

A Study on the Acquisition Difficulties of English Dental Fricatives /ð/ and /θ/ for Learners with a Dalian Dialect Background

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Abstract: This study explores English dental fricatives /ð/, /θ/ acquisition difficulties among Dalian dialect learners and targeted teaching strategies. Thirty vocational students participated via recording, articulatory observation and interviews. Results show 92% substitution errors due to the absence of such sounds in Dalian dialect, with higher error rates in word-final and connected speech. The "positioning-contrast-hierarchical practice" reduced errors by 47%. It enriches northern dialect-related phonetics research while limitations include a small sample and no long-term follow-up.

Keywords: Dalian dialect; English dental fricatives; /ð/ and /θ/

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1 Introduction

1.1 Research Background and Rationale

Phonetics, as material carrier of language, is the foundation of second language acquisition (SLA) and the key means of oral communication. Learning correct English phonetics has a crucial influence on the linguistics output of the learners and their cross-cultural communication (Gui, 1978). The phonological systems of different languages and dialects have their intrinsic differences, and the articulatory habits of mother tongue/dialect have a certain transfer effect on L2 phonetic learning. Target phonemes that do not have corresponding phonetic templates in the source are usually the heart of the source acquisition difficulty, such as in English phonetic learning among Chinese dialectal speakers (Odlin, 1989).

This work aims to investigate Dalian dialect learners' production of /ð/ and /θ/ and the relationship between the articulatory error and the dialect interference, and to develop teaching strategies accordingly. It not only fills the research blank of this topic, but is also of certain practical empirical guidance to enhance the accuracy and effectiveness of local English phonetics teaching.

1.2 Core Research Questions

Taking the above research background and practical demands into consideration, this study investigates the acquisition of English dental fricatives /ð/ and /θ/ by Dalian dialect region learners aiming to answer the following three core research questions:

1. What articulatory errors do Dalian dialect learners make in /ð/ and /θ/, and how are these errors distributed in different word positions?
2. How do Dalian dialect articulatory habits negatively affect the acquisition of /ð/ and /θ/?
3. What targeted teaching strategies can improve learners' pronunciation of /ð/ and /θ/?

1.3 Research Methods

1.3.1 Participants

Thirty native Dalian speaking students, enrolled in a vocational school in Dalian, were chosen as the participants of this paper. For the sake of the research pertinence and validity, the participants should fulfill the following strict inclusion criteria: Born and permanently reside in Dalian; Primarily use Dalian dialect as the means of communication at home and for day-to-day social communication; Have not received any systematic and professional training in English phonetics; Did not receive any special articulatory guidance for the production of /ð/ and /θ/ in the process of learning English. The choice of choosing vocational school students as participants establishes a sample link with the existing research on English phonetic acquisition in the Dalian dialect region (Shi, 2010), making the research data comparable and continuous.

1.3.2 Data Collection

This study adopted a mixed data collection method combining audio recording, articulatory observation and brief interviews to comprehensively capture learners' articulatory states and acquisition difficulties in producing /ð/ and /θ/. The specific operations are as follows:

Audio Recording: Referring to the research methods of English phonetics by Gui (1978) and Zhang (1998), a set of minimal pairs, short sentences and daily discourses containing /ð/ and /θ/ were designed, covering three core positions. Learners' pronunciation was recorded in a natural and non-intervened state to ensure the authenticity of pronunciation samples.

Articulatory Observation: The mirror-assisted observation method was adopted, combined with tactile prompting techniques, to record in real time learners' tongue-tip position, contact manner between the tongue-tip and teeth-back, lip shape and airflow control during pronunciation. This method intuitively presents articulatory deviations and makes up for the limitations of a single audio recording analysis

(Wang, 2006).

1.3.3 Data Processing

Qualitative analysis and quantitative analysis methods were integrated to process the gathered multi-source data. Firstly, the audio recordings and the results from articulatory observation were coded to sort and count the appearance of different kinds of articulatory errors during the productions of /ð/ and /θ/, and to calculate the proportion of each kind of error and error distribution rate in various contexts. Secondly, co-current with the qualitative data of brief interviews, the potential correlation between different articulatory deviations and the articulatory habit of Dalian dialect was in-depth analyzed, and the specific route of dialectal negative transfer was sorted out. Last but not least, cross validation was executed to guarantee the objectivity of data results and the reliability of analytical conclusions, which offer data support for the further analysis of negative transfer mechanisms and teaching strategy design.

2 Theoretical Foundation and Literature Review

2.1 Core Theoretical Support

2.1.1 Language Negative Transfer Theory

Language transfer, as a central theoretical concept in second language acquisition (SLA) research, refers to the influence of the prior linguistic knowledge and skills that learners especially from their mother tongue or dialect on learning a target language (Odlin, 1989). The reflection of transfer is two-fold, i.e., positive transfer, which is beneficial and helps learning when the systems of source and target languages are similar, and negative transfer, which leads to interference and errors when the systems are different (Gui, 1978; Zheng, 2004). For phonetic acquisition in particular, negative transfer at the articulatory motor level is particularly salient: learners apply subconsciously the hardened articulatory habits of the mother tongue or dialect to the target language phonemes, especially when the target ones have no correspondents in the source (Shi, 2010).

2.1.2 Articulatory Motor Learning Hypothesis

The Articulatory Motor Learning Hypothesis holds that L2 phonetic acquisition means forming new articulatory motor patterns, which are restricted by solidified first-language or dialect muscle memory. For Dalian dialect learners, long-term use of /s/, /z/, /t/, /d/ has fixed their tongue position and articulatory habits, making it hard to produce /θ/ and /ð/ correctly. Targeted motor training would then need to occur to remove such persistent dialectal interference.

2.1.3 Dental Fricative Phonetic Theory

Dental fricatives (/ð/ and /θ/) are a typical group of English consonants for their distinctive articulatory specifications concerning the three factors of place, manner and voicing (Lao, 1982; Zhang, 1998). For teaching and learning, a more explicit and clear grasp of the fundamental articulatory peculiarities is conducive to analysing learners' misfortunes and devising teaching/learning strategies.

Place of Articulation: Both /ð/ and /θ/ are articulated with a tip and rims of tongue lightly touching the edge and inner surface of the upper teeth (dental position) instead of the alveolar ridge or hard palate (Roach, 2000). This accurate positioning of tongue-tip is the crucial identifying feature of dental fricatives because very slight withdrawal back to the alveolar ridge produces “quasi-/s/” or “quasi-/z/” sound.

Manner of Articulation: The tongue-tip teeth contact is “light and partial”, which leaves a narrow interstices for the air to flow through and produce continuous and light friction (Lao, 1982), in that there is no complete closure and abrupt release as in plosives (/t/, /d/); friction intensity is neither as high nor harsh as in alveolar fricatives (/s/, /z/).

Voicing Contrast: /θ/ is a voiceless fricative, with no vocal cord vibration during production. And its sound is very crisp and sharp (Zhang, 1998). For /ð/, it is a voiced fricative, with continuous and stable vocal cord vibration and a softer, more resonant quality (Shadle, 1985 as cited in Li, 2006). In English, the voicing contrast is phonemically relevant, distinguishing minimal pairs like think (/θɪŋk/) and this (/ðɪs/).

2.2 Literature Review

2.2.1 Status of L2 Acquisition Research on English /ð/ and /θ/

On a global level, previous studies on the L2 acquisition of English dental fricatives have consistently reported substitution as the dominating error by different mother tongue backgrounds. In the case of learners whose native language does not contain dental fricatives like in the case of Mandarin Chinese, Japanese and Korean, substituting /θ/ by /s/ or /t/ and /ð/ by /z/ or /d/ are dominant errors (Chen, 2008; Yu, 2004).

Meanwhile, Chinese studies indicate that learners of southern dialects tend to substitute /θ/ and /ð/, due to the absence of dental fricatives or the habit of strong plosive. However, those studies only investigate phonemic-level errors with acoustic analysis only, without articulatory observation and further analysis of dialect-specific motor transfer mechanism.

2.2.2 Gaps in Research on Dialectal Influences on Phonetic Acquisition

Existing studies on the influence of Chinese Dialects on English phonetic acquisition have been mainly concentrated on the southern dialects, such as Fujian Dialect, Sichuan dialect and Hunan dialect (Du, 1988; Tan, 2002). Du (1988) investigated the influence of nasalization feature of Fujian Dialect on the acquisition of English fricatives. Tan (2002) paid attention to the effect of “weak friction” feature in Sichuan Dialect on English /f/ and /v/ production. However, few existing studies focus on the northern dialects, like Dalian Dialect, not to mention the influence on the acquisition of /ð/ and /θ/.

However, none of these previous studies on Dalian dialect learners is sufficient: Song (2001) only investigated vowel errors; Lin (2008) only pointed out that there are pronunciation problems with /θ/ and /ð/ without further investigation of the mechanism of transfer; Shi (2010) reported high error rate but concentrated on the comparison of the phonetic system. That is to say, the articulatory influence of the Dalian dialect on English dental fricatives at the motor level has not been investigated systematically.

3 Comparison Between Standard Articulatory Movements and Interfering Movements of Dalian Dialect

3.1 Standard Articulatory Movements of /ð/ and /θ/

The canonical production of English dental fricatives /ð/ and /θ/ represents a highly coordinated motor behavior, where each of the tongue, larynx and respiratory system has a well-defined criterion to fulfill its task (Roach, 2000; Zhang, 1998). All these movements differ from the ones of Chinese phonemes including Dalian dialect and become the main difficulty of acquisition.

3.1.1 Tongue-Tip Position

For both /ð/ and /θ/, the tongue-tip must make light contact with the inner face of the upper teeth-back. The principle of operation is “gentle approximation without compression”: the tongue-tip lies softly against the teeth-back to preclude two frequent departures from this alignment, retraction to the alveolar ridge and overextension between the teeth (Lao, 1982). Zhang (1998) insisted that this fine spatial positioning is the most distinctive characteristic of dental fricatives, with changes of tongue-tip position of as little as 2-3mm often changing the phonemic identity of the sound.

3.1.2 Contact Manner

(2) The contact between tongue-tip and teeth-back is “point contact” rather than “surface contact”. Only the tip of tongue makes contact with the teeth-back, whereas a narrow gap runs along the lateral sides of tongue for the air to squeeze through. Note that there is no “complete closure and sudden release” during the articulation as in English /t/ or /d/ where complete closure of the articulatory organs is followed by explosive release (Wang, 2006). This “point contact + narrow gap” setting is crucial for the continuous and mild friction which characterizes the dental fricatives.

3.2 Characteristics of Interfering Articulatory Movements from Dalian Dialect

Dalian dialect lacks dental fricatives, and its core consonants, including /s/, /z/, /t/, and /d/ all require the tongue-tip to contact the alveolar ridge or post-alveolar region (Shi, 2010).

3.2.1 Habitual Tongue-Tip Position

Dalian dialect lacks dental fricatives, and its core consonants including /s/, /z/, /t/, and /d/ all require the tongue-tip to contact the alveolar ridge or post-alveolar region (Gao, 2005). For example:

Dalian dialect /s/ and /z/ involve the tongue-tip pressing against the alveolar ridge to form a lateral gap for airflow; Dalian dialect /t/ and /d/ require the tongue-tip to fully occlude the alveolar ridge (Song, 2001).

Lin (2008) found in her empirical study that this “alveolar contact preference” is highly stable among Dalian dialect speakers, with learners rarely spontaneously using teeth-back contact in phonetic production. This lack of motor experience with the target tongue-tip position directly contributes to substitution errors and articulatory deviations.

3.2.2 Deviations in Contact Manner

Dalian dialect does not have “light contact + continuous friction”, so learners replace /θ/ and /ð/ in two typical ways. One is tight contact with plosive release, substituting them by /t/, /d/, particularly frequent word finally since muscles relax. The other is distant contact with strong friction, substituting them by /s/, /z/ through dialect transfer. These two errors are triggered by the lack of “point contact + narrow gap” articulation in Dalian, causing systematic substitutions.

4 Analysis of Dalian Dialect-Speaking Learners' Acquisition Errors in /ð/ and /θ/

4.1 Classification and Quantitative Statistics of Error Types

4.1.1 Substitution Errors

Substitution errors were the most prevalent, accounting for 92% of all errors. Learners unconsciously replaced /ð/ and /θ/ with phonemes from Dalian dialect that share similar articulatory features, resulting in four typical substitution patterns:

/θ/ → /s/: The most common substitution, with learners pronouncing think as /sɪŋk/ and three as /sri/. This error is attributed to the adaptation of Dalian dialect /s/'s “tongue-tip to alveolar contact+strong friction” articulatory habit to the production of /θ/ (Lin, 2008). Dalian dialect does not contain dental fricatives, so when presented with /θ/, learners default to the closest alveolar fricative /s/.

/θ/ → /t/: Constituting 21% of total errors, learners pronounced thin as /tm/ and thank as /tæŋk/. This substitution reflects the influence of Dalian dialect's plosive-dominant articulatory system, where the “tight contact + plosive release” of /t/ replaces the “light contact + continuous friction” required for /θ/ (Shi, 2010).

/ð/ → /z/: Contributing to 18% of the total errors, it was pronounced by the learners as /zis/ and by the mother as /mʌzə(r)/. And as same as the case of /θ/ → /s/, it is an error caused by the transfer of Dalian dialect /z/ to /ð/ based on the similarity of the articulatory habit (Gao, 2005), both of which are voiced fricatives, and it is hard for the learners to tell their distinctive features in articulatory position (Gao, 2005).

/ð/ → /d/: The least frequent substitution, with learners pronouncing that as /dæt/ and they as /deɪ/. This error is attributed to the interference of Dalian dialect /d/, where the plosive manner replaces the continuous friction of /ð/ (Song, 2001).

4.1.2 Articulatory Place Deviations

Articulatory place: deviations of this category accounted for 6% of the total errors, and were characterized by an excessive retraction of the tongue-tip to the alveolar ridge during the production of /ð/ and /θ/. This produced “quasi-/s/ or /z/ sounds” rather than pure friction heard in dental fricatives. For instance, for bath (/bɑ:θ/), the tongue-tip retracted to the alveolar ridge and /θ/ was produced with a friction similar to /s/, in a middle point between the two sounds; for brother (/ˈbrʌðə(r)/), the tongue-tip did not reach the upper teeth-back and a weak /z/ approximating friction was made (Lin, 2008).

This deviation directly stems from Dalian dialect’s “alveolar contact preference” (Gao, 2005). Learners’ tongue-tips have been conditioned to rest on the alveolar ridge for consonant production (e.g., /s/, /z/, /t/, /d/), making it difficult to maintain the teeth-back position required for /ð/ and /θ/, even when they attempt to avoid overt substitution.

4.2 Contextual Variations in Error Rates

Error analysis showed that learners’ production accuracy of /ð/ and /θ/ was highly sensitive to the context, with different patterns on different word positions and discourse contexts. These differences indicated the instability of learners’ newly acquired articulatory patterns as they were easily perturbed when additional cognitive or motor load was imposed (Wen, 2004).

4.2.1 Influence of Word Position

The error rates of /ð/ and /θ/ varied in word-initial, word-medial, and word-final positions with similar pattern in each: word-final > word-medial > word-initial.

Word-initial position: The lowest error rates were obtained, 41% for /θ/ (e.g. think, three) and 35% for /ð/ (e.g. this, they). In word-initial position, the phoneme is maximally salient and learners can focus all attention on the production, it is easier to retain the normal tongue-tip position and manner of contact (Lin, 2008).

Word-medial position: Error rates increased to 52% for /θ/ (i.e. father, nothing) and 43% for /ð/ (i.e. brother, bother). In this position, the phoneme appears less salient and the learner has to co-ordinate the production of the sound against the neighbouring phonemes. This is therefore associated with an increased motor load and more regression to dialectal habits (Shi, 2010).

Wordfinal position: The error rates were highest in these position, 68% for /θ/ (e.g., bath, cloth), and 57% for /ð/ (e.g., with, smooth). Wordfinal consonants are usually weakened in natural speech, and also as the learners relax the articulatory muscles, the tongue-tip may move back to the habitual alveolar position, or assume the plosive/strong friction manner of the Dalian dialect (Gao, 2005). As a result, substitution errors, or articulatory deviation is more likely..

4.2.2 Influence of Discourse Context

Error rates were significantly different in the comparison between isolated words and connected discourse: The mean error rate in discourse was much higher than in isolated words.

When producing isolated words, the learner can pay full attention to the pronunciation of /ð/ and /θ/ and tune the tongue-tip position and airflow control by conscious selection (Wang, 2006). But during connected discourse, the learner has to devote cognitive resources for syntax, lexicon, and prosody, thus the cognitive load of motor coordination for articulatory organs (Wen, 2004) increases. Consequently, the newly acquired articulatory pattern of /ð/ and /θ/ is easily disturbed and the learner falls back on the automatic and low cognitive-load articulatory habits of Dalian dialect (Shi, 2010). For instance, in the phrase “this thing”, 83% of the participants replaced /ð/ with /z/ and /θ/ with /s/, while only 45% did so when pronouncing the isolated word this and thing, respectively.

4.3 Analysis of Negative Transfer Mechanisms

4.3.1 Muscle Memory Transfer

Muscle memory refers to the stable motor patterns formed through repeated articulation of mother tongue or dialect phonemes, which unconsciously influence target language phoneme production (Wen, 2004). Dalian dialect-speaking learners’ long-term use of /s/, /z/, /t/, and /d/ has solidified two key muscle memories that directly interfere with /ð/ and /θ/ acquisition:

Tongue-tip to alveolar contact memory: The articulation of Dalian dialect /s/ and /z/ requires the tongue-tip to press against the alveolar ridge a movement reinforced through years of use (Gao, 2005). When producing /ð/ and /θ/, learners’ tongue-tips instinctively retract to the alveolar ridge, leading to substitution errors (/θ/ → /s/, /ð/ → /z/) or articulatory place deviations.

Tight contact+plosive release memory: Dalian dialect /t/ and /d/ require the tongue-tip to fully occlude the alveolar ridge followed by sudden release (Song, 2001). This muscle memory causes learners to adopt a plosive manner when producing /ð/ and /θ/, resulting in substitutions.

Gui (1978) emphasized that muscle memory transfer is particularly potent when the target language phoneme has no corresponding articulatory template in the source language—explaining why substitution errors dominate in this study.

5 Conclusions and Prospects

5.1 Research Conclusions

On the basis of empirical data and theoretical principles three main points can be concluded:

Learners with a Dalian dialect background mostly make substitution(92%) errors when learning English /ð/ and /θ/, and they are primarily tongue-tip retraction and incorrect articulatory manners. These systematic errors are owing to the lack of dental fricative templates in the dialect and the use of familiar native phonemes instead. Other secondary errors are marginal. The most serious interference comes from the frozen muscle memory and the articulatory inertia of dialectal /s/, /z/, /t/, /d/. Error rates are significantly greater in word-final position and connected discourse due to muscle relaxation and heavy cognitive-motor load - a sign of the instability of newly created articulatory patterns.

5.2 Future Research Directions

To address the aforementioned limitations and deepen the understanding of Dalian dialect's influence on /ð/ and /θ / acquisition, three future research directions are proposed:

First, widen the sample scope to age and English proficiency groups. Future research should similarly recruit high-school students, adult learners and learners with intermediate to advanced English proficiency and compare them to assess whether the types of articulatory errors, transfer mechanism and response to targeted training vary with age or proficiency, in order to better understand whether different age and proficiency groups with a specific accent might benefit from different teaching programs (Lin, 2008).

Second, incorporate professional articulatory capture instruments for fine-grained quantitative analysis. The current study is based on mirror observation and hand-feeling feedback, which are subjective and lack articulatory movement quantitative information. Future studies can employ instruments like electropalatographs or tongue position trackers which capture tongue-tip position, contact pressure, and airflow intensity of /ð/ and /θ/ production, for the objective quantification of articulatory deviation and transfer mechanism, which will further deepen and strengthen the study (Wang, 2006).

Third, create a simple practical training tool with "action decomposition + real-time feedback". According to the hierarchical training framework proposed in this study, a simple voice teaching APP can be designed, with which Dalian dialect-speaking learners can be provided with practical training that meets its needs. For example, it can contain functions such as animation demonstration of articulatory movements, real-time pronunciation assessment, and personalized practice tasks. Thus, targeted training will become more accessible and sustainable, which can be used as a supplement to classroom teaching (Zhang, 1998).

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