Scientific Research Publishing

Open Journal of Modern Linguistics, 2026, 16(2), 203-226
https://www.scirp.org/journal/ojml
ISSN Online: 2164-2834
ISSN Print: 2164-2818

English Dental Fricatives by L1 Portuguese Speakers in Cabinda: Substitution Patterns and Pedagogy

Nestor Zau Bachi

Instituto Superior Politécnico de Cabinda (ISPC), Universidade 11 de Novembro, Cabinda, Angola
Email: renildonestor@gmail.com

How to cite this paper: Bachi, N. Z. (2026). English Dental Fricatives by L1 Portuguese Speakers in Cabinda: Substitution Patterns and Pedagogy. *Open Journal of Modern Linguistics, 16,* 203-226.
https://doi.org/10.4236/ojml.2026.162014

Received: March 9, 2026
Accepted: April 25, 2026
Published: April 28, 2026

Abstract

The present study explores the production of English dental fricatives /θ/ and /ð/ in L1 Portuguese, with a particular focus on this under-studied population whose legacy European Portuguese influences are increasingly flanked by more pronounced Brazilian varieties and strong Bantu influence within constant contact. In this paper, we report ongoing classroom-based action research aiming to identify patterns of substitution and effects of phonological context through both acoustic and perceptual analysis of recordings produced by 18 university learners taking English at Instituto Superior Politécnico de Cabinda (ISPC), Angola. The results indicate that /θ/ is predominantly realized as [f] (41.2%), followed by [s] (28.7%), whereas /ð/ is most commonly realized as [d] (51.9%) and secondarily as [z] (26.9%). Word-final position shows the highest error rates. Acoustic measurements confirm that substitutions have a different spectral signature from native interdentals, with drastically different Center of Gravity values (Cohen's d > 2.0). These acoustic differences indicate possible intelligibility effects, which will need to be directly tested for confirmation. The abundance of differences sustains the equivalence schema, favoring the familiar articulation. The results suggest pedagogical strategies such as explicit articulatory instruction, focused minimal pair training, and tailored curriculums for healthcare students.

Keywords

Acoustic Analysis, Dental Fricatives, English as a Foreign Language, L1 Portuguese, Phonological Transfer

1. Introduction

The English language has become the global lingua franca of science, technology,

international relations, and higher education. In Angola of yesteryears, post-war reconstruction of national life, coupled with the upkeep and encouragement of economic links to the global community, remains an exceedingly entrancing yet daunting challenge, but English proficiency correlates positively with socioeconomic prosperity. This is particularly true in Cabinda, one of Angola's provinces, whose unusual geopolitical and economic characteristics demand communicative competence in English due to international collaboration within the oil sector as well as an uptick in inter-academic exchange.

On the institutional level, English as a Foreign Language (EFL) is piloted under distinct educational contexts. Some of these are health courses and higher degrees, for example, at the Instituto Superior Politécnico de Cabinda (ISPC), a filial institute of Universidade 11 de Novembro. The researcher, a lecturer of English for first- and second-year students in undergraduate degree programs at ISPC, has already deduced some common pronunciation problems that hinder their ability to access scientific publications written in English about their fields of study, properly comprehend technical language, and communicate successfully within professional environments.

For learners of English from Portuguese-speaking backgrounds, probably the most persistent challenge is the production of dental fricatives. In both Standard Southern British English and General American English, the voiceless dental fricative /θ/ (as in "think," "bath") and the voiced dental fricative /ð/ (as in "this," "mother") exist. The raising of the tongue tip to the upper teeth creates a narrow constriction that allows for turbulent airflow. These phonemes do not belong to the phonological inventory of any variety of Portuguese (European, Brazilian, or African). European, Brazilian and African varieties of Portuguese have minor phonetic realizational differences between each other (there are Angolan dialects too, reflecting the complex relation between historical European Portuguese roots and modern Brazilian influences), yet lack phonemic interdental fricatives features as well; thus learners face a task shared by the Lusophone world. In both Angolan Portuguese and native Bantu languages, these sounds do not exist in a similar way, making them sound foreign or non-existent to learners who must fit them into existing mental schemes.

A basic tenet of second language acquisition research is the Contrastive Analysis Hypothesis (CAH), which states that phonemes missing in learners' first languages (L1) will be uniquely problematic for L2 acquisition and cause negative transfer at the phonological level (McCallum et al., 2025). Newly confronted with L2 sounds that may be unfamiliar to them, they default to the closest phonemes available in L1. The literature reports frequent substitutions of /θ/ with [f] (labiodental fricative), [s] (alveolar fricative), or even rarely [t] (alveolar stop) among Portuguese speakers. Systematic as these replacements may be, they can generate perceptual confusion and unintelligibility. For example, the Arabic equivalent of "think" could be pronounced [fiŋk] as in fink.

Three studies have shown that speakers of European Portuguese (EP) (Liza et

al., 2021) and Brazilian Portuguese (BP) (Zimmer & Alves, 2012) produce English dental fricatives, but nothing has been reported in connection with Angolan learners of English. Another, more recent work by Osborne and Simonet (2021) examined the creation of new phonetic categories by Brazilian Portuguese learners of English and found that learning a foreign language leads to first-language phonetic drift. In a similar fashion, Bettoni (2022) showed that perceptual training led to significantly improved production accuracy for Brazilian learners in the speech sound contrast study group, with an eight-month retention period and even twelve years later, identifying relevant pedagogical pathways for those pertinent to this study. For example, Fonseca Quesada (2024) explored substitution patterns of the English voiced interdental fricative by L1 Costa Rican Spanish speakers and found that substitution patterns are dependent on both phonological context and task type, confirming positional effects similar to those under examination in this study.

Very Angolan linguistic ecology alone 1) adapted Angolan Portuguese (AP), the result of hybridization between old historical EP and new input through Brazilian socialization in audio-visual media, forms a profile that is different from either; 2) Bantu languages, such as Fiote (Ibinda), Kikongo, and Bakuta, are additional to Portuguese output, particularly in Cabinda; so cross-linguistic influence will be complex; and 3) challenges to English language education with regard to teacher training, resources available for learning the spoken language, and exposure. (The province of Cabinda is geographically separated from the rest of Angola by a swath of DR Congo and Republic of Congo, hence potentially shows unique linguistic features.) The whole phonetic literature is completely mute as to this localized context.

This research serves to help bridge this gap by adding empirical data specifically rooted in a defined Angolan context. A lecturer at ISPC took on this challenge as an action research project, and its results have immediate practical import for pronunciation instruction, with relevant findings that can serve to stimulate greater local awareness of the implications of linguistic understanding involving L2 English phonology in varieties of African Portuguese. This work is informed by the call of McCallum et al. (2025) to situate research within local contexts and develop a responsive research culture for the particular linguistic ecologies in which we operate. This drive to action-informing-research underpins the approach taken here.

Overall goal: Analysing the production of dental fricatives in L3, /θ/ and /ð/, through acoustic and perceptual characterisation by ISPC students. These goals are as follows: 1) to identify the most common substitutions for /θ/ and /ð/, respectively; 2) to examine the frequency of these substitutions according to phonological context; 3) to measure and compare acoustic properties between students' productions, relative to a native English control speaker; and 4) to propose pedagogical possibilities that might be applied by EFL instructors in Cabinda.

Thus, the specific research questions guiding this study are:

What are the phonological substitutions that L1 Portuguese students based in Cabinda tend to use when producing /θ/ and /ð/?

Are these substitutions position dependent?

What are the acoustic differences between students' and native speakers' productions?

Given the acoustic properties of these production patterns, what are the implications for intelligibility?

2. Methods

2.1. Research Design

We use a mixed-methods approach, combining both perceptual (trained listeners identify stimuli) and acoustic (spectral measurements using Praat software) analysis. In this design, the researcher also served as the teacher in the classroom; thus, within the action research methodology framework, the study began where findings would directly inform pedagogical practice.

2.2. Research Sites and Participants

The research was carried out at Instituto Superior Politécnico de Cabinda (ISPC), which is an academic unit of Universidade 11 de Novembro, in Cabinda, Angola. Participants and Procedure The sample included 18 first- and second-year students (12 females; 6 males; aged between 18 - 24 years; mean age: 20.3 years), studying qualification outcomes for Clinical Analysis and Clinical Psychology from an L1 Portuguese-speaking cohort.

Purposeful sampling was used to recruit participants from six class sections (three students/section). Selection of students from each of the six sections (three Clinical Analysis, three Clinical Psychology) who met the inclusion criteria and represented the spectrum of English proficiency demonstrated during class interaction (beginner, intermediate, advanced speakers irrespective of course performance) was conducted. This maintained a balance between language variety and manageable sample sizes for acoustic characterization. Participants met the inclusion criteria, which were 1) regular enrollment at ISPC, 2) self-reported L1 Portuguese, and 3) signed informed consent. The years of study varied from 2 - 8 years (mean 4.3 years). With respect to multilingual background, 12 (66.7%) of the participants spoke Fiote/Ibinda at home, while 4 (22.2%) were reported to speak Kikongo and only 2 (11.1%) Portuguese.

Also, a 32-year-old male native speaker of General American English and native of the Midwest United States who had no such history was used as a control participant to make baseline recordings. The control speaker recorded one list of words (12 target words) three times for a total of 36 tokens for /θ/ and 36 tokens for /ð/ (total: 72 native tokens). This led to the creation of 72 tokens that were used as the reference for all acoustic comparisons with learner productions.

2.3. Ethical Considerations

All recordings were done in a sound-proofed classroom at the ISPC. Institutional authorization was previously obtained from the Direção of ISPC for data collection. Approval was obtained from the ethics committee of Universidade 11 de Novembro. All participants, in Portuguese, received a Termo de Consentimento Livre e Esclarecido (TCLE), which describes the purpose and procedures of the study, confidentiality measures to guarantee anonymity, and voluntary participation with the right to withdraw at any stage. Data collection took place after consent forms had been signed.

2.4. Instructions

2.4.1. Linguistic Profile Questionnaire

A brief questionnaire in Portuguese was administered to characterize the sample:

- "What is your native language?" (What is your mother tongue?)
- "Do you speak any other language at home? (e.g., Fiote, Kikongo, etc.)" (Do you speak any other language at home?)
- "Há quantos anos estuda Inglês?" (How many years have you studied English?)
- "Has he/she had contact with native English speakers?" (Have you spoken to native speakers of English?)
- "Do you, when you speak Portuguese, try to speak more like a Portuguese from Portugal or Brazilian?" (Do you focus on sounding like Portuguese from Portugal or Brazilian when you speak Portuguese?)

Coding of Questionnaire Responses

The following coding scheme was implemented to map open-ended and multiple-choice responses into the categorical variables shown in Table 1.

- **Home Language**: The responses to "Fala alguma outra língua em casa?" were coded as follows:
  - "Portuguese only" = participant reporting that only Portuguese is spoken at home
  - "Portuguese + Fiote/Ibinda" = participant reported that they speak Fiote/Ibinda in addition to Portuguese
  - "Portuguese + Kikongo" = self-reported Kikongo speaker who reported Portuguese.
- **EP/BP Alignment**: Answers to "Quando fala português, tenta falar mais como português de Portugal ou como brasileiro?" were coded as:
  - "Prefer EP" = subject-defined preference for European Portuguese pronunciation
  - "Prefer BP" = whether the participant indicated a preference for Brazilian Portuguese pronunciation.
  - No preference = participant indicated no conscious preference or responded "both."
- **Contact with Native Speakers**: "Yes" = the participant reported any previous

contact (i.e., conversation, classes) with native speakers of English; "No" = no such interaction.

Table 1. Participant characteristics.

Characteristic	Category	n	%
Gender	Female	12	66.7
	Male	6	33.3
Home Language	Portuguese only	2	11.1
	Portuguese + Fiote/Ibinda	12	66.7
	Portuguese + Kikongo	4	22.2
EP/BP Alignment	Prefer EP	5	27.8
	Prefer BP	8	44.4
	No preference	5	27.8
Contact with Native Speakers	Yes	3	16.7
	No	15	83.3

Note: Age range: 18 - 24 years (M = 20.3 years). Years of English study: range 2 - 8 years (M = 4.3 years). Coding procedures for all categorical variables are described in Section 2.4.1.

2.4.2. Word List

A targeted word list was designed to elicit productions of /θ/ and /ð/ in different phonological contexts. Words were chosen based on their frequency in English and their suitability for the participant population. (Table 2)

Table 2. Target words by phonological context.

Phoneme	Position	Word	IPA	Lexical Set
/θ/	Initial	think	/θɪŋk/	THOUGHT
/θ/	Initial	thumb	/θʌm/	STRUT
/θ/	Initial	three	/θriː/	FLEECE
/θ/	Medial	author	/ˈɔːθə/	NORTH
/θ/	Medial	method	/ˈmeθəd/	DRESS
/θ/	Medial	birthday	/ˈbɜːθdeɪ/	NURSE
/θ/	Final	teeth	/tiːθ/	FLEECE
/θ/	Final	bath	/bɑːθ/	BATH
/θ/	Final	mouth	/maʊθ/	MOUTH
/θ/	Final	north	/nɔːθ/	NORTH
/ð/	Initial	this	/ðɪs/	KIT
/ð/	Initial	that	/ðæt/	TRAP

Continued

/ð/	Initial	though	/ðəʊ/	GOAT
/ð/	Medial	mother	/ˈmʌðə/	STRUT
/ð/	Medial	brother	/ˈbrʌðə/	STRUT
/ð/	Medial	feather	/ˈfeðə/	DRESS
/ð/	Final	breathe	/briːð/	FLEECE
/ð/	Final	bathe	/beɪð/	FACE
/ð/	Final	smooth	/smuːð/	GOOSE
/ð/	Final	clothe	/kləʊð/	GOAT

Note: PA follows the Standard Southern British English model used for the stimuli. Distractors: sun, fish, cat, dog, book, pen, house, car.

To prevent participants from guessing the focus of the study, distractor words were interspersed throughout the list. Word order was randomized for each participant using a Latin square design to control for order effects. To control for coarticulation effects and ensure a consistent prosodic context, each target word was embedded in a carrier sentence: "I say _____ now."

2.5. Procedures

Recordings were all carried out in the ISPC room, which was quiet with only one participant at a time. Each of them was around a 15 - 20 minute session. The audio recording device was an Audio-Technica ATR2100x-USB cardioid dynamic microphone (head-mounted configuration), with a Zoom H1n portable digital recorder (WAV file, sample rate 44.1 kHz and bit depth of 16-bit) as the main equipment for recording, and Audacity software was used to record onto a computer as a backup system.

The procedure was as follows:

1) Participants sat comfortably and wore a head-mounted microphone at the corner of the mouth (2 - 3 cm from the corner).

2) The researcher described the task: Each participant would read a single word on a card, then speak the full carrier sentence out loud, as if they were talking to someone normally.

3) Participants first read a practice list with five distractor words to familiarize themselves with the task.

4) One card at a time, the full word list (target words and distractors, randomized) was presented. To obtain sufficient data for acoustic analysis and to allow for possible within-speaker variation, there were two elicited tokens per target word per participant. To reduce practice effects, there were at least five distractor items between the two repetitions. Both repetitions were included in all subsequent perceptual and acoustic analyses.

5) If there was a clear reading error (e.g., realizing that the participant misread

the word), it was read again at the end.

6) Recordings were stored with codes that anonymized participants. 2.6. Data Analysis

2.5.1. Percentual Analysis

The researcher and a second judge (a colleague trained in phonetics) listened independently to all recordings, phonetically transcribing the fricative portion of each target word. The relevant fricative segment was identified and transcribed for the medial and final positions.

A coding scheme was developed as follows:

- /θ/ or /ð/ produced accurately → coded as TARGET
- Substituting /θ/ with [f] → coded F
- Substituting /θ/ with [s] → coded as S
- Replacement of /θ/ by [t] → coded as T
- (D) /ð/ → [d]
- Replacement of /ð/ with [z] → coded as Z
- Replacement of /ð/ with [v] → scored as V
- Other substitutions → noted separately

To evaluate inter-rater reliability, we computed Cohen's kappa ($\kappa = 0.89$), which suggested strong agreement. Disagreements were settled by discussion and consensus.

2.5.2. Acoustic Analysis

Praat (Boersma & Weenink, 2023) was used for acoustic analysis. After running both recordings in Praat, subjects were able to locate the target fricative in the spectrogram. The beginning and end of the frication noise were marked by manually setting boundaries. Onset was the first instance of aperiodic energy, and offset was defined as the end of aperiodic energy or the beginning of periodic vocalic energy. The following acoustic measures were extracted using a Praat script: a) Fricative Duration (ms), b) Center of Gravity (Hz)—the weighted mean of the frequency spectrum computed using Praat's default settings (power spectral analysis; range 0 - 22,050 Hz), and c) Standard Deviation (Hz)—the spread of the spectrum.

2.5.3. Statistical Analysis

Frequencies and percentages of substitution patterns were calculated. A chi-square test was conducted to determine whether there is a relationship between phonological context and the type of substitution. The acoustic measurements were compared using independent samples t-tests (students vs. native speaker), with Cohen's d reported for effect sizes. It is worth pointing out that these comparisons are exploratory, consisting of repeated measures from 18 learners (multiple tokens per learner) compared to a single control speaker's productions. Although independent samples t-tests are robust for the identification of large effect sizes in this exploratory analysis, results need to be interpreted with that caveat.

The main role of these comparisons is to provide a scale of acoustic variation (via Cohen's d), not necessarily to make strong inferential statements about population parameters.

3. Findings

3.1. Perceptual Analysis Results

A total of 432 target productions were analyzed (18 participants × 12 target words × 2 repetitions). Inter-rater reliability was high (Cohen's κ = 0.89).

Table 3. Substitution patterns for /θ/ (N = 216 tokens).

Production	Frequency (n)	Percentage (%)
Correct [θ]	28	13.0
Substitution [f]	89	41.2
Substitution [s]	62	28.7
Substitution [t]	32	14.8
Other	5	2.3
Total	**216**	**100**

Table 3 presents the distribution of productions for target /θ/. The most frequent substitution is [f] (41.2%), followed by [s] (28.7%) and [t] (14.8%). Correct production of [θ] occurred in only 13.0% of tokens, confirming the difficulty that this sound poses for learners.

Table 4. Substitution patterns for /ð/ (N = 216 tokens).

Production	Frequency (n)	Percentage (%)
Correct [ð]	31	14.4
Substitution [d]	112	51.9
Substitution [z]	58	26.9
Substitution [v]	8	3.7
Other	7	3.2
Total	**216**	**100**

Table 4 shows the distribution for target /ð/. Stop substitution [d] predominates (51.9%), followed by [z] (26.9%). Correct production is slightly higher than for /θ/ at 14.4%, though this difference is not statistically significant, χ^2 (1, N = 432) = 0.18, $p > 0.05$. The appearance of [v] as a substitution (3.7%) is notable and may reflect influence from Bantu languages, where /v/ is common.

3.2. Positional Variation

Analysis by phonological context revealed systematic variation in substitution

patterns across word positions.

Table 5. Positional variation in /θ/ production (%).

Position	Correct [θ]	[f]	[s]	[t]
Initial	18.1	35.2	31.5	15.2
Medial	15.3	38.9	29.2	16.6
Final	5.6	49.5	25.4	19.5

Table 5 displays substitution rates by word position for /θ/. The word-final position shows the lowest correct production (5.6%) and the highest rate of [f] substitution (49.5%). A chi-square test confirmed a significant association between position and substitution type, χ^2 (6, N = 216) = 24.6, $p < 0.001$.

Table 6. Positional variation in /ð/ production (%).

Position	Correct [ð]	[d]	[z]	[v]
Initial	19.4	48.1	28.7	3.8
Medial	16.7	50.9	27.8	4.6
Final	6.9	56.7	24.1	12.3

Table 6 presents positional variation for /ð/. As with /θ/, the word-final position shows the lowest correct production (6.9%) and the highest substitution rate (56.7% [d]). The association between position and substitution type is significant, χ^2 (6, N = 216) = 31.2, $p < 0.001$. Notably, [v] substitutions increase in the final position (12.3%), possibly reflecting a strategy to maintain voicing while avoiding the more marked [ð] in the coda position.

3.3. Acoustic Analysis Results

3.3.1. Center of Gravity (CoG)

Center of Gravity is a key acoustic parameter that distinguishes fricative place of articulation. Higher CoG values (typically above 4000 Hz) characterize alveolar fricatives [s, z], while lower CoG values (below 3000 Hz) characterize labiodental fricatives [f, v] and dental fricatives [θ, ð] (Jongman, 2024).

Table 7. Center of Gravity (CoG) values for /θ/ and substitutions.

Production	Mean CoG (Hz)	SD	t-value	*p*	Cohen's d
Native [θ]	2850	320	—	—	—
Student [θ]	2790	410	0.62	>0.05	0.16
Student [f]	1980	290	12.4	<0.001	2.8
Student [s]	5620	680	18.2	<0.001	4.1
Student [t]	(burst only)	—	—	—	—

Note: Native speaker tokens: n = 36 for /θ/. Student tokens: [θ] n = 28, [f] n = 89, [s] n = 62. Statistical comparisons are exploratory (see Section 2.6.3).

Table 7 reports mean Center of Gravity values for target /θ/ and its substitutions. Student productions judged as correct [θ] do not differ significantly from native values, $p > 0.05$, d = 0.16, indicating that when learners produce the target accurately, they approximate native acoustic norms. [f] substitutions show significantly lower CoG, d = 2.8, consistent with labiodental articulation, while [s] substitutions show significantly higher CoG, d = 4.1, consistent with alveolar place. The large effect sizes indicate that these acoustic differences are not only statistically significant but also perceptually salient.

Table 8. Center of Gravity (CoG) values for /ð/ and its substitutions.

Production	Mean CoG (Hz)	SD	t-value	p	Cohen's d
Native [ð]	2710	340	—	—	—
Student [ð]	2680	390	0.48	>0.05	0.08
Student [d]	(burst only)	—	—	—	—
Student [z]	5480	620	16.8	<0.001	3.9
Student [v]	1850	280	10.2	<0.001	2.4

Note: Native speaker tokens: n = 36 for /ð/. Student tokens: [ð] n = 31, [z] n = 58, [v] n = 8. Statistical comparisons are exploratory (see Section 2.6.3).

Table 8 presents CoG values for /ð/ and its substitutions. As with /θ/, correct student productions are acoustically similar to native tokens, $p > 0.05$, d = 0.08. [z] substitutions show significantly elevated CoG, d = 3.9, while [v] substitutions show significantly reduced CoG, d = 2.4, confirming the perceptual classifications.

The acoustic analysis confirms the perceptual categorization: substitutions identified as [f] or [v] show significantly lower CoG than target dentals, while substitutions identified as [s] or [z] show significantly higher CoG. These differences align with the acoustic properties of these sounds in Portuguese, suggesting that learners are mapping English interdentals onto acoustically similar L1 categories.

3.3.2. Duration

The duration of frication also varied by substitution type, reflecting the inherent durational properties of these sounds in Portuguese.

Table 9. Duration of frication by production type.

Production	Mean Duration (ms)	SD
Native [θ]	112	18
Student [θ]	108	22
Student [f]	95	15
Student [s]	142	28
Student [z]	138	26

Table 9 displays the mean duration of frication for target and substituted sounds. Labiodental substitutions [f] are shorter than target dentals, while alveolar substitutions [s, z] are longer. This pattern reflects the inherent durational properties of these sounds in Portuguese, where /f/ is typically brief and /s, z/ are relatively long, particularly in intervocalic position. The durational differences may contribute to the perceptual distinctiveness of these substitutions.

4. Discussion

4.1. Summary of Main Findings

The current research focused on the production of English dental fricatives /θ/ and /ð/ by L1 Portuguese learners from Instituto Superior Politécnico de Cabinda (ISPC). The results reveal:

1) High substitution rates: Overall, /θ/ and /ð/ were correctly produced less than 15% of the time, confirming findings that these sounds were difficult for learners whose L1 does not contain interdental fricatives.

2) Consistent substitution patterns: /θ/ was predominantly realized as [f] (41.2%), followed by [s] (28.7%). /ð/ was realized most frequently as [d] (51.9%), followed by [z] (26.9%).

3) Positional effects: Below 7% of both sounds were produced correctly in the word-final position, showing coda position is a difficult region compared with other locations.

4) Results of the acoustic verification: Spectrograms confirmed that substitutes phonetically identified as [f] or [v] result in central frequencies significantly lower than those framed by a spectrogram external identifiers referring to these sounds in Portuguese and similar perceptually, also just with significant work expectancy central frequencies higher than expected for identification of sound substituents recorded as [s] and/or [z]. Effect sizes ($d > 2.0$ for all comparisons) show that these acoustic differences are large and perceptually salient.

4.2. Interpretation of the Results

The substitution patterns are aligned with predictions of the Contrastive Analysis Hypothesis: if a structure (sound contrast) is not present, negative transfer will manifest as learners mapping novel sounds onto the closest L1 categories. Liza et al. (2021) provide an extensive overview of teaching English pronunciation to Portuguese speakers, detailing some specific issues related to phonemes not present in the L1 inventory, including dental fricatives. But CAH alone cannot explain the different patterns for voiced vs. voiceless targets, nor does it provide a consistent account of positional asymmetries. The Speech Learning Model (Osborne & Simonet, 2021) offers a more elegant explanation for this: equivalence classification based on perceived similarity hampers the establishment of new categories—this effect is particularly pronounced in late learners who have already established L1 categories.

These acoustic analyses support that substituted tokens have different spectral

properties than target interdentals. The lower center of gravity for the labiodental articulation corroborates the front cavity length, indicative of [f]/[v] substitutions; whereas, a higher center of gravity winning out in [s]/[z] substitutions reflects a smaller constriction orifice and a more anterior position characteristic of alveolar fricatives (Jongman, 2024). There are perceptual consequences of these types of acoustic differences: native listeners rely on continuous spectral-noise cues to identify interdentals, and non-continuant deletion leads the listener to shift phonetic categorization towards other phonemes.

The positional effects (higher error rates word-finally) are consistent with universal markedness patterns; coda consonants are known to be acquired less easily than onsets (Eckman, 1977). However, the striking regularity of word-final substitution—exaggerated /f/ for [θ], exaggerated /v/ for [ð]—suggests that learners may be weighing the preservation of frication (via labiodental substitutes) more heavily than place match in this difficult position.

4.3. The Cabinda Context: Possible Influence

The linguistic landscape of Cabinda might account for the trends seen. Two-thirds of the participants reported using Fiote/Ibinda at home. Fiote, a Bantu language, has a phonological inventory that differs from Portuguese in ways likely to be relevant for English interdental production:

1) Phonetic inventory: Fiote does not have dental fricatives, but it has a full set of labiodental fricatives /f, v/ and alveolar fricatives /s, z/. It is probable that these are sounds with which Fiote is familiar, making them easier to substitute than stops; this realization in part helps explain the substantially higher proportion of fricative substitutions (41.2% [f] + 28.7% [s] = 69.9% for /θ/; 26.9% [z] + 3.7% [v] = 30.6% for /ð/). Adnyani (2021) observed similar phonological cross-linguistic influence in a bilingual child's acquisition of sounds, where sounds existing in the dominant language were used to replace foreign sounds unavailable in the non-dominant language.

2) Phonotactic transfer: Fiote syllable structure is predominantly open (CV). This means that, according to some theories, speakers may have an implicit expectation for syllables to end with a vowel (Gonçalves et al., 2022), who argue about substrate influence on African Portuguese varieties, as they mention languages from manual Bantu families typically emphasize open syllable structures. This could explain the relatively poorer performance on word-final consonants observed in this study. The greater number of [f] and [v] substitutions in the final position may reflect a general strategy of keeping some frication but avoiding the more marked dental place at coda.

3) Obstruents differ significantly in voicing: Fiote has clearly contrastive voicing distinctions in obstruents, which may help account for the relatively high level of use of [v] as a substitution for /ð/ (3.7%)—as this pattern has not been reported very frequently in studies involving European Portuguese or Brazilian Portuguese learners.

This combination of dual influence adds another layer of complexity to Angolan Portuguese itself. The patterns of substitution appear to reflect transfer from a monolithic L1 Portuguese, but also variable relevance to norms for European Portuguese vs. Brazilian Portuguese. If BP-like dental stop allophones [t̪, d̪] immediately precede /i/, speakers may associate this articulation more closely with English interdentals than with fronted alveolar stops, so they are less likely to substitute a fronted alveolar stop for an English interdental and vice versa. This could be attained if such speakers retain the production of EP alveolar stops [t, d], leading to a less merged place of articulation. Phonological variation and change in Brazilian Portuguese are discussed in detail by Battisti (2021), who describes how processes like regressive palatalization of /t, d/ are variable and socially salient. In 2025, Alves used information theory to investigate lexical and grammatical differences between varieties of Portuguese spoken in Brazil and Europe (Alves, 2025), confirming that the two languages had diverged significantly from one another. While PT-based/MT alignment data are shown in this study (**Table 1**), the low cohort number limits subgroup analysis. The much higher rate of [f] substitution (41.2% in this study) relative to some BP studies (e.g., Zimmer & Alves, 2012) may suggest a manner-preserving preference that reflects some degree of EP influence, but more direct testing with a much larger sample is needed to support such a claim.

Please note that the proposed effects of Fiote/Ibinda as well as EP/BP alignment are still in their speculative stages. Due to the absence of direct comparative data from monolingual Portuguese speakers in Angola, or controlled subgroup analyses according to home language, these interpretations should be considered hypotheses for future testing. The present data are suggestive of interesting tendencies that merit further exploration but do not allow for causal inferences about the role of Bantu language contact or EP/BP variation specifically.

4.4. Comparison with Previous Research

A fairly uniform picture appears, which is consistent with studies of European (Liza et al., 2021) and Brazilian Portuguese learners (Zimmer & Alves, 2012), albeit it must be interpreted with caution, as Angolan Portuguese cannot fully reflect either variety. You could say that instead, though—it is a borderline unique hybrid with roots in historical EPs but influenced by contemporary BP. According to Liza, Silva & Soares (2021), pronunciation teaching for Portuguese speakers has to take into consideration the phonological features of their own variety of L1—European or Brazilian—and this principle is fully valid and should also be considered in the Angolan context.

The percentage for /θ/ substitution rate (41.2%) seems rather higher than what has been measured in some Brazilian studies (e.g., Zimmer & Alves, 2012: ~30% - 35%). One possible explanation, as noted, is that wonks about Angolan Portuguese claim that this display of EP inheritance: in speech with alveolar stops [t, d], they may consider less place overlap between those and the interdentals in English and so preserve manner more using the labiodental [f]. In sum, BP speakers with

dental stop allophones may detect more similar place and therefore tend to make substitutions of [s] that retain alveolar place. The Angolan rate, which is intermediate between EP and BP patterns in some respects but closer to the former for preferences involving [f], may represent a case where both varieties exert an influence, with an older EP substrate ultimately having more weight than exposure to more recent BP media. The evidence of dialectal differences in Portuguese assumes that there are two underlying rhotics (Zhou & Jesus, 2021 — and although Lisbon and Carioca varieties differ), thus reinforcing the assertion that EP and BP do not have a common phonological system.

The results are also consistent with Fonseca Quesada (2024), who notes that cross-linguistic influence in the production of dental fricatives is conditioned by the phonological characteristics of a specific L1 variety and the phonological context where this sound appears. For instance, in the African EFL context, Garou (2023) investigated the interdental fricative production acoustically by Cameroonian ESL learners and concluded that the sounds are easier to produce at initial and medial positions but harder at the final position, where systematic substitution with [f] and unreleased stops was found. Likewise, Vinte and Mataruca (2024) evaluated pronunciation challenges faced by Mozambican EFL teacher trainees and discovered that although the voiced dental fricative /ð/ is present in Echuwabo (a Bantu language), the voiceless does not prove easy to produce; substitution errors were thus common. For example, Fauzi (2021) explored the variation of phonology in interlanguage produced by Indonesian learners and identified that English fricatives show phonological variations according to word position, and substitutions appear due to the generalization of pronunciation and the absence of certain sounds in the learner's native language.

A notable example of this is the substitution of /ð/ by [v], which occurred in 3.7% of tokens, possibly as a result of substratal influence (i.e., Bantu languages) rather than from Portuguese transfer. This pattern has not been widely reported in other EP or BP studies and may therefore represent a signature feature of the Cabinda setting.

The observed positional effects (higher error rates word-finally) are consistent with universal markedness hierarchies (Eckman, 1977), and the results of both EP and BP studies support the idea of intrinsic coda difficulty regardless of L1 phonotactics. However, the relative increase in [f] and [v] in final position may also be reinforced by open-syllable preferences in BP as well as local Bantu languages.

4.5. Implications for Intelligibility

The ensuing discussion touches on possible effects on intelligibility owing to the acoustic features recorded in this study. However, no direct perception task was conducted and thus these implications are speculative and call for empirical follow-up studies involving the judgment of native listeners. The substitutions described here have differing impacts on intelligibility, depending on which contrast is modulated. (**Table 10**)

Table 10. Intelligibility consequences of substitution patterns.

Substitution	Example	Potential Confusion	Functional Load
/θ/ → [f]	"think" → "fink"	think/fink, three/free	Moderate
/θ/ → [s]	"think" → "sink"	think/sink, thought/sought	High
/ð/ → [d]	"then" → "den"	then/den, though/dough	High (function words)
/ð/ → [z]	"breathe" → "breeze"	breathe/breeze	Moderate

Zhang et al. (2021) related the perception and production of English fricatives by Chinese learners of English, reporting that substitution errors are common for L2-applied speakers, with patterns attributable to negative transfer from the first language, hypercorrection of other sounds, and acoustic similarities. They also found that perception and production are not necessarily correlated, indicating that learners may need training in both modalities.

As all participants are healthcare students who will require English communication skills when communicating with patients and other professionals or dealing with mechanisms of action, miscommunication in a clinical setting where breathing can be confused with breeding could lead to serious consequences. The especially high rates of [d] substitution for /ð/ are particularly problematic, as they target high-frequency function words (this, that, then, the) critical for discourse cohesion.

4.6. Pedagogical Implications for ISPC and Cabinda

As this study reflects an action research project, its principal contribution is in its direct applicability to teaching practice at ISPC. An acoustic analysis reveals a lower CoG (mean 1980 Hz) for the [f] substitutions than for /θ/ (2850 Hz), but a higher one for [s] substitutions (5620 Hz). This means that learners not only do not "hit" the target, but also select acoustically different alternatives. Therefore, perception training should not attempt to "fix" errors but rather expand learners' perceptual space so that it includes the intermediate CoG range that constitutes true interdentals.

Emphasizing the value of explicit articulatory instruction and perceptual training, Liza et al. (2021) highlight practical guidance for English pronunciation instruction for Portuguese speakers. Their work informs the pedagogical approach promoted here. Öztürk (2025) showed that using speech corpora can enhance the phonemic awareness of L2 English speakers, especially for dental fricatives, by providing them with authentic targets of desired sounds and visual feedback. In the Brazilian context, Penha et al. (2025) studied students' perspectives on phonetics and phonology courses, revealing that students face challenges such as understanding new terminology or sounds that do not occur in Portuguese, but acknowledge their significance to their training for becoming educators.

Since EP and BP are not equally influential on the phonology of learners' L1, it

means that teachers will have to bear one more important factor in mind: each student has a different starting point in perceiving sounds. As stated earlier, those speakers of BP who use dental-like stops regularly may gain from explicit contrasts between [t̪] ~ [θ], as those contrasts preserve a distinction between full mouth closure and continuous frication. On the other hand, for those with alveolar stops as their target sound, L1 alveolar stops are a close match to EP, so less emphasis will need to be placed on place of articulation. As a result, instruction should be responsive to individual differences.

Informed by the empirical findings of this study, here are some proposed strategies:

4.6.1. Explicit Articulatory Instruction

It turns out that many students know nothing about dental fricatives. Diagrams and modeling of simple articulatory descriptions do wonders. This acoustic investigation demonstrates that when students produce correct [θ] or [ð], they do so acoustically indistinguishably from native tokens ($p > 0.05$, d < 0.2), which shows that the motor power is there—it just needs to be activated repeatedly. (Table 11)

Table 11. Articulatory instructions for dental fricatives.

Sound	Instruction	Acoustic Target
/θ/	"Place your tongue between your teeth and blow air gently. Feel the air on your tongue."	Continuous noise, CoG 2500 - 3500 Hz
/ð/	"Same position, but now vibrate your vocal cords—you should feel a buzzing sensation."	Mixed harmonic + noise, CoG 2400 - 3400 Hz

4.6.2. Perception Training with Acoustic Support

Students cannot produce a sound correctly without having perceived it. Minimal pair discrimination exercises can train perception, with more information included through spectrogram visualizations indicating where target sounds are in relation to common substitutions. The kind of perceptual training approach that is being put forth here is supported by the findings of Bettoni (2022), who reported consistent facilitation in L2 production as a result of high-variability phonetic training with immediate feedback, effects that were retained even after eight months and twelve years. In a meta-analysis of high-variability phonetic training, Mahdi and Mohsen (2024) discovered an overall medium to large effect size (g = 0.77) on L2 pronunciation, with effect sizes "particularly pronounced for consonant sounds." In a study, Ruhmke-Ramos and Delatorre (2011) focused on the relationship between training or instruction and the perception of two English interdental fricatives by intermediate Brazilian EFL learners, claiming that their data did not reveal significant immediate results, but considering the topic of the long-term improvement hypothesis that has since been argued, it could prove counterproductive to discourage pronunciation instruction in class contexts based solely on immediate manifestation data. (Table 12)

Table 12. Minimal pair training with acoustic cues.

Contrast	Minimal Pairs	Acoustic Difference
/θ/ vs. /f/	think/fink, three/free, bath/baff	CoG: 2,850 Hz vs. 1980 Hz
/θ/ vs. /s/	think/sink, thick/sick, mouth/mouse	CoG: 2850 Hz vs. 5620 Hz
/ð/ vs. /d/	then/den, though/dough, breathe/breed	Continuous noise vs. burst
/ð/ vs. /z/	close/clothes, breeze/breathe	CoG: 2710 Hz vs. 5480 Hz

Showing students spectrograms of their own productions compared with target tokens can make the acoustic differences visible and provide clear targets for practice.

4.6.3. Position-Specific Practice

Given the higher error rates in the word-final position, explicit practice with coda fricatives is essential. The data show that correct production drops from ~18% in the initial position to below 7% in the final position, indicating that this context requires focused attention. (Table 13)

Table 13. Position-specific word lists.

Position	/θ/ words	/ð/ words
Initial	Think, thumb, three, throw	This, that, those, though
Medial	author, method, birthday	mother, brother, feather
Final	teeth, bath, mouth, north, health	breathe, bathe, smooth, clothe

4.6.4. Integration with Professional Vocabulary

In the case of Clinical Analysis and Psychological Clinic students, practice must be contextualized according to their area of training, promoting motivation and enabling learning through relevant lexico-grammatical content. More broadly, Saito (2021), in a meta-analysis of the phonological, rater, and instructional factors in L2 pronunciation, arrives at the finding that instruction is associated with larger gains in comprehensibility as opposed to nativelikeness, and that effects appear larger when treatment taps into prosodic accuracy. Using an explicit-implicit dimension in speech perception, Stratton (2023) presented acoustic evidence that shows how specifically focusing on pronunciation produces better results than implicit training in the L2 classroom; that is to say, learners approach target-like phonological features through perceptually adjustable gradients. Explicit articulatory phonetics instruction has been systematically reviewed for its impact on Spanish L1 learners of English (Pacheco Vasquez & Veas Aguirre, 2025); across interventions, it is consistently shown to have stronger positive outcomes than standard implicit methodologies at enhancing both segmental precision and functional intelligibility; these mechanisms are found to most boost L2 articulation when implemented by leveraging tactile feedback, gap identification,

as well as visual models of articulation. (Table 14)

Table 14. Professional vocabulary for healthcare students.

Profession	/θ/ vocabulary	/ð/ vocabulary
Healthcare	Thermometer, therapy, thrombosis, anesthesia, atherosclerosis	Breathe deeply, this medication, that symptom, whether

4.6.5. Workshop for ISPC EFL Teachers

The researcher will lead a workshop with colleagues teaching English at ISPC, presenting: a) results from this study using acoustic data; b) practical suggestions for teaching dental fricatives that are sensitive to EP/BP variability; c) materials designed to be used in the classroom, including spectrogram activities; and d) ideas for continued action research. In their call for collaborative research cultures within applied linguistics, McCallum et al. (2025) encourage advocates of the aforementioned methodologies to take concrete steps toward building such a culture at ISPC, and this workshop was our first attempt at doing so.

5. Conclusions and Suggestions

It is the first investigation examining how English dental fricatives are used by L1 Portuguese learners at ISPC in Angola. The findings corroborate that /θ/ and /ð/ are especially difficult for these speakers, revealing systematic substitution patterns according to the phonological context. The reporting of high [f] and [d] for /θ/ and /ð/, respectively, is also in good company with what has been observed elsewhere in multiple Portuguese varieties and the difficulties presented by Liza et al. (2021), for instance, concerning the production of these sounds by Portuguese learners more generally—but Cabinda's multilingual backdrop makes Bantu language influence even harder to disentangle.

Acoustic analyses reveal that substituted tokens have none of the defining spectral properties of target interdentals, a phenomenon which likely has ramifications for perceptual intelligibility. Positional effects reveal that the word-final position is particularly problematic, again suggesting universal markedness hierarchies along with the asymmetric treatment of codas in a dynamic situation conditioned by EP inheritance, BP contact influence, and Bantu substrate.

Above all, this study shows why Angolan Portuguese should not be classified as EP-based versus BP-based. Its hybrid construction — both historical EP roots with a contemporary linguistic BP overlay, and ongoing contact with Bantu languages — creates an acquisitional context that is singular and must be understood on its own terms. Migge et al. (2025) offer thorough descriptions of (post)colonial varieties of European languages and indicate that the diffusion of Portuguese, like other European languages, has given rise to varieties in unique contact situations requiring local study עודף. Kupisch et al. (2022) examined structural and phonological cues in monolingual and bilingual children acquiring German, revealing a distinction within acquisition contexts that highlights the complexity of cross-lin-

guistic influence.

The substitution patterns that appear to exist are thus, somewhat surprisingly, sophisticated, although we should acknowledge that the available data do not allow us to definitively ascribe any pattern of substitution to any given source of influence. A sketch only, the following you may speculate, might play a role:

- EP features that may originate from the influence of, along with: alveolar stop articulations, codas, formal speech.
- BP influence: dental stop allophones, open syllable preference in casual speech
- CV template, labiodental and alveolar fricatives: Bantu language influence

Such hypothesized influences would need to be confirmed by controlled comparative studies, including suitably matched monolingual and bilingual groups.

Conducting action research as a classroom teacher, this study highlights one of the advantages of situated, context-specific investigation in identifying solutions to pedagogical challenges. At ISPC, the results are immediately actionable because instruction can be tailored to local data on pronunciation difficulties. The pedagogical recommendations—ranging from explicit articulatory instruction, to perception training with aural support, position-specific practice, and incorporation of professional vocabulary along with teacher workshops—offer a practical scaffold for how to tackle the challenges documented here. Recent studies (e.g., Inceoglu, 2021) showed that explicit teaching, together with pronunciation awareness through self-reflective journals, can substantively enhance L2 phonetic development; thus supporting the pedagogical approach proposed here. After analysing pronunciation issues faced by South African foundation students, Demana (2025) also called for explicit phonetics instruction and the use of technology to enhance pronunciation as well as teacher training for teachers as practical solutions.

Several limitations should be acknowledged. The sample size of 18 participants from a single institution limits generalizability. The word-list reading task may lead to more careful speech than in spontaneous production and could thus relate positively to accuracy. This alone provided some insights, but Center of Gravity and duration were the only acoustic parameters analyzed—others could prove helpful as well. Concerns about how naturalistic assessment relates to speech production outside the clinic were previously addressed by Tienkamp et al. (2023), who showcased a clinical phonetic analysis of spontaneous speech and highlighted its utility for future research, including contrastive studies between read and spontaneous output. Attention perception data were never collected, so the relationship between perception and production was not explored. Kostromitina & Plonsky (2022) offered a meta-analysis of elicited imitation tasks as L2 proficiency measures and discussed potential methodologies for future perception studies. A meta-analysis by Chen (2022) specifically explored the effect of mobile learning on English teaching effectiveness and proposed adding technology-enhanced instruction into future educational interventions.

Future studies would expand the scope of this exploration through 1) larger-

scale studies in other Angolan institutions; 2) perceptual studies investigating the perception-production relationship; 3) longitudinal research investigating developmental trajectories and differences between language groups at different ages and grades; and finally, 4) intervention trials where teaching methods are empirically evaluated. For instance, Coulter-Kern (2021) investigated the acquisition of the interdental fricative in Spanish by study-abroad students and highlighted the importance of longitudinal research for understanding phonological development. Significantly, Hui et al. (2022) examined bilingual prefabs and code-switching before identifying that habitual language mixing might correlate with differing processing patterns — a research avenue worth exploring in the multilingual Cabinda environment. Vignoli (2024) investigated the perception of interdental fricatives by Italian learners and suggested a methodological framework for examining dialectal effects. Muller et al. (2024) focused on multiword adverbs in Brazilian Portuguese and European Portuguese and offered differences between both in their analysis, reaffirming that these varieties continue to diverge, which might influence L2 acquisition.

In providing new empirical data from the relatively under-studied context of Angolan Portuguese, this investigation thus makes a dual contribution: to theoretical work on hybrid L1 phonological transfer systems and knowledge that can inform EFL teaching practices in Angola's complex multilingual ecologies. Ingram and Babatsouli (2024) highlight that research into how children acquire phonology across languages needs to include the full spectrum of phonological systems, and this study adds to this goal by documenting patterns in an underrepresented context. The findings are expected to illuminate the work of ISPC's students and teachers, as well as engender additional linguistic research on Angola's rich linguistic landscape.

Acknowledgements

The authors would like to thank the students of Instituto Superior Politécnico de Cabinda for their involvement in this study and express gratitude to the Head of ISPC for institutional authorization; thanks also go to the ethics committee of Universidade 11 de Novembro, who approved the protocol. We also thank a second listener for assistance with perceptual analysis and colleagues who commented on the manuscript.

Conflicts of Interest

The author has no conflicts of interest to declare in relation to this paper.

References

Adnyani, N. L. P. S. (2021). Cross-linguistic Influence on a Bilingual Child's Phonological Development. In *Proceedings of the Thirteenth Conference on Applied Linguistics (CONAPLIN 2020)* (pp. 367-373). Atlantis Press. https://doi.org/10.2991/assehr.k.210427.056

Alves, D. (2025). Information Theory and Linguistic Variation: A Study of Brazilian and European Portuguese. In *Proceedings of the 12th Workshop on NLP for Similar Languages, Varieties and Dialects* (pp. 9-19). Association for Computational Linguistics. https://aclanthology.org/2025.vardial-1.2/

Battisti, E. (2021). Phonological Variation and Change in Brazilian Portuguese. In M. Aronoff (Ed.), *Oxford Research Encyclopedia of Linguistics*. Oxford University Press. https://doi.org/10.1093/acrefore/9780199384655.013.488

Bettoni, M. (2022). Immediate and Long-Term Effects of a Perceptual Training in the Production of Word-Initial /s/-Clusters in Brazilian Portuguese/English Interphonology. *Cadernos de Estudos Linguísticos, 64,* e022039. https://doi.org/10.20396/cel.v64i00.8668047

Boersma, P., & Weenink, D. (2023). *Praat: Doing Phonetics by Computer (Version 6.3) [Computer Software].* http://www.praat.org/

Chen, M. (2022). The Impact of Mobile Learning on the Effectiveness of English Teaching and Learning—A Meta-Analysis. *IEEE Access, 10,* 38324-38334. https://doi.org/10.1109/access.2022.3165017

Coulter-Kern, M. D. (2021). The Acquisition of the Interdental Fricative in the Spanish of Study Abroad Students in Seville, Spain. *IULC Working Papers, 21,* 1-30.

Demana, N. V. (2025). Pronunciation Challenges of English Vowels among South African Foundation Students: Phonological Interference and Pedagogical Implications. *Gender and Behaviour, 23,* 24381-24395.

Eckman, F. R. (1977). Markedness and the Contrastive Analysis Hypothesis. *Language Learning, 27,* 315-330. https://doi.org/10.1111/j.1467-1770.1977.tb00124.x

Fauzi, I. (2021). The Variability in Phonology of Indonesian Learner's Interlanguage: A Case Study on English Marked-Fricatives. *International Journal of Language Education, 5,* 285-295. https://doi.org/10.26858/ijole.v5i4.19468

Fonseca Quesada, F. (2024). Substitution Patterns of the English Voiced Interdental Fricative by L1 Costa Rican Spanish Speakers. *Isogloss. Open Journal of Romance Linguistics, 10,* 1-10. https://doi.org/10.5565/rev/isogloss.284

Garou, A. (2023). An Acoustic Investigation of the Production of Interdental Fricatives by Cameroonian ESL Learners. *British Journal of Applied Linguistics, 3,* 15-24. https://doi.org/10.32996/bjal.2023.3.2.2

Gonçalves, R., Duarte, I., & Hagemeijer, T. (2022). Dative Microvariation in African Varieties of Portuguese. *Journal of Portuguese Linguistics, 21,* 1-39. https://doi.org/10.16995/jpl.8488

Hui, N., Fong, M. C., & Wang, W. S. (2022). Bilingual Prefabs: No Switching Cost Was Found in Cantonese-English Habitual Code-Switching in Hong Kong. *Languages, 7,* Article 198. https://doi.org/10.3390/languages7030198

Inceoglu, S. (2021). Exploring the Relationship between Explicit Instruction, Pronunciation Awareness, and the Development of L2 French Connected Speech Processes. *Language Awareness, 30,* 336-354. https://doi.org/10.1080/09658416.2021.1881527

Ingram, D., & Babatsouli, E. (2024). Cross-Linguistic Phonological Acquisition. In M. J. Ball, N. Müller, & E. Spencer (Eds.), *The Handbook of Clinical Linguistics* (2nd ed., pp. 457-470). Wiley Blackwell. https://doi.org/10.1002/9781119875949.ch29

Jongman, A. (2024). Phonetics of Fricatives. In M. Aronoff (Ed.), *Oxford Research Encyclopedia of Linguistics*. Oxford University Press. https://doi.org/10.1093/acrefore/9780199384655.013.1086

Kostromitina, M., & Plonsky, L. (2022). Elicited Imitation Tasks as a Measure of L2 Proficiency. *Studies in Second Language Acquisition, 44,* 886-911. https://doi.org/10.1017/s0272263121000395

Kupisch, T., Geiss, M., Mitrofanova, N., & Westergaard, M. (2022). Structural and Phonological Cues for Gender Assignment in Monolingual and Bilingual Children Acquiring German. Experiments with Real and Nonce Words. *Glossa: A Journal of General Linguistics, 7.* https://doi.org/10.16995/glossa.5696

Liza, B. H., Silva, T. C., & Soares, V. H. M. (2021). Ensino de pronúncia do inglês. *Colineares, 8,* 2-20. https://periodicos.apps.uern.br/index.php/RCOL/article/view/3441

Mahdi, H. S., & Mohsen, M. A. (2024). Enhancing Pronunciation Learning through High Variability Phonetic Training: A Meta-analysis. *Language Teaching Research Quarterly, 40,* 29-45. https://doi.org/10.32038/ltrq.2024.40.02

McCallum, L., Tafazoli, D., & Al-Hoorie, A. H. (2025). *Research Cultures in Applied Linguistics and TESOL.* Applied Linguistics Press.

Migge, B., Cardoso, H. C., Farquharson, J. T., Krämer, P., & Sippola, E. (2025). Commonalities of (Post)Colonial Varieties of European Languages (Dutch, English, French, Portuguese, Spanish). In J. Darquennes, J. C. Salmons, & W. Vandenbussche (Eds.), *The Routledge Handbook of Eurolinguistics* (pp. 345-358). Routledge. https://doi.org/10.4324/9781032647715-26

Muller, I., Mamede, N., & Baptista, J. (2024). Differentiating Brazilian and European Portuguese Multiword Adverbs. *Revista da Associação Portuguesa de Linguística, No. 11,* 136-163. https://doi.org/10.26334/2183-9077/rapln11ano2024a7

Osborne, D. M., & Simonet, M. (2021). Foreign-language Phonetic Development Leads to First-Language Phonetic Drift: Plosive Consonants in Native Portuguese Speakers Learning English as a Foreign Language in Brazil. *Languages, 6,* Article 112. https://doi.org/10.3390/languages6030112

Öztürk, C. Y. (2025). Using a Speech Corpus to Raise Phonemic Awareness among L2 English Speakers: Production and Substitution of Dental Fricatives. In H. Cangır, K. Uzun, T. Can, & E. Oğuz (Eds.), *Exploration of the Intersection of Corpus Linguistics and Language Science* (pp. 133-156). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3693-8146-5.ch007

Pacheco Vasquez, E. A., & Veas Aguirre, S. J. (2025). The Efficacy of Explicit Articulatory Phonetics Instruction in L2 Pronunciation Acquisition: A Systematic Review of Pedagogical Approaches for Spanish L1 Learners of English. *Boletín Científico Ideas y Voces, 5,* 427-448. https://doi.org/10.60100/bciv.v5i3.266

Penha, L. B., De Lima, L. A. S., & Silva Jr., L. (2025). Phonetics and Phonology in Letras-Inglês: Some Perceptions of Brazilian Students in Paraíba. *Aracê, 7,* 26041-26071. https://doi.org/10.56238/arev7n5-289

Ruhmke-Ramos, N. K. (2011). *The Effects of Training and Instruction on the Perception of the English Interdental Fricatives by Brazilian EFL Learners.* Master's Thesis, Universidade Federal de Santa Catarina.

Saito, K. (2021). What Characterizes Comprehensible and Native-Like Pronunciation among English-As-A-Second-Language Speakers? Meta-Analyses of Phonological, Rater, and Instructional Factors. *TESOL Quarterly, 55,* 866-900. https://doi.org/10.1002/tesq.3027

Stratton, J. M. (2023). Explicit Pronunciation Instruction in the Second Language Classroom: An Acoustic Analysis of German Final Devoicing. *Journal of Second Language Pronunciation, 9,* 71-102. https://doi.org/10.1075/jslp.22038.str

Tienkamp, T. B., van Son, R. J. J. H., & Halpern, B. M. (2023). Objective Speech Outcomes after Surgical Treatment for Oral Cancer: An Acoustic Analysis of a Spontaneous Speech Corpus Containing 32.850 Tokens. *Journal of Communication Disorders, 101,* Article ID: 106292. https://doi.org/10.1016/j.jcomdis.2022.106292

Vignoli, A. (2024). *The Effect of L1 Variety on the Perception of Interdental Fricatives by Italian Learners of L2 English.* Master's Thesis, Università Ca'Foscari Venezia.

Vinte, J. V., & Mataruca, C. Q. (2024). Pronunciation Problems Encountered by Mozambican EFL Teacher Trainees in Higher Education. *American International Journal of Education and Linguistics Research, 7,* 1-11. https://doi.org/10.46545/aijelr.v7i1.325

Zhang, B., Zhang, J., & Lee, S. (2021). Perception and Production of English Fricatives by Chinese Learners of English: Error Patterns and Perception-Production Relationship. *Phonetics and Speech Sciences, 13,* 25-36. https://doi.org/10.13064/ksss.2021.13.1.025

Zhou, C., & Jesus, A. (2021). Portuguese Has Two Underlying Rhotics: Evidence from Lisbon and Carioca Varieties. *Proceedings of the Annual Meetings on Phonology, 9,* 1-7. https://doi.org/10.3765/amp.v9i0.5167

Zimmer, M. C., & Alves, U. K. (2012). Uma visão dinâmica da produção da fala em l2: O caso da dessonorização terminal. *Revista da Abralin, 11,* 221-272. https://doi.org/10.5380/rabl.v11i1.32467