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ACOUSTIC APPROACHES IN SECOND LANGUAGE ACQUISITION AND LEARNING: A BIBLIOMETRIC STUDY

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Abstract:

This bibliometric study investigates research trends and scholarly developments in the application of acoustic approaches to second language acquisition and learning (SLA). In recent years, the use of phonetic analysis, acoustic feedback, and speech technologies has played an increasingly important role in understanding how learners perceive and produce speech in a second language context. Despite the growing body of research, a comprehensive overview of the global patterns, influential works, thematic structures, and collaboration networks in this field remains limited. To address this gap, this study employed a bibliometric approach using data retrieved from the Scopus database between 2010 and June 2025. The search strategy utilized seven targeted keywords *second language acquisition*, *learning*, *language*, *acoustic study*, *phonetic analysis*, *phonetic*, and *speech sounds* resulting in a final dataset of 580 documents. Analytical tools including Scopus Analyzer, OpenRefine, and VOSviewer were used to clean, process, and visualize the data through descriptive metrics and network maps. The findings indicate a significant increase in publication output, particularly between 2020 and 2024, reflecting a rising interest in integrating acoustic and phonetic tools in SLA research. The research output was primarily concentrated in the social sciences and arts and humanities, with meaningful contributions from computer science and psychology. Highly cited keywords such as "speech perception," "phonetics," and "bilingualism" highlight the interdisciplinary focus of the field, while the co-authorship network shows strong international collaboration led by countries such as the United States, China, and the United Kingdom.

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This study contributes by identifying dominant research directions and offering a foundational reference for future investigations. It further underscores the value of bibliometric methods in tracing the evolution of acoustic-based SLA research and highlights the potential for technological innovations to support language learning practices.

Keywords:

Second Language Acquisition (SLA), Learning, Acoustic Study, Phonetics Analysis, Speech Sounds, Bibliometric

Introduction

Second language acquisition (SLA) is a multifaceted phenomenon involving various approaches and methodologies. The process of learning a second language (L2) encompasses linguistic, neurolinguistic, cognitive, and sociocultural dimensions (Delbio & Ilankumaran, 2019). Among these, acoustic approaches play a crucial role in understanding and improving L2 phonetic acquisition. This bibliometric study aims to explore the acoustic methods used in SLA, focusing on their effectiveness, theoretical underpinnings, and practical applications.

Acoustic approaches in SLA often involve analysing phonetic features and their acquisition by L2 learners. For instance, studies have shown that learners' native language significantly influences their phonetic features in L2. An acoustic experiment on Tibetan Lhasa speakers learning English revealed distinct phonetic characteristics in their production of English vowels (Ou et al., 2020). Similarly, the adaptation of speech organs to new articulatory manners and places is essential for L2 learners to approximate native speaker norms (Wang et al., 2016).

Visual-acoustic feedback training has emerged as an effective method for improving L2 pronunciation. This technique involves providing learners with visual representations of their acoustic output, which helps them adjust their articulatory mechanisms. Research has demonstrated that such training not only improves vowel production but also ensures the transfer of these improvements to word-level pronunciation and maintains them over time (Kartushina & Martin, 2025). This method is particularly effective when learners are exposed to multiple talkers, enhancing their ability to generalize and produce accurate sounds (Kartushina & Martin, 2025).

Featural approaches to phonetic acquisition suggest that learners develop new phonetic norms based on sub-phonemic features shared across multiple phonemes. This approach is supported by research showing that targeted training on specific phonetic features can lead to improvements in both trained and related non-trained phonemes (Olson, 2022) (Olson, 2019). However, the extent of feature generalization can vary, with some studies indicating limited featural relationships (Olson, 2022).

Sociocultural theories emphasize the role of social interaction and cultural context in SLA. These theories argue that exposure to spoken input and extensive listening are crucial for language development (Aryadoust et al., 2024). Cognitive approaches, on the other hand, focus on the mental processes involved in language learning, such as memory and perception (Delbio

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& Ilankumaran, 2019). The interplay between these perspectives highlights the complexity of SLA and the need for multifaceted approaches.

Technological advancements have significantly contributed to acoustic approaches in SLA. Tools like Electromagnetic Articulography (EMA) provide real-time visual feedback on articulatory positions, aiding learners in producing accurate L2 sounds (Suemitsu et al., 2013). Additionally, computer-aided language learning (CALL) systems, incorporating automatic pronunciation assessment, offer valuable feedback to both learners and educators, facilitating continuous improvement (Takai et al., 2020).

Acoustic approaches in SLA encompass a range of methodologies, from visual-acoustic feedback to featural and sociocultural perspectives. These approaches highlight the importance of phonetic training, technological interventions, and the influence of native language on L2 acquisition. By integrating these methods, educators can enhance the effectiveness of L2 learning, helping learners achieve more accurate and native-like pronunciation.

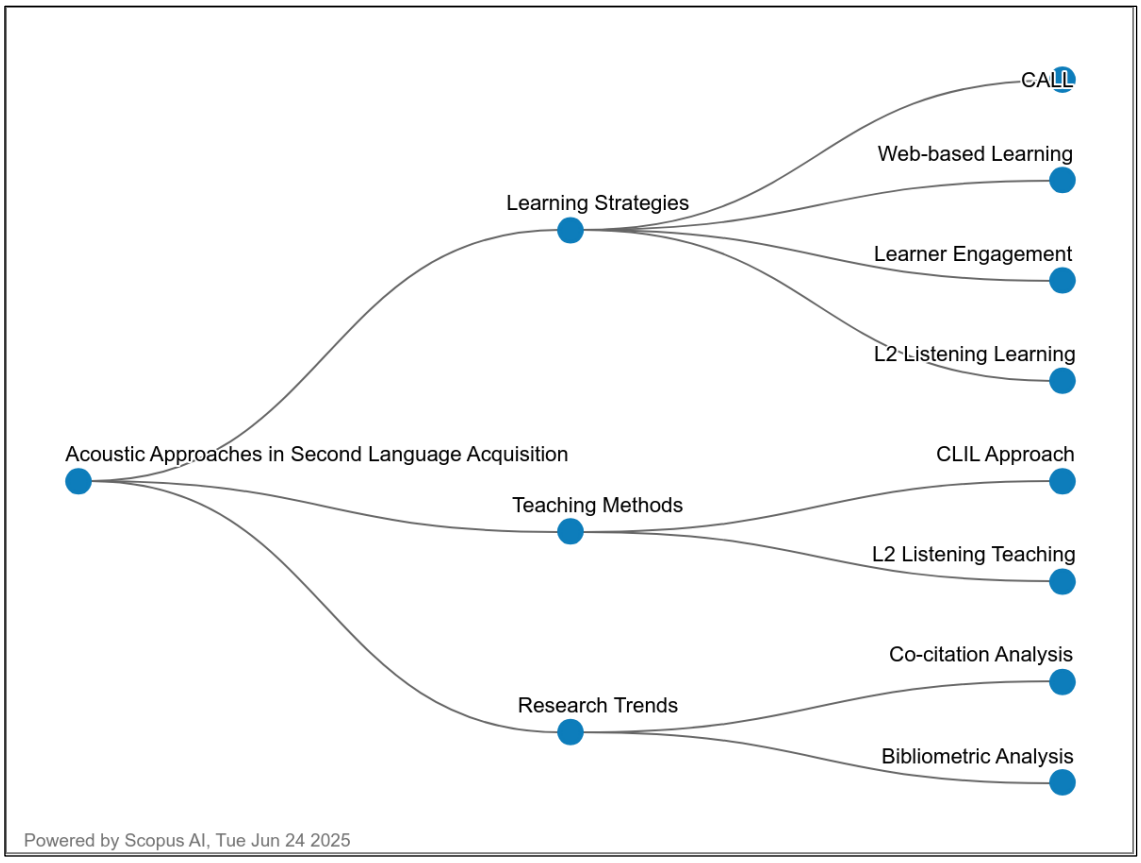

Figure 1: Conceptual Map of Research Trends in Acoustic Approaches in Second Language Acquisition

Research Question

i. What are the research trends in Acoustic Approaches in Second Language Acquisition based on the annual distribution of publications from 2005 to 2025?
ii. What are the research trends in research on Acoustic Approaches in Second Language Acquisition according to the subject area??
iii. What are the most cited articles?
iv. What are the most countries in publication?

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v. What are the popular keywords related to the study?
vi. What is co-authorship based on countries' collaboration?

Methodology

Bibliometric analysis is a structured method for collecting, organizing, and interpreting bibliographic information derived from scholarly publications (Alves et al., 2021; Assyakur & Rosa, 2022; Verbeek et al., 2002). Traditionally, it emphasizes descriptive metrics such as publication output, prominent authors, and core journals (Wu & Wu, 2017). However, the field has evolved to incorporate more advanced techniques, including co-citation and co-occurrence analyses, which offer deeper insights into patterns and intellectual linkages within the literature. A rigorous literature review process is essential in this context, involving the strategic selection of keywords, iterative search refinements, and systematic data cleansing to ensure the dataset accurately reflects the research domain (Fahimnia et al., 2015). In this study, particular attention was given to works of high scholarly impact, as they provide critical insight into the development and structure of the field concerning acoustic approaches in second language acquisition and learning.

To ensure the credibility and comprehensiveness of the data, the Scopus database was selected as the primary source due to its extensive coverage of disciplines and reputation for reliable indexing (Al-Khoury et al., 2022; di Stefano et al., 2010; Khiste & Paithankar, 2017). The search was limited to peer-reviewed journal articles and conference papers to maintain academic rigor. Other formats, such as books, lecture notes, and non-peer-reviewed materials, were excluded to uphold consistency and scholarly integrity in the analysis (Gu et al., 2019). The publication window for data collection spanned from 2010 to June 2025, aligning with the objective of capturing both contemporary developments and emerging research trends related to the use of acoustic methods in second language acquisition studies.

It is important to highlight that the lower publication count observed for the year 2025 (4%) does not reflect a true decline in scholarly activity. Instead, this reduction is attributed to incomplete indexing at the time of data extraction in June 2025. As databases continue to update and index articles throughout the year, future bibliometric analyses may incorporate the full 2025 data to provide a more comprehensive and accurate depiction of research output trends.

Data Search Strategy

To conduct this bibliometric study on acoustic approaches in second language acquisition and learning, a structured and transparent search strategy was employed using the Scopus database, recognized for its comprehensive coverage of peer-reviewed scholarly literature across a wide range of academic disciplines. The advanced search query applied was: TITLE (["acoustic study" OR "phonetic analysis" OR phonetic or "speech sounds"] AND ["SLA" OR " Second Language Acquisition" OR learning OR language]) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp")) AND (LIMIT-TO (SRCTYPE , "j") OR LIMIT-TO (SRCTYPE , "p")) AND (LIMIT-TO (LANGUAGE , "English")). This search string was designed to capture publications whose titles explicitly mention acoustic or phonetic aspects such as phonetic analysis or speech sounds while also being clearly situated within the domain of second language acquisition (SLA) or language learning. The application of Boolean operators (AND, OR) allowed for the effective narrowing of results to documents that intersect both the acoustic and pedagogical dimensions of the field.

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To ensure the quality and relevance of the dataset, a set of inclusion and exclusion criteria was systematically applied. The inclusion criteria limited the search to documents published between 2010 and 2025, written in the English language, and classified as either journal articles or conference papers. These formats were chosen because they reflect original, peer-reviewed contributions to academic discourse. In contrast, documents such as book chapters, books, reviews, and publications in non-English languages were excluded to maintain consistency and avoid discrepancies in citation metrics and peer-review standards. Similarly, the source types were restricted to journals and conference proceedings, excluding book series and other less frequently cited formats.

Following the implementation of these parameters, a total of 580 documents were identified and retrieved for analysis. This final dataset forms the empirical basis of the bibliometric investigation, enabling a detailed exploration of research output, thematic development, collaboration patterns, and methodological trends related to the integration of acoustic methods in SLA research. The well-defined search scope and clear filtering criteria ensure that the resulting analysis provides a reliable and representative overview of scholarly engagement with acoustic approaches in second language teaching and learning.

Table 1: The Search String

Scopus	TITLE (["acoustic study" OR "phonetic analysis" OR phonetic or "speech sounds"] AND ["SLA" OR " Second Language Acquisition" OR learning OR language]) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp")) AND (LIMIT-TO (SRCTYPE , "j") OR LIMIT-TO (SRCTYPE , "p")) AND (LIMIT-TO (LANGUAGE , "English")) Date access: 24th June 2025.

Table 2: The Selection Criterion Is Searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Timeline	2010 – 2025	< 2009
Document Type	Article, Conference Paper	Book Chapter, Review, Book
Source Type	Journal, Conference Proceeding	Book, Book Series

Data Analysis

VOSviewer is a prominent software tool widely utilized in bibliometric analysis, developed by Nees Jan van Eck and Ludo Waltman at Leiden University, the Netherlands (van Eck & Waltman, 2010, 2017). Renowned for its user-friendly design and robust analytical capabilities, VOSviewer is particularly effective in the visualization and exploration of scientific literature. Its core strengths lie in generating network visualizations, identifying thematic clusters, and creating density maps making it an invaluable tool for analysing co-authorship networks, co-citation relationships, and keyword co-occurrence structures. The software's dynamic and

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interactive interface enables researchers to navigate large bibliometric datasets with ease. Furthermore, its support for multiple bibliographic formats, comprehensive metric calculations, and customizable visual outputs positions VOSviewer as a key resource for scholars engaged in research landscape analysis.

One of the distinguishing advantages of VOSviewer is its ability to simplify the interpretation of complex bibliometric data through visually coherent mappings and network models. The software's emphasis on network-based representation allows for the identification of research clusters, tracking of keyword associations, and generation of detailed density overlays. Both early-career and experienced researchers benefit from its intuitive interface, which facilitates the investigation of academic contributions and the evolution of research themes. Ongoing updates and feature expansions have reinforced VOSviewer's relevance in the field, ensuring its continued role as a leading tool for in-depth bibliometric mapping, including co-authorship and citation network analysis.

In the present study, bibliographic data were sourced from the Scopus database, including metadata such as article titles, author names, journal outlets, publication years, citation counts, and keywords. The dataset, spanning the years 2010 through June 2025, was exported in PlainText format and analysed using VOSviewer version 1.6.20. The software's clustering algorithms and visualization functionalities were employed to generate maps that illustrate relationships within the dataset. Unlike conventional Multidimensional Scaling (MDS), which often utilizes cosine and Jaccard similarity indices, VOSviewer employs a distinct approach called association strength for normalization of co-occurrence frequencies (van Eck & Waltman, 2010). This method positions items in a low-dimensional space where the distance between them accurately reflects their level of similarity.

The association strength between two terms (AS_{ij}), is calculated using the formula proposed by Van Eck & Waltman, (2007):

$$AS_{ij} = \frac{C_{ij}}{w_i w_j}$$

where C_{ij} denotes the number of co-occurrences between terms i and j, while w_i, w_j represent the total number of occurrences for each term, respectively. This normalization approach evaluates the ratio between observed and expected co-occurrences under the assumption of independence, thus providing a more accurate estimation of proximity and conceptual relatedness between terms (Van Eck & Waltman, 2007; Appio et al., 2014).

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Findings

What Are the Research Trends in Acoustic Approaches in Second Language Acquisition Based on the Annual Distribution of Publications From 2005 To 2025?

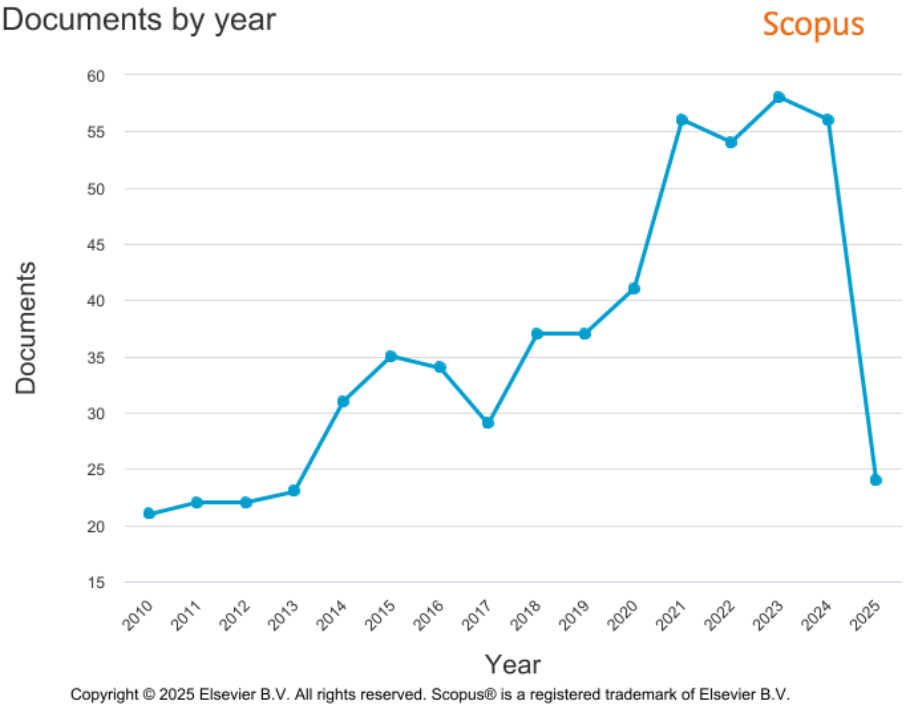

Figure 2: Graph of the Level of Research Development on Acoustic Approaches in Second Language Acquisition by Year within 15-Year Period

Table 3: The Percentage and Development of Research on Acoustic Approaches in Second Language Acquisition within 15-Year Period

Year	Number of Document	Percentage %
2025	24	4
2024	56	10
2023	58	10
2022	54	9
2021	56	10
2020	41	7
2019	37	6
2018	37	6
2017	29	5
2016	34	6
2015	35	6
2014	31	5
2013	23	4
2012	22	4
2011	22	4
2010	21	4

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Based on the annual distribution of publications presented in Figure 2 and Table 3, scholarly interest in acoustic approaches within the field of second language acquisition and learning has demonstrated a steady upward trend over the past 15 years. From 2010 to 2013, the number of publications remained relatively modest, averaging around 21–23 documents per year, each contributing approximately 4% to the total output. A notable increase began in 2014 with 31 publications (5%), followed by a consistent rise peaking at 35 documents in 2015 (6%). Although there was a slight dip in 2017 with 29 publications (5%), the research output rebounded quickly, reaching 37 documents in both 2018 and 2019 (6% each). A more substantial growth phase began in 2020 with 41 documents (7%), accelerating in 2021 and 2022 with 56 (10%) and 54 (9%) documents respectively, indicating heightened academic engagement in applying acoustic methodologies to second language research.

The peak publication year was 2023, accounting for 58 documents (10%), followed closely by 56 documents (10%) in 2024. These years reflect the highest level of research productivity and likely correspond to the broader integration of acoustic tools such as Praat, phonetic analysis, and speech visualization in language teaching and assessment studies. While a significant drop is observed in 2025, with only 24 documents (4%), this is likely due to incomplete indexing for the current year rather than an actual decline in scholarly output. Overall, the data reveals a robust and growing research trajectory, particularly in the last five years, underscoring the increasing relevance of acoustic analysis in second language pedagogy and phonetic research.

What Are the Research Trends in Research on Acoustic Approaches in Second Language Acquisition According to the Subject Area?

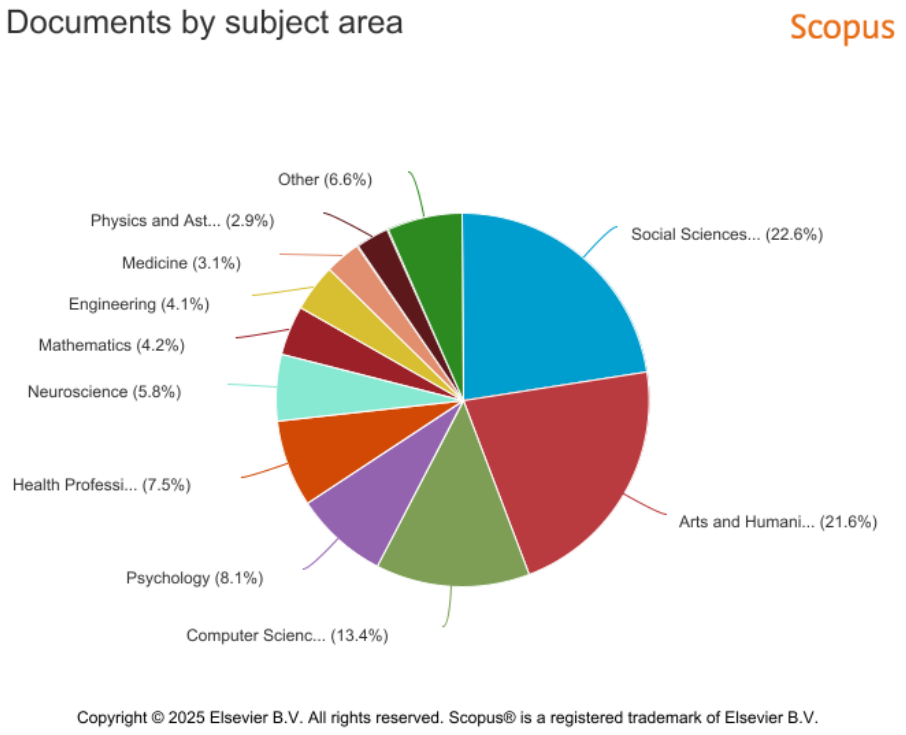

Figure 3: Percentage Distribution of Research Development on Acoustic Approaches in Second Language Acquisition by Subject Area

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Table 4: Percentage of Research on Acoustic Approaches in Second Language Acquisition by Subject Area

Subject Area	Number of Documents	Percentage %
Social Sciences	294	57.9
Arts and Humanities	282	55.5
Computer Science	174	34.3
Psychology	106	20.9
Health Professions	98	19.3
Neuroscience	75	14.8
Mathematics	55	10.8
Engineering	54	10.6
Medicine	41	8.1
Physics and Astronomy	38	7.5

Based on Table 4 and Figure 3, the subject area distribution reveals that research on *Acoustic Approaches in Second Language Acquisition (SLA)* is primarily concentrated in the Social Sciences (57.9%) and Arts and Humanities (55.5%). This strong representation indicates that acoustic methodologies are heavily utilized within linguistic, educational, and pedagogical contexts, where the focus often lies on improving pronunciation, speech perception, and phonetic instruction. These findings highlight the significance of acoustic research in understanding language learning from sociocultural and instructional perspectives, as these fields continue to explore how sound-based analysis can enhance teaching strategies and learner outcomes in SLA.

In addition, notable contributions stem from Computer Science (34.3%), which reflects the integration of technological tools such as *Praat*, speech synthesis, and machine learning in phonetic analysis and language learning applications. Psychology (20.9%) and Health Professions (19.3%) also demonstrate considerable involvement, pointing to cognitive, neurological, and therapeutic dimensions of language acquisition such as speech processing, auditory memory, and pronunciation rehabilitation. Furthermore, the presence of fields like Neuroscience (14.8%), Mathematics (10.8%), and Engineering (10.6%) suggests a growing interdisciplinary trend, where acoustic-based SLA studies intersect with computational modelling, signal processing, and neurocognitive research. Although areas like Medicine (8.1%) and Physics and Astronomy (7.5%) show lower percentages, their inclusion highlights the broadening applicability of acoustic techniques in understanding complex linguistic phenomena. Overall, the subject area breakdown underscores the expanding influence of acoustic methodologies across diverse scientific and academic domains in SLA research.

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What Are the Most Cited Articles?

Table 5: Most Top 10 Cited Authors

Authors	Title	Year	Source title	Cited by
So C.K.; Best C.T. (So & Best, 2010)	Cross-language perception of non-native tonal contrasts: Effects of native phonological and phonetic influences	2010	Language and Speech	198
Yeung H.H.; Chen K.H.; Werker J.F. (Yeung et al., 2013)	When does native language input affect phonetic perception? The precocious case of lexical tone	2013	Journal of Memory and Language	164
Fennell C.T.; Waxman S.R. (Fennell & Waxman, 2010)	What paradox? Referential cues allow for infant use of phonetic detail in word learning	2010	Child Development	150
Rost G.C.; McMurray B.(Rost & McMurray, 2010)	Finding the signal by adding noise: The role of noncontrastive phonetic variability in early word learning	2010	Infancy	143
Mcleod S.; Baker E.(Mcleod & Baker, 2014)	Speech-language pathologists' practices regarding assessment, analysis, target selection, intervention, and service delivery for children with speech sound disorders	2014	Clinical Linguistics and Phonetics	134
Cristia A.(Cristia, 2013)	Input to Language: The Phonetics and Perception of Infant-Directed Speech	2013	Linguistics and Language Compass	101
Chang C.B. (Chang, 2013)	A novelty effect in phonetic drift of the native language	2013	Journal of Phonetics	100
Antoniou M.; Best C.T.; Tyler M.D.; Kroos C. (Antoniou et al., 2011)	Inter-language interference in VOT production by L2-dominant bilinguals: Asymmetries in phonetic code-switching	2011	Journal of Phonetics	99
Antoniou M.; Liang E.; Ettlinger M.; Wong P.C.M. (Antoniou et al., 2015)	The bilingual advantage in phonetic learning	2015	Bilingualism	98
Yoshida K.A.; Pons F.; Maye J.; Werker J.F. (Yoshida et al., 2010)	Distributional phonetic learning at 10 months of age	2010	Infancy	90

The data presented in Table 5 highlights the most influential scholarly contributions to the field of *Acoustic Approaches in Second Language Acquisition and Learning*, based on citation count. Leading the list is the work by So & Best, (2010), published in *Language and Speech*, which has accumulated 198 citations. Their study emphasizes the significance of cross-language perception of tonal contrasts and how native phonological frameworks influence the processing of non-native tones an area particularly pertinent to second language learners of tonal languages. Closely following is Yeung et al., (2013), with 164 citations, whose article in

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the *Journal of Memory and Language* examines the impact of early native language input on phonetic perception. This research reflects a growing interest in the developmental trajectory of acoustic sensitivity in infancy, providing insight into the early cognitive mechanisms that underpin second language phonetic learning.

Other highly cited works include Fennell & Waxman, (2010) and Rost & McMurray, (2010), ach cited over 140 times. These studies delve into how infants utilize phonetic detail and respond to noncontrastive phonetic variability during early word learning. Their findings underscore the foundational role of acoustic cues in lexical acquisition and highlight how nuanced phonetic differences are processed and interpreted by learners. This is especially relevant to second language acquisition, where distinguishing subtle contrasts in the target language is often a challenge for non-native speakers. Additionally, Mcleod & Baker, (2014) and (Cristia, 2013) extend the relevance of acoustic approaches to applied and clinical contexts. Their research contributes to speech-language pathology and pedagogical practices, exploring topics such as intervention strategies for speech sound disorders and the characteristics of infant-directed speech.

Further contributions by Chang, (2013) and Antoniou et al., (2011, 2015) expand the focus to include phenomena such as phonetic drift, bilingual phonetic adaptation, and code-switching. These studies reveal how exposure to multiple linguistic environments affects acoustic output and perception, illustrating the fluidity of phonetic identity in bilingual speakers. Their work supports the view that second language phonetic acquisition is influenced not only by cognitive and perceptual mechanisms but also by sociolinguistic factors and usage patterns. Collectively, the top-cited publications represent a diverse and interdisciplinary body of research, spanning developmental, cognitive, clinical, and sociolinguistic perspectives. They highlight the critical role that acoustic analysis plays in deepening our understanding of second language acquisition processes across different learner populations and contexts.

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What Are the Most Countries in Publication?

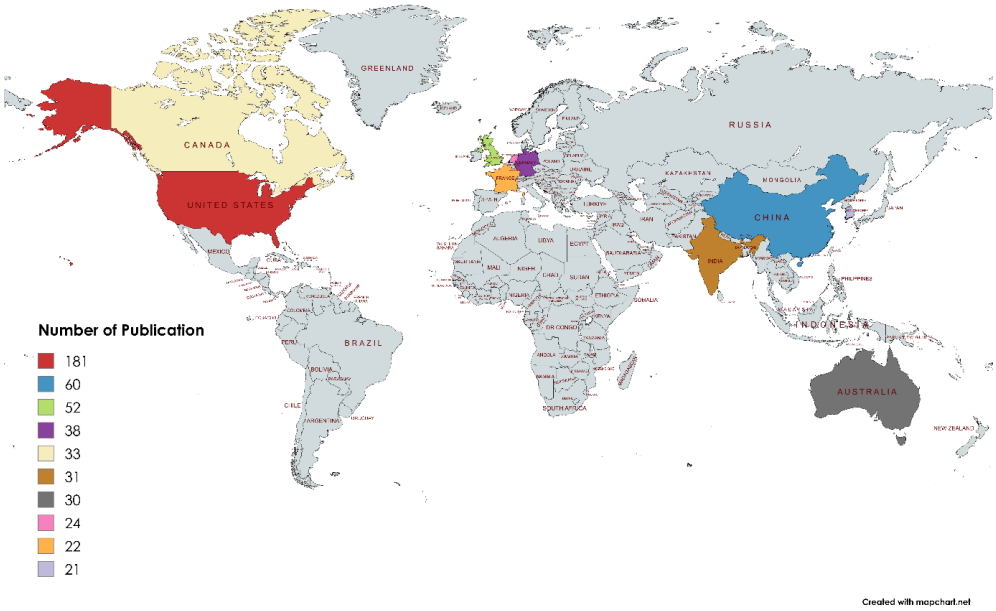

Figure 4: Country-Wise Distribution and Leading Contributors of Publications in the Field of Acoustic Approaches in Second Language Acquisition

Table 6: Most Top 10 Countries in Publication of Acoustic Approaches in Second Language Acquisition

Country/Territory	Number of Publication	Percentage %
United States	181	31.2
China	60	10.3
United Kingdom	52	9.0
Germany	38	6.6
Canada	33	5.7
India	31	5.3
Australia	30	5.2
Netherlands	24	4.1
France	22	3.8
South Korea	21	3.6

Figure 4 and Table 6 present a geographical overview of research activity in *Acoustic Approaches in Second Language Acquisition and Learning*, highlighting the top ten contributing countries. The United States leads by a substantial margin, producing 181 publications, which accounts for 31.2% of the total scholarly output in this field. This dominant contribution reflects the country's strong research infrastructure in applied linguistics, cognitive science, and speech technologies, as well as its broad network of institutions and researchers engaged in second language learning and phonetic research. China follows with 60 publications (10.3%), indicating a growing interest in integrating acoustic tools into language education, likely influenced by national initiatives aimed at enhancing English proficiency and technological integration in education.

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The United Kingdom and Germany rank third and fourth, contributing 52 (9.0%) and 38 (6.6%) publications respectively. These figures underscore the strong academic presence of European nations in phonetics, sociolinguistics, and second language pedagogy. Other notable contributors include Canada (33 publications, 5.7%), India (31, 5.3%), and Australia (30, 5.2%), reflecting regional engagement with both English language education and speech-language technologies. Additionally, the Netherlands, France, and South Korea contribute meaningfully, each producing between 21 and 24 publications, representing 3.6% to 4.1% of the total. The wide geographic spread of research highlights the global relevance and interdisciplinary interest in acoustic approaches for second language acquisition, with both Western and non-Western countries participating in shaping the research landscape. This distribution affirms the increasing recognition of acoustic phonetics as a vital tool in understanding and facilitating language learning processes across diverse linguistic and educational contexts.

What Are the Popular Keywords Related to the Study?

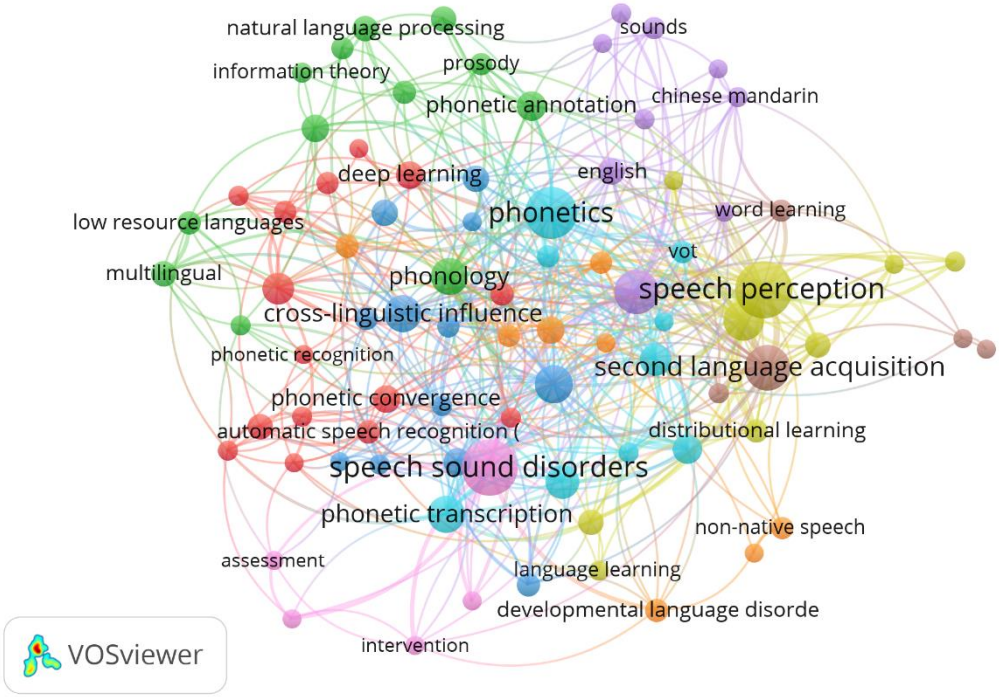

Figure 5: Network Visualization Map of Keywords' Co-Occurrence

Figure 5 and the accompanying table illustrate the keyword co-occurrence network produced using VOSviewer, revealing major thematic concentrations in the literature on *Acoustic Approaches in Second Language Acquisition and Learning*. The most frequent and strongly linked terms include "speech perception" (45 occurrences; link strength: 83) and "speech sound disorders" (44; 64), both of which signify the centrality of perceptual and clinical dimensions in acoustic research. "Phonetics" (38; 60) and "phonological awareness" (28; 48) also emerge prominently, reinforcing the significance of phonetic sensitivity and cognitive linguistic processing in SLA. The keyword "second language acquisition" itself records 29 occurrences and a high link strength of 47, clearly marking it as a foundational concept within the research domain.

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Beyond perception and awareness, keywords such as "perceptual learning" (23; 44), "phonology" (19; 43), "bilingualism" (20; 41), and "cross-linguistic influence" (19; 29) highlight the influence of linguistic diversity and multilingual experience on phonetic and acoustic learning outcomes. The notable appearances of "phonetic transcription" (19; 26) and "pronunciation" (16; 23) suggest that many studies employ acoustic tools to support speech production analysis and instructional methodologies. Other frequently linked terms like "speech recognition" (14; 24), "English" (10; 23), and "language" (12; 25) indicate a strong concentration of research on English language learning using acoustic technologies. Together, these keywords form a cohesive picture of the dual focus on both perception and production mechanisms in SLA.

The keyword network also signals a growing interdisciplinary trend, particularly in the integration of computational and technological approaches. Keywords such as "deep learning", "automatic speech recognition (ASR)", "self-supervised learning", and "acoustic phonetics" reflect an increasing reliance on AI-powered tools to conduct phonetic analysis. Meanwhile, terms like "phonetic convergence", "voice onset time", and "distributional learning" suggest that fine-grained acoustic metrics are being used to explore timing, variation, and learning dynamics in both monolingual and bilingual contexts. Collectively, the keyword co-occurrence patterns affirm the convergence of traditional phonological research with modern machine-assisted methodologies, positioning acoustic analysis as a dynamic and evolving field within second language acquisition studies.

What Is Co-Authorship Based on Countries' Collaboration?

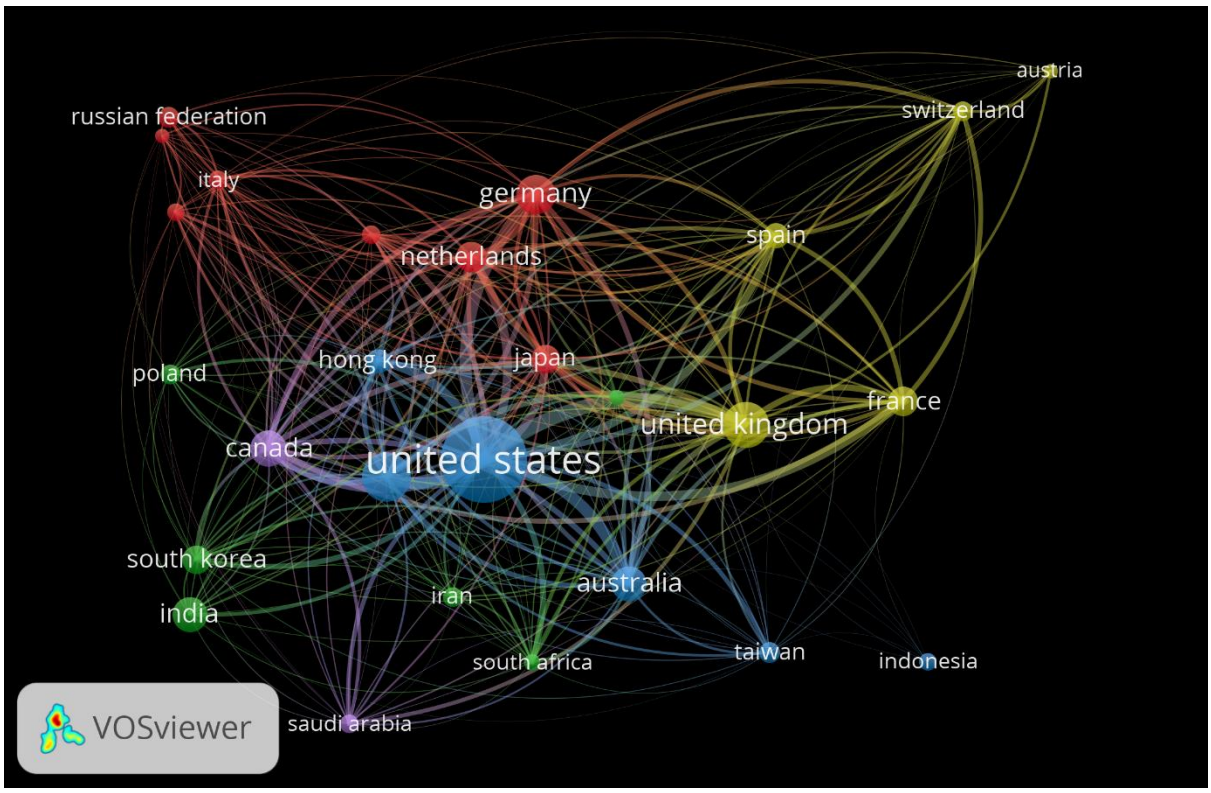

Figure 6: Network Visualization Map of Country Collaboration

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Figure 6 and the accompanying table present the results of a country-level co-authorship analysis, visualized through a collaborative network map generated by VOSviewer. The **United** States emerges as the most dominant contributor, with the highest number of publications (181 documents), total citations (3,485), and the strongest total link strength (20,921). This indicates not only a high volume of scholarly output but also extensive international collaboration, particularly with countries such as the United Kingdom, Canada, and Germany. The United Kingdom and Canada follow with strong research footprints, producing 52 and 33 documents respectively, and maintaining substantial total link strengths of 7,644 and 6,785, reflecting their active engagement in international research partnerships.

Other notable contributors include Germany (38 documents; 6,129 link strength), Australia (30; 5,607), and China (60; 5,311). While China demonstrates a high number of publications, its citation count (367) is comparatively lower than countries like Australia (750) and Canada (836), suggesting room for improvement in research impact. European nations such as France, the Netherlands, and Spain also exhibit strong link strengths, further emphasizing the central role of Western countries in advancing the field of acoustic approaches in second language acquisition. Moreover, Asian countries like Japan, South Korea, Hong Kong, and Taiwan show increasing collaborative engagement, particularly with leading Western institutions, as reflected by their moderate document output and citation scores paired with visible network positioning.

Although countries like India, Indonesia, Iran, and Saudi Arabia are present within the collaborative network, their link strengths and citation counts remain relatively low compared to dominant contributors. For instance, India has 31 documents but only 150 citations and a link strength of 521, suggesting less international visibility or impact. Conversely, smaller but research-intensive nations like Switzerland, Finland, and Singapore maintain modest document counts yet show stronger co-authorship ties, as evidenced by their link strengths above 600. Overall, the visualization illustrates a densely interconnected global research network, where core academic powers drive progress while emerging nations gradually expand their contributions in acoustic-based second language research through collaborative efforts.

Conclusion

The findings of this study highlight several practical implications that can inform both educational practice and technological development. Educators are encouraged to integrate acoustic tools such as real-time articulatory feedback systems and AI-assisted pronunciation platforms into language instruction to offer more personalized, data-driven learning experiences. Concurrently, technologists have the opportunity to design adaptive, learner-specific acoustic applications that support more precise training in speech perception and production. The synergy between educational and technological advancements holds great potential to create more inclusive and effective second language acquisition (SLA) programs, particularly for learners from diverse linguistic and cultural backgrounds.

This bibliometric study aimed to systematically map the progression and scholarly patterns related to acoustic approaches in the field of second language acquisition and learning. Through the examination of publication volume, subject area distribution, highly cited publications, international co-authorship trends, and recurring thematic keywords spanning from 2010 to mid-2025, the analysis sought to uncover the structural and intellectual development of this interdisciplinary research area. Central questions addressed in this study included the annual

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research output, thematic concentration by discipline, influential academic contributions, patterns of international collaboration, and the dominant conceptual themes underpinning the literature.

The analysis demonstrated a consistent increase in publication output, particularly between 2020 and 2024, indicating growing scholarly interest in acoustic and phonetic methodologies within SLA contexts. The research output was primarily concentrated in the social sciences and arts and humanities, with significant cross-disciplinary input from computer science, psychology, and health-related disciplines. Frequently cited studies underscored critical themes such as speech perception, phonological awareness, and bilingual phonetic development, highlighting the central role of acoustic features in language learning and instructional design. From a global perspective, the United States recorded the highest number of contributions, followed by China, the United Kingdom, and Germany. Keyword co-occurrence analysis identified "speech perception," "phonetics," and "bilingualism" as major focal points, while emerging technological themes such as automatic speech recognition and deep learning suggested a shift towards computational approaches in phonetic research.

This study offers a comprehensive overview of how acoustic-based methodologies are contributing to advancements in second language acquisition research. It provides a foundational reference for future investigations by clarifying the main research trajectories, disciplinary intersections, and global participation trends in the field. The insights gained have practical relevance for language educators, instructional designers, and speech-language professionals, especially in leveraging acoustic tools for improved pedagogical outcomes.

However, the scope of the study was limited to English-language publications indexed in Scopus, which may exclude valuable contributions from other linguistic and regional contexts. Future research may benefit from incorporating multi-language sources, expanding the temporal scope, and applying comparative bibliometric techniques across different databases. Ultimately, this study highlights the significance of bibliometric analysis in tracing knowledge development and underscores the growing convergence between linguistic inquiry and technological innovation in second language education.

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