

MARKEDNESS-BASED ACCOUNT OF PRODUCTION–PERCEPTION ASYMMETRIES IN UZBEK LEARNERS’ ACQUISITION OF ENGLISH FRICATIVES

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Abstract

This article reports a production–perception study of English fricatives by Uzbek learners of English, with a focus on markedness and the extent to which perception predicts production. Forty upper-intermediate to advanced Uzbek EFL learners (mean age = 28) completed (i) a controlled reading task and (ii) a listening discrimination task targeting six English fricatives: /θ, ð, s, z, ʃ, ʒ/. Responses (N = 960 tokens per task) were coded for accuracy and checked by three trained raters with acoustic verification in Praat. Overall, perception accuracy (88.85%) significantly exceeded production accuracy (81.24%), supporting the perception-first account of L2 segmental acquisition ($p < .05$). Marked fricatives absent from Uzbek (/θ, ð/) and a low-frequency loanword phoneme (/ʒ/) showed disproportionate production difficulty, with /ð/ produced least accurately (62.50%). Substitution patterns reflected strong L1 transfer: /θ/ → /s/ and /ð/ → /θ, z/ were frequent, and /ʒ/ was often realized as /dʒ/. Perception–production correlations varied by segment; /θ/ showed a strong positive association ($r = .532, p = .001$), whereas most other fricatives showed weak or negligible correlations. The findings refine markedness-based predictions by showing that markedness can affect production more than perception, and they motivate integrated perception–production training for interdental and postalveolar fricatives in Uzbek EFL contexts.

Keywords

Uzbek EFL learners; English fricatives; markedness; speech perception; speech production; /θ/ /ð/ /ʒ/

1. Introduction

English fricatives are typologically rich and often problematic in second-language (L2) phonological acquisition because small articulatory and acoustic differences can carry lexical contrasts (Stonham, 2018). For Uzbek learners of English, the challenge is intensified by cross-linguistic mismatches: Uzbek lacks interdental fricatives /θ/ and /ð/, and the voiced postalveolar fricative /ʒ/ is limited largely to loanwords (Abduazizov, 2007). In classroom contexts, learners therefore rely on perceptually and articulatorily similar native categories—commonly /s, z, t, d/—to approximate unfamiliar targets (Swan & Smith, 2001).

Beyond segment inventory differences, English orthography adds complexity because grapheme–phoneme mappings are inconsistent, particularly for “th”, which can represent /θ/ (thin) or /ð/ (then) (Celce-Murcia et al., 1996; Isroilov, 2021). These factors make Uzbek learners a theoretically and pedagogically relevant population for testing claims about (i) whether perception precedes production and (ii) how markedness conditions the learnability of new segments.

Two long-standing positions frame the perception–production debate. The perception-first view holds that accurate perception is typically established before stable production, so learners may identify contrasts they still cannot reliably articulate (Major, 2001; Rauber et al., 2005). In contrast, production-first accounts argue that articulatory practice or explicit instruction can lead to relatively accurate production even when perceptual categories remain unstable (Ladefoged, 1967; Sheldon & Strange, 1982). Empirical findings are mixed and appear to vary by segment class, learning context, and proficiency (Joh & Lee, 2001; Lee, 2011).

This study contributes evidence from six fricatives (/θ, ð, s, z, ʃ, ʒ/) in an under-researched L1–L2 pairing. The analysis is guided by Markedness Theory, which predicts greater difficulty

for typologically rarer or structurally complex segments (Eckman, 1977; Haspelmath, 2006). We test whether marked fricatives show larger production–perception gaps than unmarked fricatives and whether individual differences in perception predict production accuracy.

2. Theoretical background

2.1 Markedness and fricative learnability. Markedness has been used to explain asymmetries in phonological inventories and acquisition by positing that some contrasts are more complex, less frequent, or harder to implement (Trubetzkoy, 1931; Maddieson, 1984). In L2 phonology, markedness-informed versions of the Contrastive Analysis Hypothesis predict that segments absent from the learner's L1 and typologically uncommon will be especially difficult to acquire (Eckman, 1977; Haspelmath, 2006). Interdental fricatives /θ/ and /ð/ are relatively rare cross-linguistically, and /ʒ/ is also less common than its voiceless counterpart /ʃ/ (Gimson, 1980; Gordon, 2016).

For Uzbek learners, these marked sounds are expected to trigger substitution and category assimilation. Prior work across learner groups reports common replacements such as /θ/→/s/ or /t/ and /ð/→/z/ or /d/, reflecting reliance on close native categories (Brannen, 2011; Cutler et al., 2004; Swan & Smith, 2001). Within Uzbek-focused work, interdental fricatives are frequently described as among the most persistent pronunciation difficulties (Tukhtasinova & Zokirova, 2016), and earlier empirical studies report systematic substitution patterns (Aminjonov et al., 2024; Tulanboev, 2023).

2.2 Perception, production, and their relationship. Models of L2 speech learning differ in the proposed directionality between perception and production. Perception-first approaches emphasize that learners must form robust auditory categories to guide motor targets; consequently, perceptual improvement should often predict production gains (Major, 2001; Flege, 1991). Many studies report higher accuracy in perception than production for difficult segments, including fricatives (Joh & Lee, 2001; Owolabi, 2012; Evans & Alshangiti, 2018).

However, production-first findings also exist, especially under explicit training conditions. Learners may acquire an articulatory routine through instruction or imitation that allows them to produce a contrast that they still identify unreliably (Ladefoged, 1967; Sheldon & Strange, 1982; Bohn & Flege, 1990). Because results vary across segments and contexts, a useful empirical strategy is to evaluate both group-level differences (e.g., task accuracy gaps) and individual-level covariation (e.g., correlations between perception and production).

3. Method

3.1 Participants. A total of forty Uzbek learners of English (mean age = 28) participated in the study, with proficiency levels ranging from upper-intermediate to advanced. Twenty participants held TOEIC certificates and twenty held IELTS certificates; IELTS scores were converted to TOEIC for standardization, yielding an average TOEIC-equivalent score of 770. None had lived in an English-speaking country, and none reported speech or hearing impairments. Thirty participants had completed introductory phonetics/phonology coursework and were enrolled in English-related degree programs; ten were majoring in Business Administration or Information Technology.

3.2 Materials. The stimulus set comprised 24 words (4 per target fricative) designed to elicit /θ, ð, s, z, ʃ/ in initial and final positions and /ʒ/ in initial, medial, and final positions. For perception, each stimulus word was paired with a minimal pair differing by a single segment, and items were recorded by an American male speaker.

3.3 Procedure. The perception test was administered first to minimize learning effects. Participants completed a listening discrimination task by selecting which word they heard from each minimal-pair set. Afterward, participants completed a production test by reading the 24-word list aloud in a quiet room and submitting recordings to the researcher.

3.4 Scoring and analysis. Three trained researchers jointly evaluated each production token for fricative accuracy. Disagreements were resolved via acoustic inspection in Praat (spectrograms and voicing cues). For both tasks, each token was coded as correct (1) or incorrect (0), yielding $N = 960$ observations per task (4 words \times 6 phonemes \times 40 participants). Descriptive statistics summarized accuracy by segment. A paired-samples t-test compared perception and production accuracy. Pearson correlations tested whether individual perceptual accuracy predicted productive accuracy for each fricative and overall.

4. Results

4.1 Production accuracy and markedness effects. Table 1 summarizes production accuracy for the six fricatives. Unmarked fricatives that have clear Uzbek counterparts (/s, z, ʃ/) showed high accuracy, with /ʃ/ near ceiling (98.75%). In contrast, marked fricatives (/θ, ð, ʒ/) were substantially less accurate. The voiced interdental /ð/ was produced least accurately (62.50%), consistent with the prediction that absent and typologically rarer segments impose higher articulatory demands (Eckman, 1977; Haspelmath, 2006).

Table 1. Production test accuracy

Note: ($N = 960$ data from 4 words \times 6 phonemes \times 40 participants)

Sound	Token	Mean score (MS)	Accuracy rate (%)
θ	4	2.93	73.12
ð	4	2.50	62.50
s	4	3.72	93.12
z	4	3.48	86.88
ʃ	4	3.95	98.75
ʒ	4	2.92	73.12
Total	24	3.25	81.24

4.2 Substitution patterns in production. Substitution analyses clarify how learners cope with difficult segments by mapping them onto familiar L1 categories. Table 2 shows the most frequent replacements. Interdentals were typically realized as alveolar fricatives: /θ/ was most often produced as /s/ (16.25%) and /z/ (8.12%), while /ð/ was frequently substituted as /θ/ (16.87%) or /z/ (13.75%). The voiced postalveolar fricative /ʒ/ was commonly produced as the affricate /dʒ/ (23.12%), suggesting reliance on a perceptually similar but articulatorily more stable category (Brannen, 2011; Cutler et al., 2004).

Table 2. Substitution patterns in the production test

Target	Sub No.1 (%)	Sub No.2 (%)	Sub No.3 (%)	Sub No.4 (%)
/θ/	s (16.25)	z (8.12)	ð (1.87)	t (0.87)
/ð/	θ (16.87)	z (13.75)	s (3.75)	d (3.12)
/s/	z (6.25)	θ (0.62)	—	—
/z/	s (12.50)	θ (0.62)	—	—

/f/	tʃ (0.62)	ʒ (0.62)	—	—
/z/	dʒ (23.12)	ʃ (2.50)	g (1.25)	—

Note: Percentages are calculated over 160 tokens per phoneme (4 words × 40 participants).

4.3 Perception accuracy. Table 3 reports perception accuracy. Overall perception was high (88.85%), including for marked fricatives /θ/ (86.25%) and /ð/ (91.25%). The near-ceiling performance for /ʃ/ (97.50%) mirrors production results and suggests that this segment is relatively easy for Uzbek learners. Importantly, marked segments did not show the same degree of perceptual difficulty as in production, indicating that learners can often identify rare segments before they can implement them reliably in articulation (Major, 2001; Owolabi, 2012).

Table 3. Perception test accuracy (N = 960 tokens)

Sound	Tokens	Mean score (max=4)	Accuracy (%)
θ	4	3.45	86.25
ð	4	3.65	91.25
s	4	3.40	85.00
z	4	3.50	87.50
ʃ	4	3.90	97.50
ʒ	4	3.43	85.62
Total	24	3.55	88.85

Note. Scores represent mean correct identifications per four tokens.

4.4 Comparing production and perception. Figure 1 compares accuracy across tasks. Paired-samples tests show that perception significantly exceeded production for /θ/, /ð/, and /z/ and for the overall score (all $p \leq .005$). Interestingly, /s/ showed the reverse pattern, with production higher than perception ($p = .008$). For /z/ and /ʃ/, the differences were not significant. The global pattern supports a perception-first account while also indicating that task asymmetries may be segment-specific.

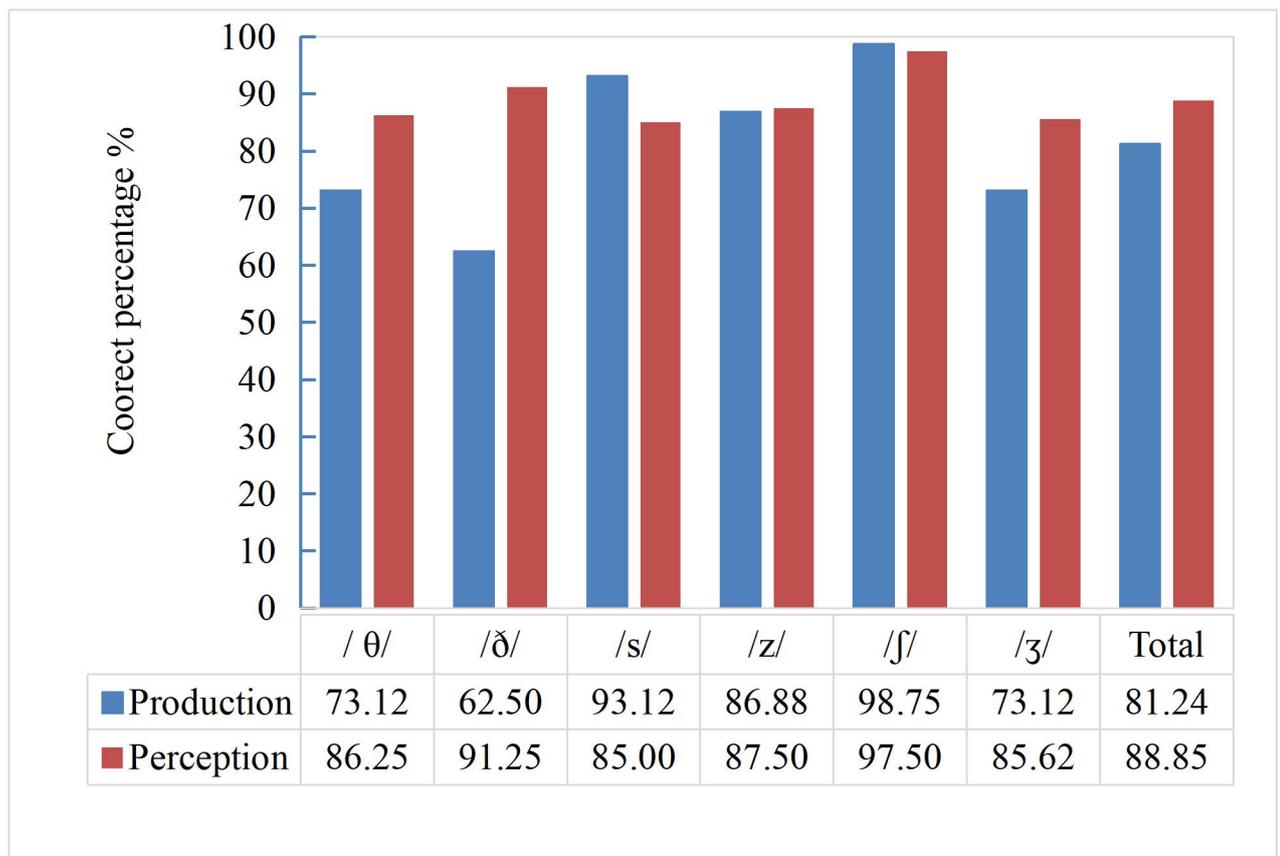


Figure 1. Mean accuracy rates (%) for perception and production by fricative.

4.5 Perception–production correlations. Pearson correlation test shows that the relationship between perception and production was not uniform across segments. The strongest association emerged for /θ/ ($r = .532, p = .001$), indicating that individuals who identified /θ/ more accurately were also more likely to produce it correctly. By contrast, /ð/, /s/, /z/, and /ʃ/ showed near-zero correlations, and /ʒ/ showed a small-to-moderate positive trend that did not reach conventional significance ($p = .094$). Overall performance showed a weak but significant positive correlation ($r = .233, p = .001$). This pattern suggests that for some marked segments, perceptual mastery may be a meaningful (but not sufficient) condition for production accuracy (Flege, 1991; Sakai & Moorman, 2018).

5. Discussion

5.1 Does perception precede production? At the group level, perception outperformed production for the overall score, and the gap was largest for the two interdental fricatives. This supports the widely reported pattern that learners can build auditory distinctions before they stabilize new articulatory routines (Major, 2001; Rauber et al., 2005). The exception—/s/ showing higher production than perception—likely reflects task design: discrimination among minimal pairs may have included confusable contrasts (e.g., /s/ vs. /z/ or /s/ vs. /θ/), whereas reading allows learners to rely on orthography and existing /s/ articulatory routines.

5.2 Markedness affects production more than perception. Markedness-based predictions were strongly supported for production: the marked set (/θ, ð, ʒ/) was substantially less accurate than the unmarked set (/s, z, ʃ/). However, the same magnitude of markedness effect did not appear in perception, where even marked segments were identified with high accuracy. This dissociation aligns with arguments that difficulty is multi-dimensional: segments can be perceptually discriminable while remaining articulatorily demanding (Haspelmath, 2006; Gordon, 2016).

5.3 L1 transfer and category mapping. Substitution patterns were consistent with reliance on Uzbek categories. Interdentals were frequently mapped onto alveolar fricatives (/θ/→/s, z/; /ð/→/z/) and, to a lesser extent, dental/alveolar stops (/t, d/). Such mappings are common across learner groups and can be interpreted as attempts to preserve stridency or voicing cues while avoiding interdental articulation (Brannen, 2011; Cutler et al., 2004). The high /z/→/dʒ/ rate suggests that learners treat /z/ as an unstable category and default to an affricate that maintains voicing and a postalveolar constriction.

5.4 Interpreting the correlation profile. The strong /θ/ correlation implies that for some marked contrasts, perception is a useful predictor of production success. In contrast, the negligible correlations for /ð/ and the unmarked fricatives indicate that factors beyond perception—such as motor control, phonetic environment, and orthographic habits—play a major role (Flege, 1995; Joh & Lee, 2001). The weak overall correlation ($r = .233$) suggests partial coupling: perception and production are related, but the relationship is not deterministic.

6. Pedagogical implications for teaching /θ/ and /ð/

These results have direct implications for pronunciation teaching in Uzbek EFL settings. Because learners' perception of interdentals can be relatively strong while production lags, instruction should not assume that accurate listening automatically yields accurate articulation. Instead, teaching should integrate (a) explicit articulatory instruction, (b) perception training on high-confusability contrasts, and (c) production practice with immediate feedback.

6.1 Explicit articulatory focus. Teachers can model tongue placement (tongue tip lightly between teeth), airflow, and voicing for /ð/ and emphasize that “biting the tongue” is minimal. Visual aids (mouth diagrams) and short mirror work can reduce learners' reluctance to use interdental articulation. Explicit comparison with Uzbek /s, z, t, d/ helps learners notice which gestures must change.

6.2 Perception-to-production bridging tasks. Minimal-pair identification should target the most frequent Uzbek substitutions (thin–sin; teethe–tease; then–zen; than–Dan). After identification, learners can immediately shadow the same items, then record and self-check. This sequencing leverages the perception advantage while forcing articulatory recalibration.

6.3 Feedback and technology. Simple acoustic feedback (waveform + spectrogram snapshots in Praat) can be used selectively to show voicing in /ð/ and the friction noise profile of /θ/. Even brief teacher-led demonstrations can help learners connect ‘what they hear’ with ‘what they did’.

6.4 Priority targets. Given the low production accuracy for /ð/ (62.50%) and high rates of /ð/↔/θ/ confusion, classroom time should prioritize voiced–voiceless contrasts for interdentals. For /z/, teachers should anticipate /dʒ/ substitutions and provide structured contrasts (beige–badge; measure–major) to stabilize the fricative category.

7. Conclusion

This study examined Uzbek learners' production and perception of six English fricatives within a markedness framework. The results showed a robust perception advantage overall, substantial production difficulty for marked fricatives—especially /ð/—and systematic L1-based substitution patterns. Perception–production associations were segment-specific: /θ/ showed a strong positive correlation, while other fricatives showed weak or negligible links. Together, the findings suggest that markedness shapes production more strongly than perception and that effective pronunciation instruction should explicitly connect auditory discrimination with targeted articulatory training for interdental and postalveolar fricatives.

Limitations include the use of a controlled word-based design and a single talker for perception stimuli. Future work should test sentence-level contexts, multiple talkers, and longitudinal training effects to determine which instructional sequences most effectively close the perception–production gap.

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