phonetics," and "learning," suggest an interest in understanding how complex auditory and cognitive processes

contribute to the acquisition and processing of complex word forms. This cluster highlights the nature of research on complex word formation, drawing on insights from phonetics, phonology, and cognitive science. Moreover, Cluster 8, comprising four keywords (3.7%), delves into the cognitive mechanisms underlying syntactic processing and sentence comprehension. The keywords within this cluster, including "syntactic processing," "sentence comprehension," "working memory," and "language," emphasize the role of cognitive resources and processing strategies in understanding complex syntactic structures, including those involving complex words. This cluster highlights the cognitive demands of processing complex word forms and their integration into larger syntactic units.

Cluster 9, also with four keywords (3.7%), explores the interface between syntax, semantics, and information structure in constructing and interpreting complex sentences. The keywords within this cluster, including "syntax," "semantics," "information structure," and "complex sentence," suggest an interest in understanding how complex words contribute to the overall meaning and organization of complex sentences. This cluster highlights the interplay between different levels of linguistic analysis in the study of complex word formation. Finally, Cluster 10, with two keywords (1.9%), focuses on the evolution of language, including sign language. The keywords within this cluster, "sign language" and "language evolution," suggest an interest in understanding how complex word formation emerges and develops in spoken and signed modalities and how these processes contribute to the broader evolution of language. This cluster highlights the diversity of human language and the importance of cross-linguistic and cross-modal comparisons in the study of complex word formation. In summation, these clusters, derived from the thematic analysis of keywords, provide a framework for future investigations to expand the examination of complex word formation in a syntactic framework.

DISCUSSION

The results of this scientometric investigation illuminate the evolving landscape of research on complex word formation within contemporary syntactic frameworks. The bibliographic analysis reveals a growing body of literature, with an upward trend in publications over the past decade, indicating an increasing interest in this domain (*see also* Figure 10). This surge in scholarly activity aligns with the rising prominence of usage-based approaches to language study, as noted by Jorroch and Prawdzic-Jankowska (2024), which emphasize the role of frequency and usage patterns in shaping linguistic structure, including word formation. The key terms analysis further underscores the nature of this field, highlighting the interconnectedness of complex word formation with various linguistic subfields, such as syntax,

semantics, morphology, and psycholinguistics (*see also* Figure 11). This aligns with recent works by Cinková et al. (2024), Z. Wang et al., (2024), and Zukoff (2023), emphasizing the need for integrated approaches to linguistic analysis that consider the interplay between different levels of linguistic structure. These findings have significant implications for grammar pedagogy as they highlight the need for teaching approaches that go beyond rote memorization and emphasize the dynamic and interconnected nature of language.

If we look back at some of the trend analysis results that emerged, there are interesting discussion points. The analysis revealed noteworthy patterns in the complex word formation research publication landscape. Several prominent publishing firms emerged as key contributors to the field, with *Lingua* (Q1|SJR: 0.5) and *Languages* (Q1|SJR: 0.4) exhibiting a strong presence. These publishers are renowned for their high-quality linguistics publications, and their significant involvement in disseminating research on complex word formation underscores the growing recognition of this field within the broader linguistic community (Allaithy et al., 2025; Hyland, 2016). Furthermore, the analysis identified leading authors who have contributed substantially to the field, including prominent figures such as Verspoor, M. and Culbertson, J. These scholars have significantly shaped our understanding of complex word formation through their influential research and publications, establishing themselves as key voices in the field. Regarding geographic distribution, the analysis revealed a concentration of research activity in North America and Europe, particularly in countries with strong traditions in linguistic inquiry, such as the United States, the United Kingdom, Germany, and the Netherlands. This finding aligns with previous studies that have documented the dominance of these regions in various linguistic subfields (Lüdi, 2015; Yanaprasart, 2020; Yanaprasart & Lüdi, 2018). However, the analysis also highlighted emerging research hubs in other parts of the world, such as China and Japan, suggesting a growing global interest in complex word formation. This trend towards increased internationalization of research is encouraging, as it fosters cross-linguistic perspectives and promotes a more inclusive and diverse research community.

Furthermore, the prominence of Clusters 1 and 2, centered on "word construction" and "syntax," respectively, underscores the fundamental importance of these themes in understanding complex word formation. The findings resonate with recent research by Bundgaard-Nielsen & Baker (2020) and Mansfield (2021) highlighting the crucial role of syntactic frameworks in modelling the internal structure and external relations of complex words. The diverse subclusters within these major clusters further emphasize the breadth of research in this domain, encompassing language production, acquisition, processing, and clinical applications. Notably, the sub-cluster within Cluster 1 focusing on language development and disorders aligns with increasing

recognition of the challenges faced by individuals with language impairments in acquiring and utilizing complex word formation, as documented in Brimo et al., (2023), Hall-Mills and Wood (2023), and Yang et al. (2024). For grammar pedagogy, these findings highlight the need for differentiated instructions that cater to the diverse needs of learners, including those with language difficulties. By incorporating insights from research on language development and disorders, educators can create more inclusive and effective learning environments.

The intermediate clusters (3, 4, 5, and 6) provide further evidence of the interdisciplinary nature of research on complex word formation. The prominence of Cluster 3 ("compounds") reflects the ongoing interest in this specific type of complex word, as exemplified by the works of Kolbusz-Buda (2024) and Vinyar (2024) on compound typology and processing. The emergence of Cluster 4 ("artificial intelligence") highlights the growing role of computational approaches in linguistic analysis, echoing the arguments of da Cunha Silva et al. (2023) and Nugraha (2024a; 2024b) for integrating computational methods in morphological research. Furthermore, the focus on "syntactic complexity" in Cluster 5 aligns with recent works by Lenhart et al., (2022) and Xu and Li (2021) on the development and measurement of syntactic complexity in different registers and genres. Finally, the emphasis on "verb" in Cluster 6 underscores the crucial role of verbs in complex word formation, as demonstrated by Fendel (2024), Ullrich (2020), Nugraha (2024c), and Nugraha and Vincze (2024) in their analysis of verbal compounds and complex predicates. These findings have implications for grammar pedagogy as they highlight the need for incorporating diverse perspectives and methodologies in teaching complex word formation. By drawing on insights from various related disciplines, educators can provide a more comprehensive and engaging learning experience.

The minor clusters (7, 8, 9, and 10) offer valuable insights into specialized field inquiry areas. The focus on speech perception and recursion in Cluster 7 aligns with recent works by Schnur and Wang (2024) and Tskhovrebov and Shamonina (2023) on the role of these factors in language processing and evolution. The emphasis on syntactic processing and sentence comprehension in Cluster 8 echoes the findings of Kupriyanov et al. (2023) on the cognitive demands of sentence processing. The exploration of the syntax-semantics interface in Cluster 9 resonates with recent works by Horsch (2021) and Zhukova and Janda (2024) on construction grammar and its implications for understanding complex word formation. Finally, the inclusion of sign language in Cluster 10 highlights the importance of considering diverse modalities in linguistic research, as argued by Fedorenko et al. (2020), Nomvete and Easterbrooks (2020), and Vogelzang et al. (2020). These minor clusters, while representing a smaller proportion of the research landscape,

contribute to a more nuanced and comprehensive understanding of complex word formation. For grammar pedagogy, these findings underscore the importance of adopting a holistic approach that considers the cognitive, perceptual, and sociocultural dimensions of language learning. By integrating these perspectives, educators can foster a deeper appreciation for the complexities of language and its role in human communication.

CONCLUSION

In conclusion, this scientometric investigation has provided a data-driven overview of the research landscape surrounding complex word formation within contemporary syntactic frameworks. The analysis revealed a growing body of literature, highlighting key trends in authorship, institutional contributions, and thematic foci. While this study offers insights into the field, it has limitations. The reliance on a single database (Scopus) and the specific parameters employed may have inadvertently excluded relevant publications. Future research could expand the scope of analysis by incorporating data from other databases and refining search strategies, thereby enabling investigations into the impact of individual scientists or research groups, facilitating comparative analyses of academic institutions or countries, detecting nuanced interdisciplinary research trends, and ultimately informing evidence-based science policy and funding strategies. Besides, future research could benefit from a mixed-methods approach that incorporates qualitative research content analysis to provide a more nuanced understanding of the field. To some extent, this study offers implications for grammar pedagogy, highlighting the need for teaching approaches that reflect the dynamic and interconnected nature of complex word formation, cater to diverse learner needs, and integrate insights from contemporary research.

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