

Thumb, Sumb, Fumb: Development of Interdental Fricatives

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BACKGROUND

Development of Fricatives

It is commonly known that fricatives are a later acquired class of sounds for English-speaking children (Ingram et al., 1980).

- Interdental fricatives (/θ/ and /ð/) are among the latest acquired fricatives, with age of mastery in typically developing children between 5;0 and 6;0 (Ingram et al., 1980; McLeod & Bleile, 2003).
- Fricatives are often produced as stops in early typical phonological development (McLeod & Bleile, 2003).
- While stopping accounts for the frequently observed substitution of /d/ for the voiced interdental fricative /ð/ (Ingram et al., 1980), it does not account for the commonly observed substitutions of /f/ or /s/ for the voiceless interdental fricative /θ/. This pattern has been referred to as *fricative simplification* (McLeod & Bleile, 2003) and has been observed in some dialects of English (Blevins, 2004).
- Substitution patterns of fricatives are variable, ranging from “a more closed articulation (e.g., /ð/ to /d/)... or an acoustically similar fricative” (Ingram et al., 1980).

Goals of the Current Study

This study investigates the following questions:

1. What do children produce when the target is an interdental fricative?
2. Are there age-based patterns of development for interdental fricatives?
3. What is the accuracy of interdental and non-interdental fricatives in syllable onset and syllable coda positions?

METHODS

Participants

- 72 children (29 male, 43 female) ages 2;6 to 4;3
 - Age groups: 2;6-2;11 (32 participants), 3;0-3;5 (28 participants), 3;6-4;3 (19 participants)
- Residents of Northern Arizona whose primary language is American English
- Typically developing, with no history of speech, language, or hearing concerns (based on parent report)
- All participants attained a standard score of 90 or higher on the Goldman-Fristoe Test of Articulation, 2nd Edition (GFTA-2). The Expressive Vocabulary Test, 2nd Edition (EVT-2) and the Peabody Picture Vocabulary Test, 4th Edition (PPVT-4) were also administered
- Average standard scores on the assessments were 104 (GFTA-2), 115 (EVT-2), and 113 (PPVT-4)

Procedures

- The above assessments were administered as part of a larger study examining speech and language development in children ages 2;6 to 4;3.
- Participants completed one 60-minute data collection session in a sound-treated therapy room in a university clinic or a quiet preschool room.
- Sessions were audio recorded using a high-quality Zoom H6 digital recorder with shotgun microphone.
- All assessment procedures were administered by a certified speech-language pathologist or trained speech-language pathology graduate student.
- The investigator who administered the assessment then completed a broad phonetic transcription of the GFTA-2 stimulus words, using the audio recording of the session.
 - Target words with interdental fricatives included the following: *bath*, *bathtub*, *thumb*, *that/this*, *feather*.
- Each participant's audio recording and transcriptions were entered into Phon, a software system capable of conducting multiple types of phonological analyses (Rose & Stoel-Gammon, 2015).

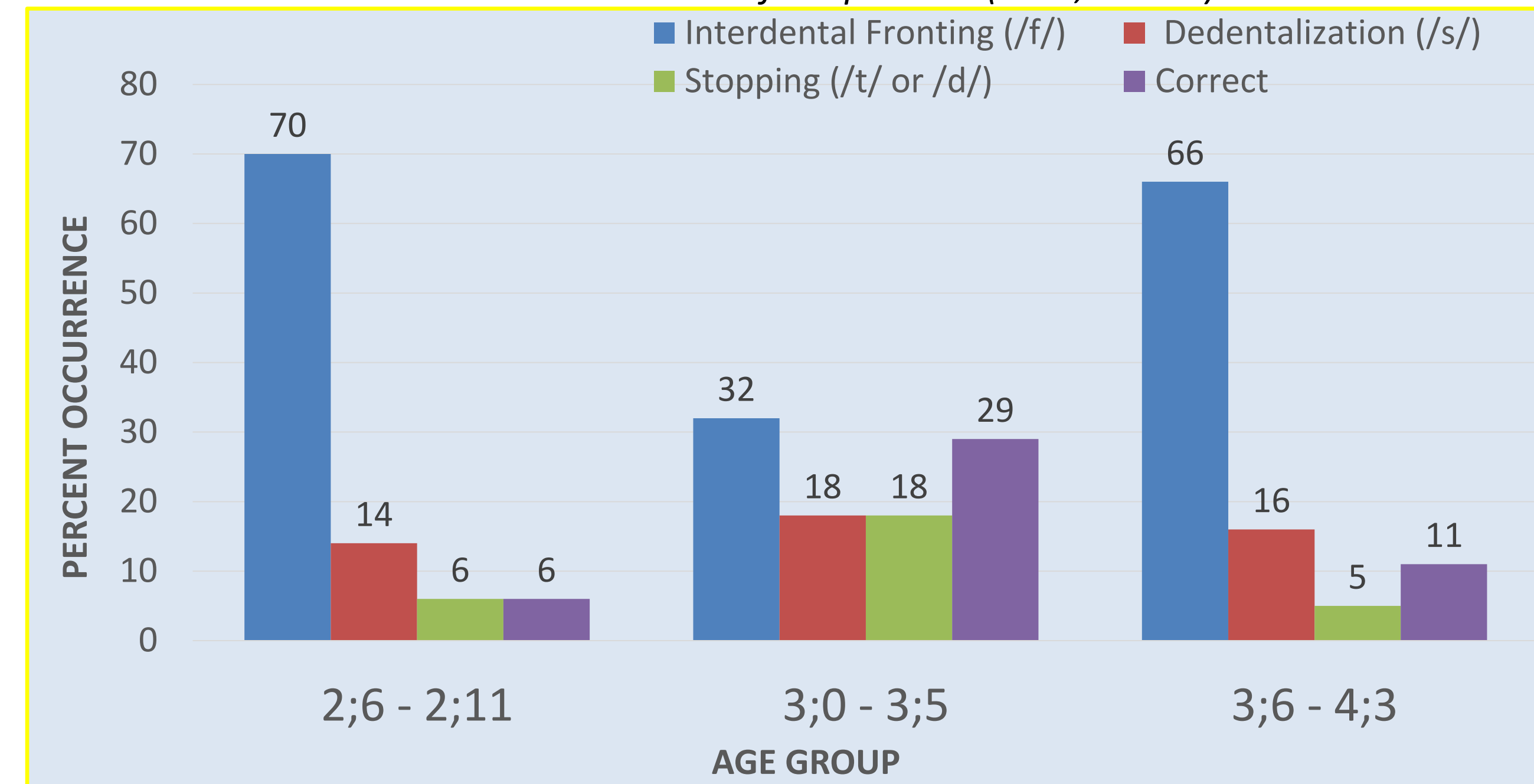
Reliability

- Independent transcription of GFTA-2 stimulus words was performed by one researcher for 12 participants. Overall point-to-point inter-rater reliability for consonants ranged from 78% to 99% with a mean of 91%.

RESULTS

Graph 1: Productions of /θ/ by Age Group

Word-initial and word-final position (*bath*, *thumb*)



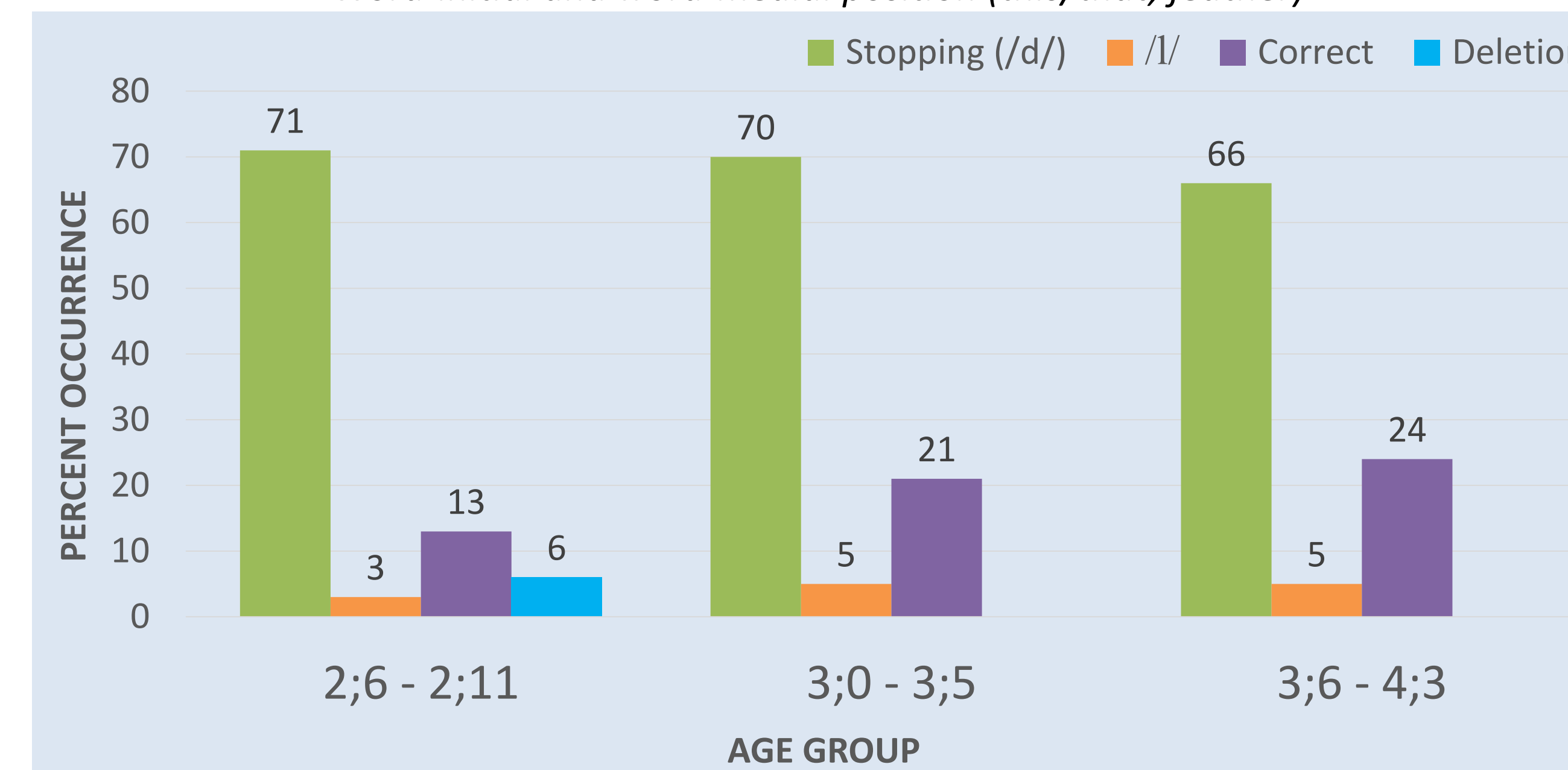
* Graph 1 includes the top four patterns of production observed in each age group

Patterns of Production

- *Interdental fronting* was the most common substitution pattern across all age groups, followed by dedentalization.
- In the 3;0-3;5 age group, a more even distribution of processes was observed:
 - *Interdental fronting* was 38% less common than in the younger age group
 - *Stopping* was 12% higher (three times the frequency of the 2;6-2;11 age group)
 - *Correct productions* were 23% more common than in the younger age group
- Interestingly, the substitution patterns of the oldest age group were similar to the youngest age group.

Graph 2: Productions of /ð/ by Age Group

Word-initial and word-medial position (*this/that*, *feather*)



* Graph 2 includes the top three or four patterns of production observed in each age group

Patterns of Production

- As expected, stopping was the primary substitution pattern among all age groups, and frequency of this process remained relatively stable across age groups.
- Accurate production of /ð/ increased with age.

Table 1: Variability of /θ/ by Age Group

All word positions (*bath*, *bathtub*, *thumb*)

	2;6—2;11	3;0—3;5	3;6—4;3
Average Number of Different Realizations	1.75	1.71	1.74
% of Participants with Complete Variability	13%	18%	16%
% of Participants with No Variability	40%	46%	42%

- Within each age group, average variability of realizations for /θ/ (i.e., average number of different realizations) was calculated, e.g., [bæf, bæstʌb, tʌm] = 3 different realizations of /θ/. Average variability was relatively consistent across groups. The 3;0-3;5 age group had the highest percent of participants with no variability.

RESULTS (continued)

Table 2: Accuracy of Fricatives by Syllable Position and Age Group

	Onset				Coda			
	2;6 – 2;11	3;0 – 3;5	3;6 – 4;3	All (average)	2;6 – 2;11	3;0 – 3;5	3;6 – 4;3	All (average)
Interdental Fricatives (/θ, ð/)	11%	21%	21%	18%	8%	36%	11%	18%
Other Fricatives (/f, v, s, z, ʃ/)	73%	81%	82%	79%	69%	80%	67%	72%

- In both onset and coda positions, non-interdental fricatives were, on average, 58% more accurate than interdental fricatives.

CONCLUSIONS & DISCUSSION

Patterns of Interdental Fricative Production

- Current results replicated previous findings, indicating the production of /f/ for /θ/ is the most common substitution pattern across children ages 2;6-4;3. This process can therefore be considered “typical” with regard to development of /θ/ and, for the purpose of this research, has been named *interdental fronting*. Surprisingly, there was an increase in accuracy of /θ/ in the 3;0-3;5 age group, coupled with a more even distribution of other substitutions. The oldest age group demonstrated similar accuracy to the youngest age group.
- Unlike its voiceless counterpart, accuracy of /ð/ increased steadily with age. *Interdental fronting* (/ð/ → /v/) was not prevalent, suggesting this process is separate and distinct for /θ/ only.

Accuracy of Interdental Fricatives (Table 2)

- When all age groups were analyzed together, there were no differences in overall accuracy of interdental fricatives based on syllable position. However, the 3;0-3;5 age group showed the largest gap in performance accuracy between onset and coda positions (15%). This was the only age group with higher accuracy in coda position.

Individual Variability

- Interestingly, the group with the most evenly distributed /θ/ productions (i.e., 3;0-3;5) demonstrated the highest proportion of participants with *no* variability and the highest proportion of participants with *complete* variability.

Implications for Future Research

- These findings confirm presence of a rarely discussed yet very common substitution pattern (*interdental fronting*) in typical language development, worthy of further research.
- Further research should examine older age groups to determine when the process of *interdental fronting* subsides, which will aid clinicians in diagnostic decision-making and intervention planning.
- Investigation should examine individual variation with emphasis on the role of misperception (substitution of an acoustically similar sound) as a possible cause of *interdental fronting*.

References

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