

Technology Use in Korean EFL Pronunciation Intervention Studies: A Systematic and Meta-Analytic Review

In Young Yang¹ & Seongseog Park^{2†}

¹Korea National University of Transportation,

²Chuncheon National University of Education

ABSTRACT

This study systematically reviews L2 English pronunciation interventions in the Korean EFL context, focusing on technology use. 116 Korea Citation Index (KCI)-accredited journal articles published between 2003 and 2025 were analyzed. The studies were classified as Computer-Assisted Pronunciation Training (CAPT) or non-CAPT and coded for type of technology-mediated feedback, pronunciation skill focus, and target pronunciation features. Non-CAPT studies were about twice as common as CAPT studies. Slightly more than half of the CAPT studies utilized automatic assessment, while the remainder utilized speech visualization and manipulation. Across the dataset, production was more frequently measured than perception, and segmental features were the most frequent pronunciation targets, with CAPT studies showing a higher concentration on segmental training. A meta-analysis comparing Automatic Speech Recognition (ASR)-based and non-ASR-based CAPT showed positive effect sizes for both categories, with a significantly larger effect size for non-ASR-based CAPT under a random-effects model. The findings cautiously suggest that technological advancements do not necessarily correspond to greater learning gains and highlight the need to examine pronunciation targets and feedback design in technology-mediated interventions.

Keywords: L2 pronunciation intervention, Korean EFL, computer-assisted pronunciation training (CAPT), systematic review, ASR

1. Introduction

Technology has become central to English language teaching. Pronunciation has been marginalized in research and teaching practices in the Korean English-as-a-Foreign-Language (EFL) context as well as globally. However, recent

* This was supported by Korea National University of Transportation in 2026.

† Corresponding author: pasusk@cne.ac.kr



Copyright © 2026 Language Education Institute, Seoul National University.

This is an Open Access article under CC BY-NC License (<http://creativecommons.org/licenses/by-nc/4.0>).

technological affordances have received attention in pronunciation teaching, and relevant research has increasingly been conducted under the umbrella term Computer-Assisted Pronunciation Training (CAPT) (Fouz-González, 2025). In particular, advanced Automatic Speech Recognition (ASR)-based feedback tools are gaining prominence in educational contexts as a means of addressing challenges in pronunciation teaching and learning (Ngo et al., 2024).

Technological development has expanded pronunciation practice beyond traditional listen-and-repeat activities toward more interactive approaches. Technology can provide learners with immediate pronunciation feedback even in large classes. The widespread availability of computers and mobile devices has made CAPT more common in classrooms. Some researchers have developed useful web- and mobile-based programs including the English Accent Coach for high-variability phonetic training (HVPT; Thomson, 2026) and ASR feedback programs for pronunciation classes such as iSpraak (Nickolai, 2015).

Technology, beginning with record players, has long been present in classrooms (O'Brien & Levis, 2017), and its use in pronunciation teaching has gradually evolved. More recently, however, technological support for pronunciation interventions appears to have accelerated in EFL contexts. Studies have increasingly examined the effects of technological tools, such as AI-based chatbots and ASR, on pronunciation and other areas of language learning (e.g., Li et al., 2025; Ngo et al., 2024).

In this context, this study aims to summarize pronunciation intervention research in the Korean EFL context and examine trends in technology-related aspects of these interventions, including the pronunciation features targeted (segments or suprasegmentals), the pronunciation skills measured as outcomes (production or perception), and the use of technology in CAPT studies. Drawing on pronunciation intervention research in the Korean EFL context published in Korea Citation Index (KCI)-accredited journals between 2003¹⁾ and 2025, this study presents a systematic review and a meta-analysis of the effect of CAPT. Recently, several reviews have examined the applications of technology in pronunciation teaching (Amrate & Tsai, 2025; Ngo et al., 2024; Vančová, 2023). However, this topic has rarely been addressed in the Korean context. Therefore, this study attempts to provide comprehensive insights into trends in second language (L2) pronunciation teaching and learning in Korea. The research background and analytical framework are described in the next section.

1) 2003 was not selected arbitrarily; it is the year of the earliest study that met the selection criteria and was identified in the KCI database.

2. L2 Pronunciation Intervention Components

2.1. Pronunciation skills in interventions and outcome measurements

Pronunciation intervention involves two speech modes or skills, production and perception (Amrate & Tsai, 2025; Saito & Plonsky, 2019; Sakai & Moorman, 2018). Previous pronunciation intervention research has placed greater emphasis on production than perception, and production outcomes have been assessed more frequently (Amrate & Tsai, 2025; Thomson & Derwing, 2015). Additionally, it is not uncommon to find reviews on L2 pronunciation interventions that have examined intervention effects based on learners' produced speech samples (e.g., Saito & Plonsky, 2019). However, according to a meta-analysis by Sakai & Moorman (2018), auditory training improves perceptual ability ($d=0.92$, $SD=0.96$) and, to some degree, enhances productive ability ($d=0.54$, $SD=0.45$). Saito & Plonsky (2019) suggest that syllabi should include both production and perception training, citing Nagle (2018). Lee et al. (2020) provided further empirical evidence that perception-based pronunciation instruction is more effective than production-based instruction for segments and suprasegmentals, with greater retention in a delayed post-test. HVPT has also suggested a similar tendency, with high-variability perception training effects being transferred to production (Barriuso & Hayes-Harb, 2018). Thus, perceptual improvement is critical for pronunciation improvement and pronunciation outcomes must be examined regarding both perception and production.

2.2. Target pronunciation features in interventions

In pronunciation interventions, instruction should include both segments and suprasegmentals. Levis (2005) addressed the bias toward segmental training in classrooms, underscoring the importance of communicative contexts' suprasegmental aspects. Thomson & Derwing (2015) reviewed 75 studies, reporting that more studies limited the scope of training within segments (53% compared with 23% of suprasegmental studies and 24% of studies focusing on both). Amrate & Tsai (2025) reviewed CAPT studies, finding that segments received more focus (14 of 30) in pronunciation interventions than suprasegmentals (six studies). Rogerson-Revell (2021) also noted that traditionally, CAPT focuses on phonemes and minimal pairs, which is a limitation of many CAPT systems. Many intelligibility and comprehensibility

studies (e.g., Derwing et al., 1998; Trofimovich & Isaacs, 2012) suggest that language's suprasegmental aspects contribute significantly to communication, underscoring the integration of segments and suprasegmentals in pronunciation interventions.

2.3. Technology use in interventions

When considering intervention characteristics, technology should be included, with CAPT being actively discussed in this field. Since the late 2010s, an increasing number of studies have examined the CAPT's effects, future, and techniques (e.g., Amrate & Tsai, 2025; Fouz-González, 2025; Mahdi & Al Khateeb, 2019; Ngo et al., 2024; Rogerson-Revell, 2021). As Fouz-González (2025) notes, CAPT is sometimes used as an umbrella term; it does not refer to a single technological tool or ASR app. It includes a variety of HVPT, Text-to-Speech (TTS), captioned video, visualization, ASR, chatbot, resynthesis, and virtual interactions that are used appropriately in lesson designs of pronunciation teaching.

O'Brien & Levis (2017) note that “the use of pronunciation technologies within an L2 teaching and learning context is captured within the field of Computer-Assisted Pronunciation Teaching (CAPT)” (p. 1), suggesting that CAPT refers to technology that supports pronunciation teaching and learning. Rogerson-Revell (2021) also views CAPT, a subarea of Computer Assisted Language Learning (CALL), as a technology-supported digital tool for pronunciation teaching and learning, including AI, ASR, perception training, and visual feedback such as spectrograms and waveforms.

In early CAPT literature, Neri et al. (2002) characterized ideal L2 pronunciation training according to input, output, and feedback, which they identified as key factors in effective pronunciation training. More specifically, they emphasized that input should be abundant and diverse, including multitalker models and visual input of articulatory information. An effective CAPT program should provide practice opportunities beyond isolated minimal-pair repetition, including connected speech, varied practice materials such as sentences and dialogues, and communicative activities such as role-plays. The authors particularly highlighted the importance of feedback, noting that learners often fail to perceive their errors because of the L2 phonological system and that self-auditory monitoring is insufficient.

Mahdi & Al Khateeb (2019) conducted a meta-analysis of 20 studies using CAPT and found a positive effect on foreign-language pronunciation. In the same study, beginners and intermediates benefited more from CAPT, and university students

benefited more than other school-level students. Ngo et al. (2024) limited their meta-analysis to the effect of ASR and synthesized experimental comparisons between ASR-based pronunciation learning and a non-ASR control condition, reporting an overall effect of $g=0.69$.

Researchers have consistently emphasized the pedagogical use of technology and CAPT's contribution to improving learners' speech intelligibility but not nativelikeness (Fouz-González, 2025; O'Brien & Levis, 2017; O'Brien et al., 2018; Rogerson-Revell, 2021). Neri et al. (2002) also suggested that feedback on every error is not desirable and that priorities should be set based on effects on intelligibility along with other learner factors and error characteristics. Instruction with and without advanced technological support leads to different instructional designs, focuses, and measurements. Fouz-González (2025) further claims that CAPT research showing a specific technology being effective in certain situations is insufficient and that it is necessary to explain the role specific technology plays at the pronunciation instruction stage.

2.4. Research questions

The research questions are as follows:

1. In Korean EFL pronunciation intervention research, how are CAPT and non-CAPT studies distributed, and how has technology-mediated feedback been implemented?
2. How do CAPT and non-CAPT interventions differ in pronunciation skills measured and pronunciation features targeted?
3. What is CAPT's overall effect size, and how do ASR-based tools compare with non-ASR-based tools?

3. Method

3.1. Data search

Study identification, screening, and inclusion were conducted with reference to the PRISMA flow diagram, and eligible empirical studies on L2 English pronunciation interventions were selected for the systematic review. Table 1 presents the inclusion and exclusion criteria. PRISMA flow-based procedures for search, screening, eligibility assessment, and final inclusion are summarized and described in Figure 1.

Table 1. Inclusion and exclusion criteria

Criteria		Included	Excluded
Publication	Publication year	Published up to 2025, with no predetermined starting year	
	Publication language	English or Korean	
	Publication index	Articles published in KCI Accredited or KCI Excellent Accredited journals	
	Publication type	Peer-reviewed journal articles	
Topic	Study focus	L2 English pronunciation intervention	
Method	Study design	Intervention designs permitting quantitative group-level comparison of pronunciation outcomes across time, between groups, or across instructional conditions	
	Outcome measure	L2 pronunciation outcomes measured through learners' speech production or perception performance	Outcomes based only on surveys, attitudes, perceptions, or general speaking/listening scores
Context and participants	Participants	Korean learners in the Korean EFL context	Non-Korean learners or Korean learners in non-EFL contexts

The original search was conducted on December 28, 2025, using only English search terms. The entire search was completed on July 28, 2026, including both English and corresponding Korean search terms. The updated search retained the original publication year until 2025 and added studies newly indexed after December 28, 2025. No lower publication-year limit was predetermined. The search included publications through 2025, with 2003 emerging as the earliest publication year among the eligible records.

The search was limited to academic journal articles indexed in the KCI (kci.go.kr) for the following reasons: 1) to maintain consistency and ensure reproducibility of the search process and 2) to better reflect the Korean EFL pronunciation intervention research landscape and its educational contexts. Research indexed in the KCI does not represent all studies conducted in the Korean EFL research field. Therefore, this study's results should be interpreted cautiously within the scope of KCI-indexed literature.

The search terms were as follows: 1) English pronunciation, 2) L2 pronunciation, 3) English consonant(s), 4) English vowel(s), 5) English suprasegmental(s), 6) English prosody, 7) English rhythm, and corresponding Korean terms²⁾. For English terms with plural forms, such forms were searched separately, and duplicates were removed. Korean spacing variants were checked using “영어 발음” and “영어발음.” The two forms yielded identical search results; therefore, additional spacing variants were not included in the final search.

The authors intentionally avoided including pronunciation teaching or intervention because L2 English pronunciation intervention research inconsistently adopts the relevant terms. In other words, intervention research learning outcomes are sometimes reported without mentioning the intervention process in the titles or keywords. Specifically, searching for the CAPT keyword in KCI yielded only five L2 English pronunciation studies (confined to particular authors). With this in mind, we designed pronunciation-centered search strategies to include as many intervention studies as possible and to provide a more comprehensive overview of research trends over time. Furthermore, intervention research in fields other than L2 English teaching within the CALL system was automatically excluded.

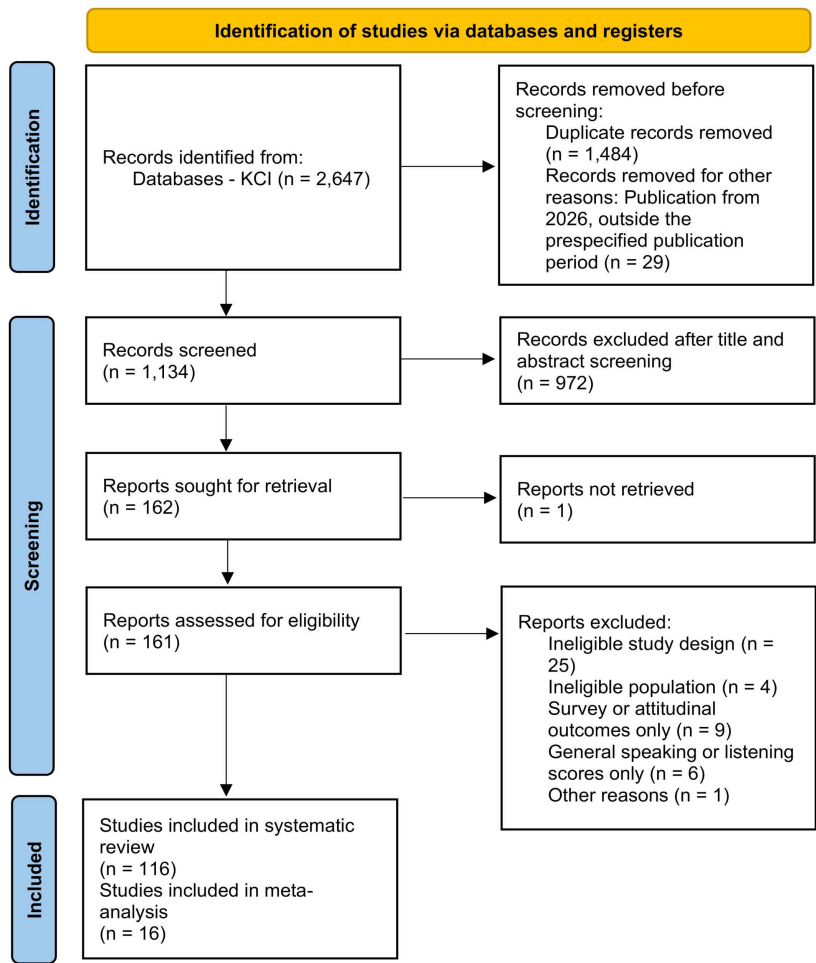
Search term selection focused on broader categories, as including every individual phonological category or natural class was impractical. Each search term was entered separately into the KCI Integrated Search interface, which retrieved records from indexed fields such as titles, keywords, and abstracts. For each search, the journal subject areas were restricted to the Humanities, Social Science, and Interdisciplinary Studies, excluding journals classified under Natural Science, Engineering, Medicine and Pharmacy, Marine Agriculture, Fishery, and Arts and Kinesiology. Additionally, bibliographic records were exported only from KCI Accredited and KCI Excellent Accredited journals, excluding Candidate and General journals. The search yielded 2,647 records. After removing 1,484 duplicate records and 29 records published in 2026 outside of the prespecified publication period, 1,134 unique records were screened.

3.2. Data screening

Study selection followed these steps: First, titles and abstracts were reviewed to exclude studies without interventions or a quantitative comparison of pronunciation

2) See Appendix A for the complete search strategy and exact search terms.

outcomes; 162 papers were selected for full-text review and 161 papers were retrieved. Next, during the full-text review, studies that did not meet the inclusion criteria listed in Table 1 were excluded for the following reasons: 1) ineligible study design, 2) ineligible population (i.e., non-Korean EFL learners or Korean ESL learners), 3) survey or attitudinal outcomes only, 4) general speaking or listening scores only, and 5) other reasons (i.e., secondary analysis of previously published data). This procedure yielded 116 studies.



Note. Source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.

Figure 1. PRISMA 2020 flow diagram of study identification, screening, and inclusion.

3.3. Coding for the systematic review

The final 116 studies were coded for the systematic review, including: 1) technological mediation in the learner speech feedback process (speech visualization and manipulation, automatic assessment, none); 2) intervention methodology (CAPT or non-CAPT); 3) pronunciation skills for outcome measurements (production, perception, both); and 4) target pronunciation features of the intervention (segment, suprasegmental, both, unspecified).

CAPT required the following conditions: 1) computer- or mobile-based activities, 2) individualized or learner-controlled practice, 3) pronunciation-related external corrective feedback provided by the technology. The present study examined how a specific technology was used and whether it met these conditions. For example, if a pronunciation intervention study adopted a web-based program that provided learners with individualized or learner-controlled practice but did not provide meaningful support or feedback for monitoring or modifying production, it was not considered CAPT. Thus, the same technological tool may or may not constitute CAPT.

Whether a specific study focused on perception, production, or both in the intervention is important, but this information was not readily available or consistently reported. In general, pronunciation intervention involves perceptual input and training in perception and production (i.e., listen-and-repeat). Therefore, it was difficult to categorize the studies into two types, except for a few intensive perception training studies. For clarity, this review coded studies based on their pronunciation skill outcomes.

3.4. Study selection and coding for the meta-analysis

Studies with CAPT were screened and selected for meta-analysis. First, the possibility of statistical combination among the 34 studies coded as CAPT was assessed, excluding studies that did not report pre- or post-test means or standard deviations (*SD*) for the experimental and/or control groups. Studies that reported speech sample *N*-values (rather than participant *N*-values) and their means and *SD*s were also excluded. These studies did not provide the necessary statistical information to calculate effect sizes and were not suitable for reliable comparison among studies due to inconsistent *N*-values reported.

Next, to ensure a consistent interpretation of results across the outcome-measure variables, studies with only acoustic measurements were excluded; rating scores

based on an assessment construct generally allow for positive or negative changes to be interpreted consistently within and across studies, whereas acoustic characteristics may differ between studies depending on the features measured and even within studies across participants. Additionally, this study’s overall purpose is to provide an evaluation of pronunciation interventions that is interpretable in educational contexts, and studies with acoustic measures have limited potential for pedagogical interpretation and classroom applicability.

Sixteen studies were included in the meta-analysis. The coding encompassed technological features (ASR and non-ASR), pre- and post-test means, standard deviations, and participant numbers. If a study assessed both perception and production, it was coded separately. Similarly, studies involving control and comparison groups were coded separately. When a study reported multiple pronunciation outcome measures, each was coded independently unless the author provided an overall pronunciation mean. This process yielded 20 effect sizes. The meta-analysis was performed using *R* 4.5.1, with functions from the meta package—funnel, metabias, trimfill, and metagen—and the forest plot.

4. Results

4.1. Overview of the studies included in the systematic review

In the Korean EFL context, pronunciation intervention studies have mostly been conducted with college students; such studies are rarely conducted with other school levels or age groups. Among the studies included, sample sizes varied considerably, with a mean of 39.2 participants (*SD*=29.8), a median of 32, and a range from 3 to 173 (see Table 2).

Table 2. Summary of profile information in the 116 reviewed pronunciation intervention studies

Education level (N)				
Primary	Secondary	University	Graduate/Adult	Mixed/Unspecified
15	10	84	5	2
Sample size				
Total N	Mean sample size	SD	Median	Min-Max
4,542	39.2	29.8	32	3–173

4.2. Technological characteristics of CAPT studies in the Korean EFL context

4.2.1 CAPT vs. non-CAPT

Among the 116 pronunciation intervention studies, 34 used CAPT and 82 did not (see Table 3).

Table 3. Distribution of CAPT and non-CAPT studies

CAPT		Non-CAPT		Total	
N	%	N	%	N	%
34	29.3	82	70.7	116	100

Figure 2 shows the CAPT and non-CAPT studies published annually. The number of pronunciation intervention studies varied from zero (2004) to ten (2012, 2021), with significant fluctuations.

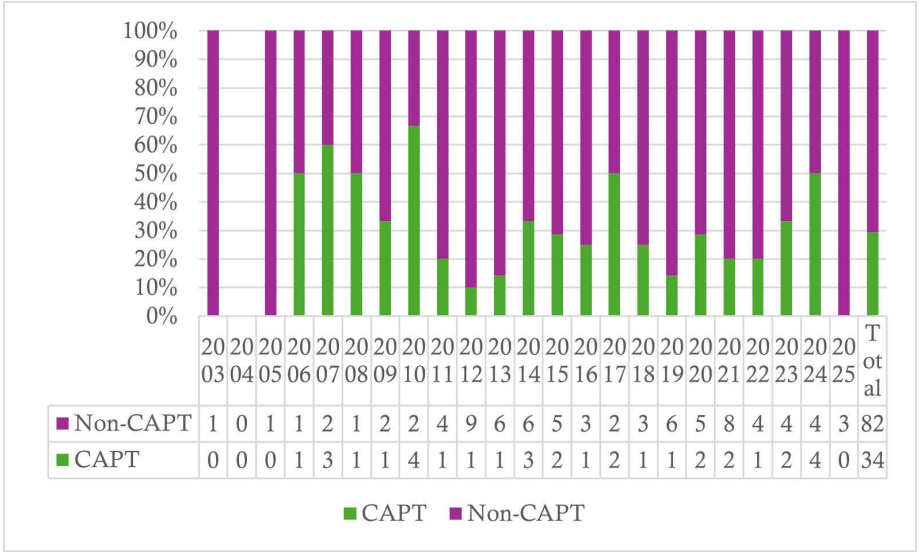


Figure 2. Distribution of CAPT and non-CAPT studies by year.

Among the total studies published, CAPT studies account for approximately 30%. No pronunciation intervention research was conducted in 2004, and no CAPT

studies were conducted in 2003, 2005, or 2025. More CAPT studies were conducted in 2007 and 2010, and the same proportions of CAPT and non-CAPT studies were recorded in 2006, 2008, 2017, and 2024. Non-CAPT studies were predominant in years other than those mentioned above.

4.2.2. Technological characteristics of CAPT studies

Table 4 presents the distribution of technology-mediated feedback in CAPT. Referring to Neri et al. (2002), we classified feedback into two broad categories: 1) speech visualization and manipulation, corresponding to what Neri et al. termed “visual displays” (p. 452), and 2) automatic assessment. Referring to the CAPT systems at the time, Neri et al. (2002) emphasized the need for external corrective feedback since “learners often fail to perceive phonetic differences between their L1 and the L2” and the issue of feedback “represents the biggest challenge for systems” (p. 451). Accordingly, the present analysis gives primary attention to feedback, as it provides a clearer difference among studies reviewed.

Table 4. Types of technology-mediated feedback in CAPT studies

Feedback category	Types	n	%
Speech visualization and manipulation	Visual display	13	38.2
	Prosodic resynthesis	3	8.8
	Perceptual corrective feedback	2	5.9
Automatic assessment	Automatic scoring	9	26.5
	Transcription	7	20.6
Total		34	100

Among the 34 CAPT studies, 16 utilized speech analysis software to make learners aware of their pronunciation challenges, 13 of which required learners to compare their speech characteristics with model pronunciation in terms of pitch contour, spectrogram, and/or waveform, and three of which required learners to do so in terms of the learners’ own voice with enhanced pronunciation features using speech synthesis. These two techniques reduce learners’ load and bias or distortion in perceiving pronunciation problems and provide a more objective evaluation of learners’ speech.

The automatic assessment category includes automated perception training that provides immediate correctness feedback, as well as production training that uses ASR-generated feedback, such as pronunciation scores and speech recognition outcomes (transcriptions). Although Neri et al. (2002) focused primarily on automatic assessment of speech production, we extended this category to perception training when the technology automatically evaluated learners' responses and provided immediate correctness feedback. AI chatbot-mediated interventions are also categorized herein because they essentially involve speech recognition. In this category, learners can access and evaluate their pronunciation more objectively through technology, with self-regulated practice and repetition. This type accounted for 47.1% of the CAPT studies, indicating that ASR is a major focus of CAPT research. Intervention studies have recently adopted ASR-based tools more often than visual displays. In our database, all 11 CAPT studies since 2020 utilized ASR-based tools, whereas all CAPT studies with speech analysis software were conducted before 2020.

4.3. Intervention characteristics of CAPT studies

Table 5 displays the number and proportions of CAPT and non-CAPT studies based on the pronunciation skill focus (production, perception, or both) from the outcome measurements.

Table 5. Pronunciation skills measured in CAPT and non-CAPT studies

Modes	CAPT		Non-CAPT		Total	
	n	%	n	%	n	%
Production	23	67.6	65	79.3	88	75.9
Perception	4	11.8	10	12.2	14	12.1
Both	7	20.6	7	8.5	14	12.1
Total	34	100	82	100	116	100

Production has been extensively investigated in pronunciation interventions. Production tasks were used more often than perception tasks in both CAPT and non-CAPT studies. Perception tasks were included in 11 CAPT and 17 non-CAPT studies, and some studies adopted both production and perception outcomes.

Table 6 shows the target pronunciation features (segment, suprasegmental, or both) addressed in CAPT and non-CAPT studies. Studies were coded as unspecified when

they referred only to general pronunciation improvement without indicating whether the intervention targeted segmental features, suprasegmental features, or both.

Table 6. Pronunciation features targeted in CAPT and non-CAPT studies

Features	CAPT		Non-CAPT		Total	
	n	%	n	%	n	%
Segment	20	58.8	31	37.8	51	44.0
Suprasegmental	4	11.8	27	32.9	31	26.7
Both	6	17.6	19	23.2	25	21.6
Unspecified	4	11.8	5	6.1	9	7.8
Total	34	100.0	82	100.0	116	100.0

The counting generally met our expectations; segments were addressed more frequently in the pronunciation interventions. Specifically, segmental-only training accounted for 44.0% of the studies, whereas suprasegmental-only training accounted for 26.7% and training for both accounted for 21.6%. However, the strength of this tendency differed between CAPT and non-CAPT studies. In CAPT studies, 26 studies addressed segmental features and 10 addressed suprasegmental features, including studies that targeted both. In non-CAPT studies, 50 studies addressed segmental features and 46 addressed suprasegmental features, also including studies that targeted both, slightly fewer than the number of segmental training studies.

4.4. Meta-analytic findings for CAPT studies

4.4.1. Publication bias

In conducting the meta-analysis, publication bias was examined by serially conducting funnel plot inspection, Egger’s regression test, and trim-and-fill analysis. Figure 3 presents the original funnel plot at the top and the adjusted funnel plot at the bottom. The original funnel plot shows the effect sizes on the x-axis and their standard errors on the y-axis for the 20 cases. Effect sizes with standard errors greater than 0.6 are skewed to the right of the central axis, with at least one effect size exceeding 2.0. This asymmetry suggests that the possibility of publication bias cannot be entirely ruled out.

Based on Egger’s regression test, the null hypothesis of no relationship between effect size and standard error was not rejected ($t(18)=1.57, p=.13$). The bias estimate,

corresponding to the intercept of the regression equation, was 1.65 ($SE=1.05$), very close to zero given its standard error.

Finally, the trim-and-fill analysis results indicated that four effect sizes were potentially missing. After imputing these missing effect sizes, the overall effect size was reduced from a medium effect (0.64) to a small effect (0.45). The adjusted funnel plot shows 24 effect sizes, including the four imputed effect sizes represented by four white dots on the far left.

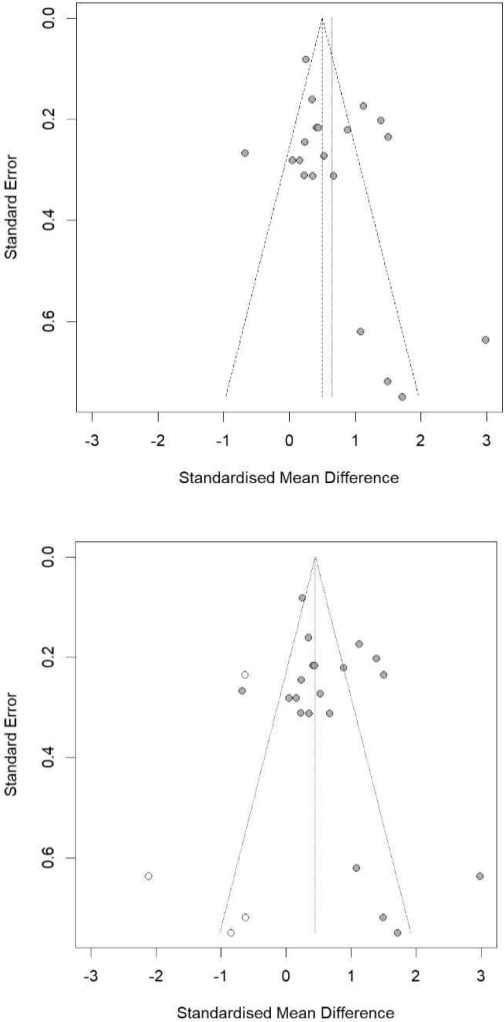


Figure 3. Original and adjusted funnel plots.

In sum, there appears to be some indication of publication bias among the 16 studies and 20 effect sizes included in the meta-analysis. Egger's regression test results were not significant, but the trim-and-fill analysis suggested that a relatively large number of effect sizes may be missing. Also, the estimated overall effect size was reduced after these effect sizes were imputed. However, because the main purpose of this study is to examine the moderating effect of technology type (ASR vs. non-ASR), this finding is interpreted as a caution regarding the overall effect estimate rather than as the central result of the analysis.

4.4.2. Heterogeneity of effect sizes and overall effect size

20 effect sizes were calculated from the reported *N*, *M*, *SD*, and *r* for the experimental and control groups, as shown in Figure 4. If *r* was not reported in a study, it was derived from other reported statistics or imputed as *r*=0.50. Heterogeneity among effect sizes was assessed using a *Q*-test ($p<.001$, $Q(19)=110.51$) and the I^2 statistic (82.8%). The *Q*-test indicated significant heterogeneity, and the I^2 value indicated substantial to considerable heterogeneity (Higgins & Green, 2008, p. 278). Consequently, a random-effects model was used to estimate the overall effect size and conduct moderation analyses. The analysis yielded an estimated overall effect size of $\bar{g}=0.64$ [95% CI: 0.36–0.93], with $\tau^2=0.33$.

The null hypothesis of $\bar{g}=0$ was rejected ($z=4.38$, $p<.001$). Although the overall effect size is within the ‘medium’ range (0.5–0.8), the 95% CI overlaps with the ‘small’ range (0.2–0.5) (Cohen, 1988, pp. 25–27). After adjusting for potential missing effect sizes using the trim-and-fill analysis, the corrected overall effect size slightly decreased to $\bar{g}=0.45$ [95% CI: 0.11–0.79], suggesting a small effect.

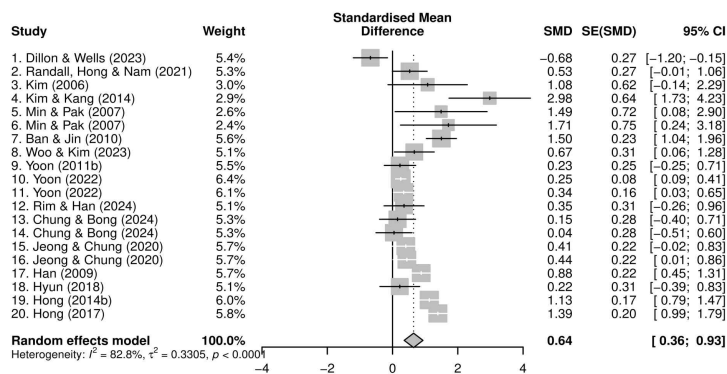


Figure 4. Forest plot of individual effect sizes.

4.4.3. Moderator analysis of ASR-based and non-ASR-based interventions

CAPT studies were categorized by technology type into ASR and non-ASR, and the moderating effect between ASR and non-ASR was statistically significant ($Q(1)=32.61$, $p<.001$) under a random-effects model with group-specific between-study variances (i.e., τ^2 is not common). The mean effect size for ASR-based pronunciation training tools ($k=14$) was 0.49, and for non-ASR-based tools ($k=6$) it was 1.01. The mean effect size for non-ASR-based training programs was larger; a more detailed interpretation is provided in the discussion.

Table 7. Results of the moderator analysis

Moderator variable	N of ES	Mean of ES [95% CI]	τ^2	Q-test
Technology type	ASR	0.49 [0.15, 0.83]	0.33	$Q(1)=32.61$
	Non-ASR	1.01 [0.59, 1.43]	0.17	$p<.001$

Note. The subgroup difference was not statistically significant under the common- τ^2 specification, indicating that the finding was sensitive to the heterogeneity assumption.

5. Discussion

5.1. Summary of findings

The reviewed studies most frequently involved participants in higher education, with university students accounting for over 70% of all studies. By contrast, learners in elementary, middle, and high school settings were relatively underrepresented. This imbalance in participant populations is particularly noteworthy in that L2 pronunciation is particularly sensitive to age-related effects (Hyltenstam & Abrahamsson, 2003). This indicates a need for more intervention research across diverse educational levels. The main findings of the systematic review and meta-analysis are summarized as follows.

First, the characteristics of technology use in Korean EFL pronunciation intervention studies indicate that technology has been incorporated into

pronunciation instruction since the mid-2000s, although non-CAPT studies have generally outnumbered CAPT studies. To date, 34 of 116 studies have been categorized as CAPT, accounting for approximately 30% of the data set. However, recent advances in educational technology using AI- and ASR-based tools have led to an increase in the adoption of ASR-based tools for pronunciation interventions since 2020.

Second, in both CAPT and non-CAPT studies, production outcomes dominated the intervention effect measurements, suggesting that the role of perception in pronunciation learning may have received insufficient attention.

Third, the target pronunciation features revealed interesting patterns in their distribution. CAPT studies focused more on segments than suprasegmentals. In other words, suprasegmentals were relatively underrepresented among CAPT studies. Including studies that focused on both segments and suprasegmentals, suprasegmentals were addressed in 10 of 34 CAPT studies and 46 of 82 non-CAPT studies.

Finally, the overall effect size in CAPT intervention studies indexed in the KCI was positive but medium-to-small. Under the model allowing subgroup-specific heterogeneity estimates, non-ASR studies showed a significantly larger mean effect size than ASR-based studies. However, the finding should be interpreted cautiously. The meta-analysis included only 16 studies, and the non-ASR subgroup consisted of five studies with six effect sizes, also showing sensitivity to the specification of between-study heterogeneity.

5.2. Descriptive synthesis and pedagogical implications

5.2.1 Technology use in Korean EFL pronunciation intervention research

Traditionally, pronunciation teaching has been associated with listen-and-repeat approach; however, advanced technology has frequently been applied to pronunciation interventions in Korean EFL contexts. Additionally, the use of advanced tools alone was not sufficient for an intervention to be classified as CAPT in this review. Rather, the classification depended on how technology was integrated into pronunciation instruction.

Our review of 116 Korean EFL pronunciation interventions revealed several attempts to provide learners with more objective feedback and greater opportunities for independent learning. One such effort involves integrating speech analysis

software, which has typically been used for research, into pronunciation interventions. Learners become familiar with the tool, learn to interpret the signals, record their voices, and compare their recordings with models to identify their pronunciation difficulties and explore ways to improve (e.g., Han, 2009). As O'Brien & Levis (2017) noted, tools used for research can also serve pedagogical purposes. However, these techniques require learners to be trained to interpret the information presented by the software. Furthermore, the relationship between acoustic signals and articulatory gestures is not always direct, which may pose an additional challenge for learners (Neri et al., 2002).

Another approach supported self-regulated learning by allowing learners to hear target pronunciation features incorporated into their own recorded speech. Yoon (2011b) introduced a researcher-developed intonation training program using Pitch-Synchronous Overlap and Add (PSOLA) in Praat. Learners recorded their voices, and the researcher enhanced their speech using native intonation patterns. Learners then compared their intonation with that of the native model in their own voices and trained their intonation through self-regulated learning. Previous research suggests that providing enhanced pronunciation models in learners' own voices may facilitate pronunciation learning, as in Golden Speaker Builder (Ding et al., 2019). However, this type of technology use may lead learners to view the native model as ideal, which is not desirable as Neri et al. (2002) pointed out.

As Fouz-González (2025) points out, beyond the use or effectiveness of a particular technology, it is also important to consider where and how it is integrated into each stage of pronunciation lesson design. In other words, teachers need to have expertise in integrating appropriate technology at appropriate stages of the learning process to improve learners' pronunciation.

5.2.2. Pronunciation skills in CAPT

The differences between CAPT and non-CAPT reflect lesson design differences such as targeted pronunciation skills and pronunciation features. Certain pronunciation intervention features were overlooked while others garnered researchers' attention.

Production was the primary pronunciation skill emphasized and measured in the interventions. This finding aligns with the trend observed in the systematic review by Amrate & Tsai (2025), which reported that production was addressed more frequently in the assessment and training in CAPT. In our database, this tendency

was more pronounced in the non-CAPT studies. Some CAPT studies involved intensive perception training with immediate correctness feedback. Their outcomes were measured using perception tasks (e.g., Hong, 2014b, 2017). Importantly, all pronunciation interventions inherently involve perception activities or training related to sound discrimination although these activities may not be as intensive as in perception-focused studies. However, many studies do not explicitly describe how they integrate perception and production training into the intervention. Even when perception activities are conducted alongside production activities, the intervention effects are often measured only in terms of production.

Recently, perception training, especially HVPT, has gained prominence in second and foreign-language pronunciation learning and teaching (Barriuso & Hayes-Harb, 2018). However, our pilot search in 2025 found no KCI-indexed study that actually implemented HVPT as an intervention for L2 English learners and reported learning gains. HVPT-related publications were identified, but these included a meta-analysis, a study using English Accent Coach to examine Korean learners' phoneme perception, and studies involving the learning of Korean rather than L2 English. In our database, Hong (2014b, 2017) employed 17 talkers for perception training stimuli and provided immediate correctness feedback on sound identification. Although the author did not explicitly label the procedure as HVPT, the approach aligns with the basic principles of HVPT; however, it does not meet all three conditions for canonical HVPT defined by Uchihara et al. (2025). Given that perception training improves both perception and production skills (Bradlow et al., 1997; Lee et al., 2020; Thomson, 2011), analyzing both is essential to accurately evaluate intervention effects (Thomson & Derwing, 2015).

5.2.3. Pronunciation features in CAPT

Regarding target pronunciation features, suprasegmentals are notably less emphasized in CAPT studies. Amrate & Tsai (2025) also report the more frequent focus on segmental features as a training focus in CAPT. Thomson & Derwing (2015) also described that segmental inputs were reported more than twice as frequently as suprasegmental inputs in the CAPT research. This pattern may partly reflect limitations of the tools currently used in pronunciation interventions. Many research tools rely on ASR technology; traditional ASR-based tools used in earlier research relied on phone- or phoneme-level pronunciation scoring, often using Goodness of Pronunciation measures (Witt & Young, 2000). Furthermore,

pronunciation interventions using research-based software tend to focus on distinguishing between specific consonant contrasts or vowel contrasts. A balanced focus on segmental and suprasegmental sounds is necessary, as research has demonstrated that suprasegmental features, such as stress, rhythm, and intonation, are critical in effective oral communication or speech comprehensibility (Derwing et al., 1998; Hahn, 2004; Kang, 2010; Levis, 2018). Ultimately, the development of effective pronunciation intervention tools requires contributions from researchers and educators and necessitates collaboration with software developers.

5.3. Effectiveness of CAPT and pedagogical implications

In the meta-analysis, effect sizes were compared between CAPT studies that used ASR-based tools and those that did not. The overall effect size was positive and medium-to-small. Both ASR-based and non-ASR-based CAPT studies showed positive mean effect sizes. The mean effect size was larger for non-ASR-based CAPT, and the test of subgroup differences showed statistical significance under the separate- τ^2 model. Given the small and unequal subgroup sizes and the sensitivity of the result to the heterogeneity assumption, the finding should be interpreted cautiously.

The meta-analysis included 16 studies yielding 20 effect sizes, with the non-ASR subgroup consisting of only five studies and six effect sizes. Furthermore, the studies differed in their intervention characteristics as well as in the presence or absence of ASR-based tools. Therefore, the observed group difference may represent a study-level association and should not be interpreted as direct evidence that non-ASR technology is more effective than ASR.

Drawing on Kang's (2026) findings on the differential contributions of broad and focused intervention scope to speech intelligibility, we conducted an additional descriptive examination of the ASR-based studies in the present dataset. Eight of the eleven studies included either broad pronunciation targets—such as both segmental and suprasegmental features or a wide range of segmental features—or unspecified pronunciation targets. In contrast, two non-ASR studies implemented multitalker-based perception training (i.e., HVPT) focusing on vowels (Hong, 2014b, 2017). Another non-ASR study, Min & Pak (2007), which yielded one of the largest effect sizes, trained participants in ten 30-minute sessions, focusing on three vowel contrasts, pitch contour, and duration. These instructional characteristics may have contributed to the observed effect.

The findings nevertheless suggest that technological advancements do not

necessarily lead to better learning outcomes. Rather, these patterns raise the possibility that setting specific and focused instructional targets warrants greater attention. This interpretation is consistent with previous discussions of technology in CAPT. More broadly, as previous research suggests, factors such as lesson design, appropriate technological support for learners, and high-quality pedagogical feedback focusing on pronunciation features that enhance communication may be as important as, or potentially more important than, the level of technological sophistication (Fouz-González, 2025). In addition, in intelligibility-oriented instruction, pronunciation targets may need to be prioritized according to their relative contribution to communication.

Technical limitations also remain. Most importantly, technological development should aim to foster understandable speech or intelligibility, as emphasized by O'Brien & Levis (2017). An ideal, effective ASR feedback system may not require learners to pay equal attention to every pronunciation error, as Neri et al. (2002) noted. ASR feedback may not always lead to improvements in speech intelligibility when it focuses primarily on segmental accuracy without considering the communicative importance of particular pronunciation features. Also, as Neri et al. (2002) pointed out, automatic assessment should reflect human judgments of pronunciation quality, since language learning ultimately aims to facilitate human communication. Rogerson-Revell (2021) also noted that humans are able to process greater variability and complexity in natural speech.

Learners face diverse challenges depending on their native language backgrounds; pronunciation education no longer aims for nativelikeness (Munro & Derwing, 1995; Levis, 2005). Moreover, no current program can address all these issues effectively (Fouz-González, 2025). These considerations suggest that effective technology use may continue to require substantial teacher expertise in selecting appropriate pronunciation targets and integrating technology in ways that support communicative goals.

5.4. Methodological implications and suggestions for future research

Defining CAPT was an important methodological issue in this review because the search strategy was designed to capture pronunciation intervention research as broadly as possible rather than to retrieve only the small number of studies explicitly labeled as CAPT or pronunciation teaching with technology. Future reviews of technology-mediated pronunciation interventions would benefit from classification

frameworks that more precisely reflect how technology supports the pronunciation learning processes of input, output, and feedback.

Some studies were excluded from the meta-analysis because they did not report pre- and post-intervention data or standard deviations. This highlights an area for improvement in research reporting. Specifically, some studies reported the number of speech samples rather than the number of participants and conducted statistical analyses on this, leading to their exclusion from the meta-analysis. Additionally, in intervention studies, variables including intervention duration, intensity, and assigned class hours are important but are often not specified. Furthermore, only a few studies examined intervention effects according to participants' proficiency levels; future research should examine intervention effects according to pronunciation proficiency.

5.5. Limitations

This study provides a comprehensive overview of pronunciation intervention research in the Korean context; however, it has several limitations. First, only KCI-indexed papers were included, and studies published in international academic journals within the Korean EFL context were excluded. Additionally, the search terms were not exhaustive. Another limitation is that screening and coding processes relied on researcher discussion and consensus rather than independent double-coding. Consequently, no inter-rater reliability statistic was calculated. Furthermore, only 16 CAPT studies were included in the meta-analysis, making generalization difficult. Many studies excluded from the meta-analysis employed acoustic analysis to measure outcomes and focused on segmental features. Their exclusion may have reduced the representation of segment-focused interventions in the meta-analysis, and the meta-analytic findings should be interpreted with this limitation in mind. The most significant limitation concerns the choice of learning outcome measures, for which Saito & Plonsky (2019) provided a useful meta-analytic framework. Therefore, a systematic and meta-analytic review that considers differences in outcome measurement methods is also necessary. Finally, as in Ngo et al.'s (2024) meta-analysis of ASR-based pronunciation interventions, a more refined meta-analysis focusing on a specific technology could contribute further to L2 pronunciation learning and teaching.

6. Conclusion

This study systematically reviewed Korean EFL pronunciation intervention research by classifying studies as CAPT or non-CAPT and characterizing them in terms of technology-mediated feedback types, pronunciation skills measured, and pronunciation features targeted. This study also evaluated the effect of technology-based interventions through a meta-analysis. Technology has consistently attracted pronunciation researchers' attention, but the key is not merely using technology but integrating it effectively into pronunciation teaching design. To conduct research with practical pedagogical implications and optimize classroom technology use, expertise in both L2 pronunciation pedagogy and relevant technologies is important; further empirical research on pronunciation interventions in Korea is also needed. Collaboration between researchers and teachers could address these needs more effectively and bridge the gap between research and practice.

References

- Note.* One asterisk (*) indicates studies included in the systematic review; two asterisks (**) indicate studies included in both the systematic review and meta-analysis.
- *Ahn, M. (2024). Articulatory training and vowel production: The case of [i] and [ɪ] by Korean learners of English. *English Language and Linguistics*, 30(2), 81-92.
- Amrate, M., & Tsai, P. H. (2025). Computer-assisted pronunciation training: A systematic review. *ReCALL*, 37(1), 22-42.
- **Ban, J.-C., & Jin, K.-A. (2010). Effectiveness of using autonomous intelligent robots for English teachers on students' achievement and affective traits: A case study in an elementary school. *The Journal of Curriculum and Evaluation*, 13(2), 389-410.
- Barriuso, T. A., & Hayes-Harb, R. (2018). High variability phonetic training as a bridge from research to practice. *The CATESOL Journal*, 30(1), 177-194.
- Bradlow, A. R., Pisoni, D. B., Akahane-Yamada, R., & Tohkura, Y. I. (1997). Training Japanese listeners to identify English /r/ and /l/: IV. Some effects of perceptual learning on speech production. *The Journal of the Acoustical Society of America*, 101(4), 2299-2310.
- *Chang, H.-J. (2008). Effectiveness of pronunciation training on suprasegmentals. *Korean Journal of Applied Linguistics*, 24(1), 85-108.
- *Cho, H. (2007). The effectiveness of speech analysis programs for teaching English pronunciation: Focusing on voiced plosives. *EONEOHAG*, 49, 149-171.
- *Cho, H. (2012). An experiment on learning English pronunciation through WaveSurfer:

- Focusing on voiced plosives. *English Language and Linguistics*, 18(2), 173-190.
- *Cho, H. (2016). Effectiveness of pronunciation training for English segments by the use of a speech analysis program: Focusing on dark /ɪ/. *The Journal of Humanities Studies*, 102, 317-338.
- *Cho, H.-K., & Kim, S.-H. (2012). Koreans' pronunciation errors of English stop-sonorant sequences and the effect of explicit pronunciation instruction. *The Journal of Humanities Studies*, 40(2), 135-156.
- *Cho, M.-H. (2014). Perception and production of English grapheme <a> by Korean students. *The Journal of the Korea Contents Association*, 14(2), 527-534.
- *Cho, M.-H. (2017). The relationship between perception and production of English grapheme <i> by Korean EFL students. *Journal of the Korea Entertainment Industry Association*, 11(3), 183-190.
- *Cho, M.-H. (2019). Training effect on the perception and production of English grapheme <u> by Korean learners of English. *The Journal of the Korea Contents Association*, 19(11), 226-233.
- *Choe, W. K. (2022). The effect of pronunciation teaching on the realization of English rhythm by Korean learners of English. *Phonetics and Speech Sciences*, 14(2), 19-28.
- *Choi, J.-O. (2007). Teaching English pronunciation and listening skills. *English Language & Literature Teaching*, 13(2), 1-23.
- **Chung, B., & Bong, H. K. M. (2024). The effectiveness of AI-assisted language learning: Possibilities of facilitating the intelligibility of Korean-accented English. *The Journal of Asia TEFL*, 21(3), 520-535.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Mahwah: Lawrence Erlbaum Associates.
- Derwing, T. M., Munro, M. J., & Wiebe, G. (1998). Evidence in favor of a broad framework for pronunciation instruction. *Language Learning*, 48(3), 393-410.
- **Dillon, T., & Wells, D. (2023). Effects of pronunciation training using automatic speech recognition on pronunciation accuracy of Korean English language learners. *English Teaching*, 78(1), 3-23.
- Ding, S., Liberatore, C., Sönsaat, S., Lučić, I., Silpachai, A., Zhao, G., Chukharev-Hudilainen, E., Levis, J., & Gutierrez-Osuna, R. (2019). Golden speaker builder-An interactive tool for pronunciation training. *Speech Communication*, 115, 51-66.
- *Eom, M. (2025). The effectiveness of a structured learning module of YouGlish on English pronunciation and intonation. *Foreign Languages Education*, 32(1), 1-24.
- Fouz-González, J. (2025). Teaching and learning pronunciation with technology: Current possibilities, pedagogical recommendations, and directions for the future. In *Proceedings of the 15th Pronunciation in Second Language Learning and Teaching Conference* (Vol. 15, pp. 1-15).
- Hahn, L. D. (2004). Primary stress and intelligibility: Research to motivate the teaching of suprasegmentals. *TESOL Quarterly*, 38(2), 201-223.
- *Han, J.-I. (2003). Effects of formal instruction on liquid accuracy: A longitudinal study.

Korean Journal of Linguistics, 28(2), 185-206.

- **Han, J.-I. (2009). Effects of using speech-analysis software on Korean college students' pronunciation improvement. *Foreign Languages Education*, 16(2), 79-101.
- Higgins, J. P., & Green, S. (Eds.). (2008). *Cochrane handbook for systematic reviews of interventions*. Chichester: John Wiley & Sons.
- *Hong, S. (2012). A phonetic study on the production and training of English lexical stress by Korean speakers. *The Journal of Modern British & American Language & Literature*, 30(4), 99-122.
- *Hong, S. (2014a). Do non-native speakers of English benefit from acoustic information on English stress? *The Journal of Human Studies*, 33, 3-28.
- **Hong, S. (2014b). Training effects after training Korean listeners for the contrast of English /ɑ, ɔ, ʌ/. *Language and Linguistics*, 65, 299-330.
- **Hong, S. (2017). Effects of perceptual training on the identification of American English monophthongal vowels by Korean listeners. *Studies in Modern Grammar*, 95, 55-80.
- *Hong, S. (2018). The relationship between prosody and reading in English utterances. *Studies in British and American Language and Literature*, 131, 335-353.
- *Hong, S. (2019a). The effects of reading practice on pausing of Korean English learners' utterances. *The Journal of Human Studies*, 50, 103-125.
- *Hong, S. (2019b). A study on production and learning of prosodic phrasing by Korean learners of English. *Studies in British and American Language and Literature*, 135, 187-204.
- *Hong, S. (2020). Pitch accent placement on function words in Koreans' English utterances. *The New Studies of English Language & Literature*, 75, 1-19.
- *Hwang, S., & Cho, H. (2013). An acoustic analysis of English obstruents produced by Korean speakers: focusing on case studies. *The Journal of Humanities Studies*, 46(4), 503-521.
- *Hwang, Y., & Kim, C. (2019). A case study on the improvement of English speaking ability using American drama. *The New Studies of English Language & Literature*, 74, 229-255.
- Hyltenstam, K., & Abrahamsson, N. (2003). Maturation constraints in SLA. In C. J. Doughty, & M. H. Long (Eds.), *The handbook of second language acquisition* (pp. 538-588). MA: Blackwell Publishing.
- **Hyun, I.-S. (2018). Effects of the ASR-embedded dictionary app use on college students in EFL pronunciation class. *Journal of Research in Curriculum & Instruction*, 22(6), 400-413.
- *In, J., & Han, J. (2016). The prosodic changes of Korean English learners in robot assisted learning. *Journal of the Korean Association of Information Education*, 20(4), 323-332.
- *Inceoglu, S., Lim, H., & Chen, W. H. (2020). ASR for EFL pronunciation practice: segmental development and learners' beliefs. *The Journal of Asia TEFL*, 17(3), 824-840.
- *Jang, J. (2016). A study of rhythm and stress through motion-based game activities for elementary English education. *Journal of Research in Curriculum & Instruction*, 20(6), 447-458.
- *Jang, J. (2017). Effects of explicit and implicit instruction on the speech intelligibility of L2 pronunciation. *Studies in Foreign Language Education*, 31(2), 301-326.
- *Jang, J. (2019). Investigating second language pronunciation correlates of accentedness,

- comprehensibility, and intelligibility for young and adult learners of English. *Studies in Foreign Language Education*, 33(1), 289-309.
- *Jang, J. (2020). Comparing explicit and implicit pronunciation instructions on second language intelligibility. *Studies in Foreign Language Education*, 34(1), 413-430.
- *Jang, J. (2021). Effects of L2 English intonation on the development of second language pronunciation: Relations between form-meaning associations and access to meaning. *Studies in Foreign Language Education*, 35(1), 235-248.
- *Jang, J., & Lee, J. (2015). Comparing two types of explicit pronunciation instructions on second language accentedness. *Linguistic Research*, 32, 15-32.
- **Jeong, J.-K., & Chung, H. (2020). Effects of using smartphone applications in teaching English segments on middle school students' listening and pronunciation abilities. *Journal of Learner-Centered Curriculum and Instruction*, 20(23), 459-481.
- *Jeong, S.-Y., & Cho, M.-H. (2015). Relation between perception and production of English vowels by phonetic training. *The Journal of the Korea Contents Association*, 15(2), 542-551.
- *Jeong, S.-Y., & Cho, M.-H. (2016). An acoustic analysis of Korean EFL students' English vowel production: Focused on 'new' English vowel categories. *Korean Journal of English Language and Linguistics*, 16(2), 405-424.
- *Ji, K., & Park, M. (2012). Effects of English suprasegmental element instruction on the perception and production of prominence in discourse and word stress. *Primary English Education*, 18(3), 253-277.
- *Kahng, J. (2006). The effect of pronunciation training on Korean adults learners' perception and production of English Vowels, /i/, /ɪ/, /u/, and /ʊ/. *Foreign Languages Education*, 13(1), 45-65.
- *Kang, H. (2022). A study of English vowel pronunciation by Korean university students with articulatory and auditory training. *The Linguistic Association of Korea Journal*, 30(4), 1-18.
- Kang, O. (2010). Relative salience of suprasegmental features on judgments of L2 comprehensibility and accentedness. *System*, 38(2), 301-315.
- Kang, S. (2026). *Intelligibility-oriented Computer-Assisted Pronunciation Training for Korean middle school EFL learners: A two-phase study of broad and focused instructional scopes* (Doctoral dissertation). Seoul National University, Seoul.
- *Kang, Y. (2025). Characteristics of EFL learners' English pronunciation: A focus on the acquisition of suprasegmental pronunciation of English interrogative sentences. *English Language Teaching*, 37(1), 131-151.
- *Kim, H. (2011). English intonation-raising strategy and its effect on Korean elementary school students' English pronunciation. *The New Korean Journal of English Language & Literature*, 53(4), 203-224.
- *Kim, J. (2021a). A study of the effects of explicit English pronunciation instruction on college learners' pronunciation improvement. *Studies in English Language & Literature*, 47(2), 205-232.
- *Kim, J. (2021b). Pre-service primary teachers' reading English sentences with thought groups

- as grammatical units and their pronunciation improvement. *The Journal of Mirae English Language and Literature*, 26(3), 201-232.
- *Kim, J. D. (2025). The effects of reading aloud on Korean university EFL learners' pronunciation accuracy and learning perceptions: A speech-to-text (STT)-based analysis. *Journal of Language Sciences*, 32(2), 1-28.
- *Kim, J. H., & Yoo, I. W. (2021). Helping Korean adult L2 learners improve their intelligibility with explicit pronunciation instruction. *The Journal of Asia TEFL*, 18(4), 1128-1143.
- *Kim, J.-E. (2007). A phonetic study of Koreans' production of English vowels and their pronunciation pedagogy. *The Linguistic Association of Korean Journal*, 15(15), 41-54.
- *Kim, J.-E. (2009). An acoustic study of English pronunciation correction based on the English pronunciation teaching materials. *The Journal of Studies in Language*, 25(1), 69-84.
- *Kim, J.-E. (2010). Korean speakers' pronunciation and pronunciation training of English stops. *Phonetics and Speech Sciences*, 2(3), 29-36.
- *Kim, J.-E. (2013a). A study on the influence of Korean regional dialects to English vowel pronunciation and correction. *Phonetics and Speech Sciences*, 5(2), 81-90.
- *Kim, J.-E. (2013b). A study on the influence of English vowel pronunciation training on word initial stop pronunciation of Korean English learners. *Phonetics and Speech Sciences*, 5(3), 31-38.
- *Kim, J.-E. (2016). Effects of English suprasegmental teaching by Korean speakers: A phonetic study. *The Jungang Journal of English Language and Literature*, 58(1), 259-273.
- *Kim, J.-E. (2019). A study on the voice onset time of English stops in the textbook reading. *The Linguistic Association of Korea Journal*, 27(1), 29-41.
- *Kim, J.-m. (2005). Stress assignment rules in Korean English. *Studies in Phonetics, Phonology and Morphology*, 11(2), 71-82.
- *Kim, J.-m. (2015). Non-native acquisition of phonological weight: A learnability problem for English vowels produced by Korean learners. *Studies in English Language & Literature*, 41(2), 157-180.
- *Kim, J.-m., Flynn, S., & Oh, M. (2007). Non-native speech rhythm: A large-scale study of English pronunciation by Korean learners. *Studies in Phonetics, Phonology and Morphology*, 13(2), 245-275.
- *Kim, J.-m., & Lee, O.-h. (2005). Reduced vowel quality accounts for Korean accent of English. *Studies in English Language & Literature*, 31(4), 73-93.
- **Kim, J.-S., & Kang, M.-K. (2014). The effects of the Hunminglish pronunciation instruction for Korean adult English learners. *The Journal of Studies in Language*, 30(3), 503-520.
- **Kim, M. (2006). On the effective use of ASR programs in a college class of English phonetics and phonology. *English Language and Linguistics*, 22, 115-132.
- *Kim, M. (2020). A study of rhythm improvements and relevant linguistic factors in the pronunciation of English learners. *Studies in Foreign Language Education*, 34(1), 237-261.
- *Ko, H.-J., & Cha, H.-J. (2018). The effects of repeated narrative shadowing learning on

- Korean university students' English pronunciation and affective attitude. *Korean Journal of General Education*, 12(6), 311-340.
- *Ko, Y.-J. (2010). An effective teaching method of English pronunciation by changing the starting position of the articulator tongue. *Studies in English Language & Literature*, 36(3), 171-200.
- Lee, B., Plonsky, L., & Saito, K. (2020). The effects of perception- vs. production-based pronunciation instruction. *System*, 88, 102185.
- *Lee, H.-L., & Lee, Y. (2015). A comparison of the effects of teacher model reading and audio use on elementary school student's English reading prosody. *Primary English Education*, 21(4), 5-32.
- *Lee, J. (2010). Error patterns for different levels of Korean college students in EIL pronunciation and effects of formal instruction. *The Sociolinguistic Journal of Korea*, 18(2), 159-187.
- *Lee, J.-Y. (2011). The effects of pronunciation instruction using duration manipulation on the perception of English vowel sounds. *English Teaching*, 66(3), 95-122.
- *Lee, J.-Y. (2024). The effects of shadowing activities on EFL university students' English pronunciation and perceptions of English learning. *Convergence Studies in English Language & Literature*, 9(2), 413-439.
- *Lee, K. A. (2023). Improving English pronunciation accuracy among Korean adult learners. *Modern English Education*, 24, 272-283.
- *Lee, O.-S. (2019). Suprasegmental instruction and the improvement of EFL learners' listening comprehension. *English Language & Literature Teaching*, 25(4), 41-60.
- *Lee, S. (2012a). Effects of activities based on the level of cognitive depth on pronunciation learning in elementary English classes. *Journal of the Korea English Education Society*, 11(3), 65-85.
- *Lee, S. (2012b). Effects of analytic activities for segmental phonemes and supra-segmentals learning in elementary English classes. *Studies in English Education*, 17(2), 265-286.
- *Lee, Y. (2020). The effectiveness of explicit form-focused instruction in teaching the schwa /ə/. *The Journal of the Korea Contents Association*, 20(8), 101-113.
- *Lee, Y. (2021). Effectiveness of mobile assisted pronunciation training in the acquisition of English vowels, /o/ and /ɔ/. *Foreign Languages Education*, 28(3), 53-76.
- *Lee, Y.-K. (2021). Using problem-based learning in English pronunciation instruction: Focusing on fricatives. *The Journal of Linguistic Science*, 99, 329-349.
- *Lee, Y.-K. (2023a). Study of focus on form and focus on forms on L2 pronunciation development of English consonant. *Studies in Modern Grammar*, 117, 153-169.
- *Lee, Y.-K. (2023b). Task-based language teaching: An empirical study of EFL pronunciation acquisition. *The New Studies of English Language & Literature*, 86, 179-200.
- *Lee, Y.-K. (2024a). Study on task-based language teaching in L2 pronunciation development. *Studies in Modern Grammar*, 122, 171-188.
- *Lee, Y.-K. (2024b). TBLT implementation and evaluation: English consonantal contrast learning for novice-level Korean EFL learners. *The Journal of Linguistic Science*, 108, 29-48.

- Levis, J. M. (2005). Changing contexts and shifting paradigms in pronunciation teaching. *TESOL Quarterly*, 39(3), 369-377.
- Levis, J. M. (2018). *Intelligibility, oral communication, and the teaching of pronunciation*. Cambridge: Cambridge University Press.
- Li, M., Wang, Y., & Yang, X. (2025). Can generative AI chatbots promote second language acquisition? A meta-analysis. *Journal of Computer Assisted Learning*, 41(4), e70060.
- *Lim, J. (2012). Effects of minimal pair instruction in perceptual discrimination of nonce words by Korean learners of English. *Korean Journal of the Applied Linguistics*, 28(2), 199-219.
- Mahdi, H. S., & Al Khateeb, A. A. (2019). The effectiveness of computer-assisted pronunciation training: A meta-analysis. *Review of Education*, 7(3), 733-753.
- **Min, S., & Pak, H. H. (2007). Teaching pronunciation using sound visualization technology to EFL learners. *English Language & Literature Teaching*, 13(2), 129-153.
- *Moon, S.-J., & Han, H. (2013). A study on the improvement of English speaking skills through tracking. *The Jungang Journal of English Language and Literature*, 55(2), 73-92.
- Munro, M. J., & Derwing, T. M. (1995). Foreign accent, comprehensibility, and intelligibility in the speech of second language learners. *Language Learning*, 45(1), 73-97.
- Nagle, C. (2018). Perception, production, and perception-production: Research findings and implications for language pedagogy. *Contact*, 44(2), 5-12.
- Neri, A., Cucchiari, C., Strik, H., & Boves, L. (2002). The pedagogy-technology interface in computer assisted pronunciation training. *Computer Assisted Language Learning*, 15(5), 441-467.
- Ngo, T. T. N., Chen, H. H. J., & Lai, K. K. W. (2024). The effectiveness of automatic speech recognition in ESL/EFL pronunciation: A meta-analysis. *ReCALL*, 36(1), 4-21.
- Nickolai, D. (2015). *iSpraak* [Computer program]. Retrieved from <https://www.ispraak.net>
- *Noh, Y. (2024). The impact of ChatGPT-assisted learning on English speaking proficiency of Korean university students. *The New Studies of English & Literature*, 89, 89-114.
- O'Brien, M. G., Derwing, T. M., Cucchiari, C., Hardison, D. M., Mixdorff, H., Thomson, R. I., Strik, H., Levis, J. M., Munro, M. J., Foote, J. A., & Muller Levis, G. (2018). Directions for the future of technology in pronunciation research and teaching. *Journal of Second Language Pronunciation*, 4(2), 182-207.
- O'Brien, M. G., & Levis, J. M. (2017). Pronunciation and technology. In *Proceedings of the 8th Pronunciation in Second Language Learning and Teaching Conference* (Vol. 8, pp. 1-9).
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., . . . Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, Article n71.
- *Park, H., & Lee, J. K. (2022). Bidirectional effects of training order on perception and production accuracy of English L2 vowels. *Studies in Phonetics, Phonology and Morphology*, 28(2), 229-257.

- *Park, M. S. (2018). Effects of explicit pronunciation instruction on the development of second language syllable structure. *Studies in English Education*, 23(2), 447-471.
- *Park, N.-Y. (2023). Effects of shadowing practice by text-to-speech app on college students' English speaking ability. *Journal of Language Sciences*, 30(2), 133-163.
- R Core Team (2025). R: A language and environment for statistical computing (version 4.5.1) [Computer software]. Retrieved from <https://www.R-project.org/>
- **Randall, R., Hong, Y., & Nam, H. (2021). The effect of real-time score feedback on L2 English learners' pronunciation and motivation in an ASR-based CAPT system. *Korean Journal of Applied Linguistics*, 37(4), 7-50.
- **Rim, J., & Han, K. (2024). Effects of English classes using AI chat-bot on improvement of English pronunciation and vocabulary abilities of elementary students. *Journal of the Korean Association of Information Education*, 28(3), 303-311.
- Rogerson-Revell, P. M. (2021). Computer-assisted pronunciation training (CAPT): Current issues and future directions. *RELC Journal*, 52(1), 189-205.
- *Rolf, I. N., & Im, S. (2014). Cognitive linguistics and pronunciation: The case for intelligibility. *The Journal of Linguistic Science*, 68, 103-120.
- Saito, K., & Plonsky, L. (2019). Effects of second language pronunciation teaching revisited: A proposed measurement framework and meta-analysis. *Language Learning*, 63(3), 652-708.
- Sakai, M., & Moorman, C. (2018). Can perception training improve the production of second language phonemes? A meta-analytic review of 25 years of perception training research. *Applied Psycholinguistics*, 39(1), 187-224.
- *Son, J. (2014). Can synchronous videoconferencing lessons improve Korean students' English pronunciation? *English Teaching*, 69(1), 199-218.
- *Sung, E. (2008). The effects of computer-assisted pronunciation training in the production of English coda consonants and consonant clusters. *Multimedia-Assisted Language Learning*, 11(3), 46-68.
- Thomson, R. I. (2011). Computer assisted pronunciation training. *Calico Journal*, 28(3), 744-765.
- Thomson, R. I. (2026). *English Accent Coach* (version 4.4) [Computer program]. Retrieved from <https://www.englishaccentcoach.com/>
- Thomson, R. I., & Derwing, T. M. (2015). The effectiveness of L2 pronunciation instruction: A narrative review. *Applied Linguistics*, 36(3), 326-344.
- Trofimovich, P., & Isaacs, T. (2012). Disentangling accent from comprehensibility. *Bilingualism: Language and Cognition*, 15(4), 905-916.
- Uchihara, T., Karas, M., & Thomson, R. I. (2025). High variability phonetic training (HVPT): A meta-analysis of L2 perceptual training studies. *Studies in Second Language Acquisition*, 47(3), 794-827.
- Vančová, H. (2023). AI and AI-powered tools for pronunciation training. *Journal of Language and Cultural Education*, 11(3), 12-24.
- Witt, S. M., & Young, S. J. (2000). Phone-level pronunciation scoring and assessment for interactive language learning. *Speech Communication*, 30(2-3), 95-108.

- **Woo, M., & Kim, J. (2023). Effects of AI PengTalk classes on improvement of English pronunciation abilities and affective factors of elementary students. *Modern English Education*, 24, 26-44.
- *Yang, B. (2015). Production and perception of English vowels by college students before and after lessons. *Phonetics and Speech Sciences*, 7(3), 79-88.
- *Yang, I. Y. (2017). Instructional effects on voice onset time perception in L2 speech segmentation. *Language Research*, 53(3), 561-585.
- *Yang, S.-J. (2020). A study of the effects of animation recording activities on English pronunciation and speaking proficiency. *Secondary English Education*, 13(2), 29-52.
- *Yi, D. (2009). Teaching English stress using a drum: Based on phonetic experiments. *English Language & Literature Teaching*, 15(2), 261-280.
- *Yoo, H.-J., & Lee, E.-J. (2015). The effects of explicit and implicit pronunciation instruction using a movie on middle school students' English listening ability. *Studies in English Education*, 20(4), 111-142.
- *Yoo, S., & Ahn, H. (2024). The effects of prosody training with AI chatbot on the English pronunciation improvement of Korean EFL learners. *Korean Journal of English Language and Linguistics*, 24, 1300-1317.
- *Yoon, K. (2011a). Evaluation of teaching English intonation through native utterances with exaggerated intonation. *Phonetics and Speech Sciences*, 3(1), 35-43.
- **Yoon, K. (2011b). Using the prosody cloning technique in teaching English prosody. *Studies in English Language & Literature*, 37(1), 245-271.
- *Yoon, K., Heo, A.-n., & Ahn, S.-C. (2010). Teaching English intonation through learner utterances with cloned native intonation. *Modern Studies in English Language & Literature*, 54(1), 147-171.
- *Yoon, K., Oh, J.-Y., & Ahn, S.-C. (2010). Teaching English prosody through English poems with cloned native intonation. *The Journal of English Language and Literature*, 56(4), 753-772.
- *Yoon, S. Y. (2011). The impact of blended learning on teaching and learning English pronunciation. *English Teaching*, 66(4), 139-163.
- *Yoon, S. Y. (2013). The effectiveness of online English pronunciation class and students' perspectives. *Multimedia-Assisted Language Learning*, 16(3), 97-123.
- **Yoon, T. (2022). A study on the effects of Read Along by Google with primary ELLs' pronunciation and affective domains. *The Journal of the Korea Contents Association*, 22(10), 437-444.
- *Yoon, T., & Kim, B. (2021). Effects of online tongue twister activities on pronunciation, speaking skills and affective factors of elementary English learners. *The Journal of Educational Development*, 41(2), 287-306.
- *Yu, K.-a. (2021). The effectiveness of communication-oriented pronunciation instruction and students' perception. *Korean Journal of General Education*, 15(3), 253-265.
- *Yuk, J. S., & Chung, H. (2021). The effects of focus-on-form pronunciation instruction on the evaluation of high school students' utterances. *Studies in Foreign Language Education*,

35(3), 225-250.

- *Yun, Y. (2012). The learning effects of English vowels using the phonological information of Korean vowels. *The Journal of Modern British & American Language & Literature*, 30(2), 75-91.
- *Yun, Y. (2014a). Comparison of the effects of pronunciation learning from an English native speaker's correction and self-correction: With focus on English voiced stops and word duration. *English Language & Literature Teaching*, 20(4), 127-143.
- *Yun, Y. (2014b). Research on the effects of pronunciation correction for the English voiced alveopalatal fricative produced by Koreans. *The Jungang Journal of English Language and Literature*, 56(4), 373-390.
- *Yun, Y. (2014c). The effects of two pronunciation correction methods by native speakers of English: With the focus on stress and word durations. *Studies in English Education*, 19(2), 75-95.
- *Yun, Y., & Lee, N. (2012a). Research on the effect of pronunciation training of English diphthongs for Koreans. *Modern Studies in English Language & Literature*, 56(4), 125-145.
- *Yun, Y., & Lee, N. (2012b). Research on the effect of pronunciation training of English unaspirated stops for Koreans. *Language and Linguistics*, 57, 141-158.
- *Yun, Y., & Lee, N. (2013a). Research on English voiced stops and lax vowels produced by Koreans. *Language and Linguistics*, 61, 81-110.
- *Yun, Y., & Lee, N. (2013b). Research on the effect of training of vowel durations influenced by the voicing features of the word-final consonants. *The Jungang Journal of English Language and Literature*, 55(4), 443-464.

In Young Yang

Associate Professor

Department of English Language and Literature

Korea National University of Transportation

50, Daehak-ro, Chungju 27469, Korea

E-mail: inyoun@ut.ac.kr

Seongseog Park

Associate Professor

Department of Korean Education

Chuncheon National University of Education

126, Gongji-ro, Chuncheon-si, Gangwon-do 24328, Korea

E-mail: pasusk@cnue.ac.kr

Received: July 9, 2026

Revised version received: August 6, 2026

Accepted: August 20, 2026

Appendix A. Complete Search Strategy

The final search was conducted in the Korea Citation Index (KCI) on July 28, 2026. Each search term was entered separately using the same search settings; therefore, no single combined Boolean search string was used.

Search field: KCI Integrated Search

Publication years: Up to 2025 (no lower year limit)

Subject categories: Humanities, Social Science, and Interdisciplinary Studies

Journal status: KCI Excellent Accredited and KCI Accredited journals

The exact search terms were as follows:

English pronunciation

영어 발음

L2 pronunciation

제2언어 발음

외국어 발음

English consonant

English consonants

영어 자음

English vowel

English vowels

영어 모음

English suprasegmental

English suprasegmentals

영어 초분절음

English prosody

영어 운율

English rhythm

영어 리듬