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THE PRODUCTION OF THE ENGLISH INTERDENTAL FRICATIVES BY BRAZILIAN FORMER AND FUTURE EFL TEACHERS

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To Sil, Julio, Lu and Ariel.

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ABSTRACT

THE PRODUCTION OF THE INTERDENTAL FRICATIVES BY BRAZILIAN FORMER AND FUTURE EFL TEACHERS

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2010

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The present study investigated the production of the English interdental fricatives by Brazilian former and future EFL teachers. The main objectives of the present study were to investigate: (a) the pattern of production and replacements for the voiceless interdental fricative in word-initial and final positions; (b) the pattern of production and replacements for the voiced interdental fricative in word-initial and final positions; and (c) whether word-position might affect the degree of difficulty for the accurate production of the interdentals. The participants of the study were eight undergraduate learners from the Letras English Course at UFSC and three former English teachers from language schools in the south of Brazil. Data were collected through a questionnaire and a production test. The test, which was audio and video recorded, contained the interdentals in each word position, initial and final. Despite the limitations of the study, results show a high percentage of accurate productions especially of word-initial and final /θ/. For /ð/, more accurate productions were observed in word-initial than in word-final position. The predominant production types observed were: (a) the realization of [θ] for /θ/ in word-initial and final positions; (b) the realization of [ð] for /ð/ in word-initial position; and (c) the realization of [θ] for /ð/ in word-final position. The results suggest that the high number of accurate productions might be due to the participants' frequency of English contact and high proficiency level. The difficulty observed for the production of word-final /ð/ may be related more to lack of word familiarity than to markedness constraints.

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RESUMO

THE PRODUCTION OF THE INTERDENTAL FRICATIVES BY BRAZILIAN FORMER AND FUTURE EFL TEACHERS

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O presente estudo investigou a produção das fricativas interdentais do Inglês por antigos e futuros professores brasileiros de Inglês como língua estrangeira (EFL). Os principais objetivos deste estudo foram investigar: (a) o padrão de produção e de substituição para a fricativa interdental surda em posições inicial e final de palavra, (b) o padrão de produção e de substituição para a fricativa interdental vozeada em posições inicial e final de palavra, e (c) se a posição do fonema nas palavras pode afetar o grau de dificuldade para a produção acurada das interdentais. Os participantes do estudo são oito alunos de graduação do Curso de Letras Inglês na UFSC e três ex-professores de Inglês de escolas de idiomas no sul do Brasil. Os dados foram coletados através de um questionário e um teste de produção. O teste, que foi gravado em áudio e vídeo, continha as interdentais em cada posição da palavra, inicial e final. Apesar das limitações do estudo, os resultados mostram uma elevada percentagem de produções acuradas especialmente de /θ/ em posição inicial e final de palavra. Para /ð/, as produções acuradas foram observadas com maior freqüência em início de palavra do que em posição final de palavra. Os tipos predominantes produção observadas foram: (a) a realização de [θ] para /θ/ no início e fim de palavra; (b) a realização de [ð] para /ð/ em início de palavra; e (c) a realização de [θ] para /ð/ em posição final de palavra. Os resultados sugerem que o elevado número de produções acuradas pode ser devido a maior freqüência de contato dos participantes com o Inglês e seu alto nível de proficiência. A dificuldade encontrada para a produção do /ð/ final pode estar relacionada mais à falta de familiaridade com as palavras do teste do que apenas à restrições de marcação.

Número de páginas: 91 (excluindo apêndices), e 125 (incluindo apêndices)
Número de palavras: 29.510 (excluindo apêndices)

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LIST OF ABREVIATIONS

AAVE – African American Vernacular English
AOL – Age of learning
BP – Brazilian Portuguese
CPH – Critical Period Hypothesis
CVE – Cajun Vernacular English
dB - Decibels
EFL – English as a Foreign Language
ESL – English as a Second Language
Hs – Hypotheses
Hz - Hertz
IL – Interlanguage
L1 – First Language
L2 – Second Language
LOL – Length of Learning
MDH – Markedness Differential Hypothesis
NI – Native Italian
NZE – New Zealand English
OT – Optimality Theory
P - Participant
RQs – Research Questions
SCH – Structural Conformity Hypothesis
SLM – Speech Learning Model
SPSS – Statistical Package for the Social Sciences
TOEFL – Test of English as a Foreign Language
UFSC – Universidade Federal de Santa Catarina
UFSM – Universidade Federal de Santa Maria
VOT – Voice Onset Time

CHAPTER 1

INTRODUCTION

Learning a new language seems to be a challenge most of the time. It is seen as a complex process (Gass and Selinker, 2001; Ellis, 1994, 1997) which depends, among other things, on the individual characteristics of the learners involved in the process and the context in which learning takes place. Considering the case of Brazilian Portuguese (BP) learners in their attempt to learn English as a foreign language (EFL) in Brazil, learning will, most of the time, take place through formal instruction in the context of the classroom. This is different from learning English in a country where this language is officially spoken – second language (L2) acquisition – where learning tends to be more 'natural' since the input received by learners is much more frequent and authentic. Thus, the task of foreign language learning requires more effort from learners, and the chances of success in achieving 'native-like' proficiency are quite reduced.

Teachers of EFL seem to know, based on their classroom experience, what type of errors students usually make. In my short experience as an English instructor in a language institute, I noticed that learners had difficulty in producing the 'th' sounds as in the words *th*ink, *th*at, bo*th*, ba*th*e. Even being taught explicitly about how these sounds should be articulated, some learners still pronounced them in a deviant manner. This difficulty that most learners have when trying to produce a sound which is 'different' from the ones of their native language or even completely 'new' to them is what has driven this research.

Regarding pronunciation difficulties, Baptista (2001) points out the difficulty that Brazilian learners of EFL have with the consonantal sounds not found in the Portuguese sound inventory: /θ/, /ð/, /ɹ/, /h/, /j/ and /w/, occurring in the beginning of words such as *th*ink, *th*at, *r*at, *h*at, *y*ear and *w*oman, respectively. Considering the fricative phonemes, English has /f, v, s, z, θ, ð, ʃ, ʒ/ (Giegerich, 1992), whereas Brazilian Portuguese has only /f, v, s, z, ʃ, ʒ/ (Cristófaro-Silva, 1999). This study will focus on the English interdental fricatives /θ/ and /ð/, which are not part of the BP sound inventory.

Several studies have been conducted to better understand the different phonological elements and environments which seem to cause

Brazilians some difficulty when learning the English language. Just to cite a few of them, regarding vowels, Baptista (2000) and Rauber (2006a) investigated how the English vowels are acquired, perceived and/or produced by the BP learners, and Nobre-Oliveira (2007) observed the influence of perceptual training on the learning of English vowels. Concerning consonants, Kluge (2004, 2009) investigated the perception and production of the English final nasals, Reis (2004, 2006) investigated the perception and production of the English interdental fricatives in word-initial position, and Ruhmke-Ramos (2009) investigated the effects of training and instruction on the perception of the English interdental fricatives. There are also studies on the problem of sequences of consonants: Rauber (2002, 2006b) studied the production of initial /s/-clusters, and Bettoni-Techio (2008) observed the effects of perceptual training on their perception and production. In addition, Delatorre (2006) studied the production of vowel epenthesis in words ending in the –ed morpheme by Brazilian EFL learners, and Mariano (2009) investigated whether explicit instruction and/or training could positively affect the pronunciation of –ed. Considering position within the word, Silveira (2004) investigated the effect of instruction on the production of English word-final consonants.

The interdental fricatives, in addition to being absent from the BP sound inventory, are considered marked and hence infrequent in the world's languages (Dubois & Hovath, 2004). Keeping this in mind, this study is based partly on Eckman's (1977) Markedness Differential Hypothesis (MDH), in which he claims, based on language universals and on the relationship between one's first language (L1) and the L2, that the more marked (less frequent or less universal) the L2 form, the more difficult it will be. After criticisms of the MDH, Eckman proposed the Structural Conformity Hypothesis (SCH, 1991), which supports the idea that universal generalizations take into consideration not only primary languages but also hold true for interlanguages.

The absence of interdentals in the BP inventory may lead to the difficulty BP learners have in perceiving and producing these target sounds in English. A common strategy used not only for speakers of L1 but also L2/FL speakers and learners is sound substitution. As Lee and Cho (2002, p. 255) explain, "many children who acquire English as their first language frequently show replacement errors (e.g. juice [dus], shoe [tu], read [wid], leg [wɛg])". Following the same pattern, L2 learners also have a tendency to replace difficult L2 target sounds by L1 sounds which might be perceived as similar to the targets. Bearing this in mind,

some studies have shown the voiceless and voiced English interdentals to be replaced with different phonemes, such as /t/ and /d/ respectively, by native speakers of French Canadian (Brannen, 2002), Russian (Weinberger, 1996) and Brazilian Portuguese (Reis, 2004, 2006); the voiceless interdental to be replaced by [s] by Korean speakers (Lee, 2000; Jesney, 2005) and by [f] by Polish speakers (Gonet & Pietron, 2006), just to cite a few.

Thus, there is a tendency for BP learners to replace the English voiceless interdental fricative /θ/ as in *thank* [θæŋk] by the voiceless stop /t/ as in [tæŋk], given that /t/ is a phoneme already present in the Portuguese language. Moreover, the voiced interdental fricative in *them* [ðɛm] may be produced as [dɛm] (Reis, 2006). The same substitutions are assumed to occur in the BP learners' productions in all word positions: initial, medial or word-final.

This research aims at corroborating or not the results found by Reis (2006) regarding the common substitutes for the interdental fricatives in word-initial position. Furthermore, it contributes to the area of L2 phonetics and phonology by observing the realization of the phonemes in word-final position, as well as verifying through comparison which word position yields more errors. To my knowledge, no studies so far have compared the frequency of errors in the production of word-initial and final /θ ð/ by EFL teachers-to-be and former teachers. Thus, this is the gap the present study aims to fulfill.

This thesis is organized into five chapters in order to present and discuss the results of this investigation. Chapter 2 reviews the relevant literature related to, among other issues, the acquisition of an L2 sound system, the markedness factor and the most important studies which investigated the production of the interdental fricatives by speakers of different L1s as well as by speakers of different varieties of English. Chapter 3 describes the research questions and hypotheses that guided the study and the method adopted for gathering the data and information on the participants. Chapter 4 presents the analysis and the discussion of the results, and Chapter 5 concludes the investigation, discussing the limitations of the present research and indicating possible suggestions for future research.

CHAPTER 2

REVIEW OF THE LITERATURE

This chapter presents a review of the most relevant literature for the present study. It is divided into seven sections. Section 2.1 briefly discusses the acquisition of an L2 sound system together with the issue of non-standard pronunciation and stigmatization. Section 2.2 discusses the issue of foreign accent, as a consequence of the unlikelihood of adult learners reaching native-like competence in the L2 phonological system. Section 2.3 presents the consonant inventories of English and Brazilian Portuguese. Section 2.4 introduces the characteristics of the English fricatives. Section 2.5 reports specifically on the characteristics of the English interdental fricatives and is subdivided into section 2.5.1, which describes their articulatory features, and 2.5.2, which describes their acoustic features. Section 2.6 discusses the markedness factor and introduces some studies on consonants related to this matter. Section 2.7 reviews studies on the interdental fricatives and their common replacements, not only in some L1 varieties of English (section 2.7.1) but also for speakers of English as an L2 from different L1 backgrounds.

2.1 Acquiring an L2 sound system

For any child learning his mother tongue, it is expected that, whenever a sound heard is not yet well articulated, some other sound will be used in order to compensate for his not-yet-developed articulatory ability. Sound substitution seems to be common for speakers learning any of the world languages. Thus, since all children learning their first language (L1) go through this process of replacing one sound for another, there is no shame for an adult speaker experiencing the same 'problem' in the L2: sound substitution is a widely used strategy in the learning of the sound system of a second language (L2) or foreign language (FL) (Lee & Cho, 2002; Jenkins, 2000).

Considering English as an L1, it seems that the sounds children acquire last are the interdental fricatives, those sounds with the *th* spelling, such as *th*ink, *th*at, bo*th*, ba*th*e (Vihman, 1996). These sounds are rare in the languages of the world and are thus considered marked sounds (Eckman, 1977). Taking it all into account, it is no wonder that so many learners of English as a foreign or second language rarely

produce these sounds accurately, that is, following the articulatory characteristics for the production of these phonemes in the same way native English speakers do.

Many English as a Foreign Language (henceforth, EFL) learners find it problematic to perceive and produce the distinction between pairs of words which are distinguished only by the contrast between the two interdentals or between one of them and other similar sounds, such as the minimal pairs *tank - thank*, *thigh - thy*, *taught - fought - sought - thought*, *tin - fin - sin - thin*. Since each of these words carries different meanings, it seems important for a speaker to be able to notice the difference and differentiate them so as to understand what his/her interlocutor means in a conversational situation. However, it must be acknowledged that the interdental fricatives, which are the target sounds under investigation in the present research, may not interfere greatly in communication, since the speaker can probably take the context into consideration in order to comprehend the discourse and maintain the flow of interaction. Despite this fact, the researcher considers it relevant to investigate these phonemes for the sake of enriching L2 phonology theory and perhaps aiding EFL teachers to consider the formal instruction of these sounds in earlier levels of language teaching.

Moreover, even though the non-standard pronunciation of the interdentals does not often provoke miscommunication, the non-native like production of these sounds is often seen as stigmatized (Gelderen, 2006). In Britain and the United States, for instance, speakers who mispronounce *th*-words are frequently underestimated, in terms of their level of education, by speakers who have a native pronunciation.

This stigma may be partly due to association with groups of native speakers whose English is considered by many to be substandard, such as African Americans (African American Vernacular English - AAVE[1])**,** speakers (Dubois & Horvath, 2003), Cockney English

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[1] AAVE, also called African American English, represents a variety of English characteristically used by African Slave Descendants in North America. Its pronunciation is in some aspects common to Southern American English, which is spoken by many African Americans and many non-African Americans in the United States (Patrick, 2007).

(Ladefoged, 2001), and speakers of Irish English (Gelderen, 2006), are reported to replace the interdental fricatives by other phonemes. Besides native speakers of English, many speakers of other languages such as French, Italian, German, Hungarian, Brazilian Portuguese, Russian, among others, seem to have difficulty producing the English interdental fricatives. Among the most common replacements reported are /t/, /f/ and /s/ for replacing the voiceless /θ/, and /d/ and /z/ for replacing the voiced /ð/. Some of the relevant studies considering the groups of speakers previously mentioned will be presented in section 2.7.1.

Given that stigmatization is an important issue to be considered, it seems relevant to investigate how these sounds are produced by Brazilian Portuguese speakers in order to suggest better ways to avoid difficulties and reach a more 'acceptable' (less stigmatized) pronunciation. It seems even more interesting to observe the interdentals in the context here investigated, which is of EFL[2] and not English as a Second Language (ESL), for here university programs are preparing Brazilian teachers of English to become 'models' for their Brazilian Portuguese learners. Thus, having a standard pronunciation seems to be extremely important for these future EFL teachers because the majority want to sound like educated people. Finally, the observation and study of how EFL speakers produce certain sounds such as the interdental fricatives is important for theory, since it might expand the knowledge in the field of L2 phonetics and phonology.

2.2 Unlikelihood of reaching native-like L2 phonological competence

In the literature and elsewhere there is a commonly held idea that most learners will never attain native-like proficiency in regard to

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[2] Even though this researcher understands there are differences when contextualizing the learning of English as a foreign (EFL) as opposed to as a Second Language (ESL), in the rest of this thesis the terms EFL/ESL will be used interchangeably.

pronunciation. According to Flege (1992, p. 565), "adult learners are rarely, if ever, completely successful at mastering the sound system of an L2". Besides Flege, other researchers share this idea of the near impossibility of reaching native-like levels of phonological competence (Bongaerts, Van Summeren, Planken and Schils 1997, cited in Jesney, 2005; Flege, Munro and MacKay, 1995). One may feel even more frustrated by perceiving, for instance, that language experience might not lead to improvement in pronunciation (Flege, 1992). What researchers agree on is that learners who begin contact with the FL by their teens will be more successful at acquiring the L2 sound system. Hence, it can be concluded that, at least considering pronunciation, the younger one starts learning an L2 the better the outcome will be (Singleton & Ryan, 2004).

Foreign accent is a result of this lack of success in attaining ultimate levels of phonological performance. The speaker is said to speak with an 'accent' when his pronunciation is somewhat different from that of a native speaker. This might involve a certain phoneme (e.g., saying *tanks* [tanks] for *Thanks* [θanks]), incorrect word stress (e.g., saying *maNAger* instead of <u>MA</u>nager), or inappropriate intonation and/or rhythm. There are plenty of factors that cause foreign accent (Flege, 1992, p. 590), the most commonly discussed being lack of rich L2 input, the need for learners to speak the L2 in the early stages of L2 learning (instead of receiving a greater amount of positive evidence - input - first), and incorrect perceptual representation of the L2 sound.

In addition to the idea of foreign accent, it seems also interesting to mention 'accent' in general, since it is not something specifically connected to an L2 but also to our own L1. Considering our native language, for instance, we understand that we may choose to speak with a certain accent that may be representative of the social and geographical environment we come from. Thus, an accent seems to be related to the individual's identity, and through the recognition of accent, we can tell an individual's or a certain group's origin. As McMahon (2002) states,

Individuals adopt a particular mode of speech (or, more accurately, move along a continuum of modes of speech) depending on who they want to identify with, who they are talking to, and what impression they want to make. (p. 92)

That is, people tend to speak differently depending on the context of a given communicative act, and, to a certain extend we are able to

alter the forms of speech we are producing depending on our purposes, though we may not be totally aware of these 'decisions' all of the time.

Finally, though it is not a matter of phonology, but of sociolinguistics, to discuss the social judgments speakers make on the basis of (foreign) accents, it seems relevant to investigate how Brazilian teachers-to-be of EFL produce certain sounds, such as the interdental fricatives, in order to perhaps propose ways for improving one's phonological performance and reducing any negative impact that might be caused by foreign accent.

As previously discussed, speaking with a foreign accent often results in a stigmatized judgment by native and highly proficient speakers. And stigmatization is not as recent an issue as we might think it is. Gelderen (2006) explains that even in the beginning of the Modern English[3] period, having correct pronunciation was already important. Regional variants, used to identify where a speaker of English came from, have often tended to be stigmatized when not used in the 'appropriate' context. According to Gelderen (2006), the interdental fricatives produced as stops are among these regional differences that have spread and become stigmatized. For instance, for some speakers of African American English, Irish English and Newfoundland English the words *three* and *tree* are pronounced in the same way (as [tri]). However, as Gelderen states, "this use of [t] and [d] is a social rather than a regional variant" (p. 206).

It is totally accepted nowadays that the English language has spread to the point of becoming the 'world's official language' spoken by more non-native than native speakers (Leech, Rayson & Wilson, 2001). Possible reasons for its spreading are colonialism, migration and, what seems to be more the case nowadays, globalization (Gelderen, 2006). Due to our living in this global society, each day a greater number of speakers understand the necessity of taking part in international business, government, higher education, music, arts. And for that to be accomplished, speaking English seems to be essential

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[3] The Modern English period begins in the year 1700 and continues up to the present time (Gelderen, 2006).

much of the time. What might be of our concern, however, is the marginalization of non-native speakers of this language for their less-standardized pronunciation that might occur for the sake of globalization.

2.3 The English and Portuguese consonant inventories

The English language has 24 consonant phonemes in its basic sound inventory (Giegerich, 1992). These are: (a) six oral stops (plosives) /p b t d k g/; (b) two affricates, the voiceless /tʃ/ and the voiced /dʒ/; (c) nine fricatives, the voiceless /f θ s ʃ/ and the voiced counterparts /v ð z ʒ/, as well as the voiceless /h/; (d) three nasal stops /m n ŋ/; (e) the approximants, divided into two liquids /l r/ and two glides /w j/.

Besides the consonants just presented, there are also the voiceless fricative /x ʍ/ phonemes which are usually observed in the Scottish variety of English (Giegerich, 1992). Considering the latter phoneme, McMahon (2002, p. 31) states that for Scottish and New Zealand speakers "the /w/ contrasts with /ʍ/, the voiceless labial-velar fricative, which tends to occur in words spelled <wh->". This distinction may still be maintained by some Americans, although it seems to be gradually disappearing (Labov, Ash & Boberg, 2006).

According to Cristofaro Silva (1999), the consonantal system of PB consists of the following consonantal phonemes. Considering their manner of articulation, Brazilian Portuguese has: (a) the six plosives /p b t d k g/, which consist of three voiceless and voiced pairs; (b) six fricatives: the voiceless /f s ʃ/ and the voiced counterparts /v z ʒ/; (c) the two laterals /l/ and /ʎ/; (d) the voiced flap /ɾ/, and the 'strong' 'r' /ʁ/, and (e) three nasals /m n ɲ/.

Some variation can be observed either related to regional or to contextual changes. For instance, for *cariocas* (speakers from Rio de Janeiro) words such as *tia* (aunt) and *dia* (day), might be produced with the affricates [tʃ] and [dʒ], respectively, which are regional variants of /t/ and /d/. Besides, *gauchos* (speakers from Rio Grande do Sul) usually produce the lateral /l/ in word-final position, as in the word *final*, as the

velar [ɫ], while other speakers around the country often vocalize it into [u].

More variation is observed, according to Silva (2007) if we are to consider the sounds of /ʀ/ in BP: depending on region and context, it is variably realized as an alveolar vibrant [r], an alveolar tap [ɾ], a velar fricative [x], a glottal fricative [h] or a retroflex [ɹ]. All in all, the interdental fricatives, which are the focus of this study, are not part of the BP inventory and that might be a possible reason for EFL learners' difficulty in their acquisition.

2.4. The English Fricatives

Fricatives are sounds made "with a small opening between the articulators, allowing the air to escape with audible friction" (Yavas, 2007, p. 8). Expanding the definition, we may say that the *friction* characteristic of these phonemes is produced by the partial obstruction of the air (which is produced by the lungs and forced up in an egressive way) passing through the oral tract in order to be expelled in the form of an audible sound. Fricatives are all specified with the features [+continuant] and [-sonorant] because the airstream is not totally blocked in the oral tract for their production.

If the partial obstruction of fricatives is located in the front part of the mouth (in the palato-alveolar region or further forward), the phonemes are described as [+anterior]. The fricatives /f v θ ð s z/ are [+anterior]. Consonants that need the blade of the tongue raised to be produced are [+coronal]. These include the interdentals /θ ð/ as well as the alveolars and palato-alveolars. In terms of the amount of noise produced, the fricatives with greater noisiness - [+strident] - are /s ʃ f ʒ z v/, while the interdentals and the velar fricatives /θ ð h/ are [-strident] (Giegerich, 2002). Table 1 illustrates the feature specifications of the English fricatives that have just been presented.

Table 1. Feature specifications of the English fricatives[4]

	f	v	θ	ð	s	z	ʃ	ʒ	h
[Consonantal]	+	+	+	+	+	+	+	+	+
[Sonorant]	-	-	-	-	-	-	-	-	-
[Continuant]	+	+	+	+	+	+	+	+	+
[Anterior]	+	+	+	+	+	+	-	-	-
[Coronal]	-	-	+	+	+	+	+	+	-
[Strident]	+	+	-	-	+	+	+	+	-
[Voice]	-	+	-	+	-	+	-	+	-

In acoustic terms, fricatives differ in the intensity of the frication noise produced. Just to illustrate, the figure below (Gonet & Pietron, 2006, p. 15) presents a spectrogram of the voiceless fricatives /h, θ, f, ʃ, s/, emphasizing the intensity of the noise component.
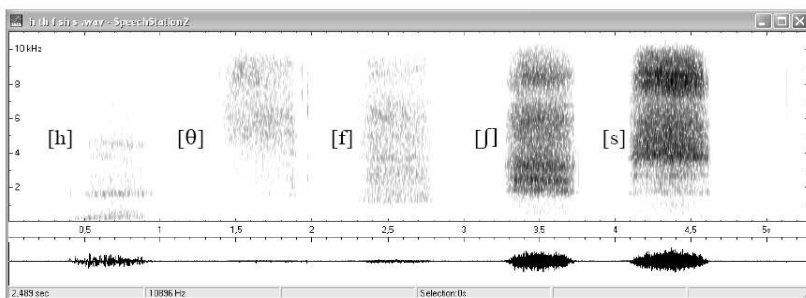
Figure 1. Spectrogram of the English voiceless fricatives /h, θ, f, ʃ, s/.

Considering the voiceless fricatives, Ladefoged comments that words with [f] and [θ] are only distinguished by the movement of the second formant into the following vowel. Besides, given that "the differences between these two sounds are so small, they are often confused in noisy circumstances, and they have fallen together as one sound in some accents of English, such as London Cockney"

[4] Table 1 retrieved feature information from Giegerich (1992, p.128).

(Lagefoged, 2001, p. 182). As it can be seen in the darker bars of the spectrogram above, the acoustic intensity is higher for [ʃ] and [s], while [f], [θ] and [h] are sounds with lower intensity of energy and thus show a lighter bar in the spectrogram.

The voiced fricatives, /v ð z ʒ/ follow similar patterns to those of their voiceless counterparts, but since they are voiced, there is the addition of a voicing bar that can be visualized in at the lower part of the spectrogram. Similar to these counterparts, words with [v] and [ð] can only be distinguished by the formants of the following vowels. Furthermore, the energy of the fricatives [z] and [ʒ] is perceived by their higher frequencies observed in the spectrogram by much darker bars.

2.5 The English interdental fricatives

In simple terms, *interdental fricatives* are sounds characterized by friction produced by a partial obstruction of the airstream coming from the lungs into our vocal tract. What is peculiar in these sounds is that the obstruction is dental, that is, provoked by the teeth. Thus, in our oral cavity, the tip or blade of our tongue is placed between the upper and lower front teeth, and the air passing by this narrow constriction is forced out provoking some turbulence (friction). The name *interdental* represents the sounds' place of articulation, while the term *fricative* is related to the manner of articulation, that is, how these sounds are produced. For some speakers, the tip of the tongue barely touches the area behind the upper teeth, while for others, the tongue is placed closer to the upper teeth, allowing the air to pass in between them and the lower ones (Yavas 2007). That is why these sounds may be called either *dental*, following the former explanation, or *interdental*, following the latter. English interdental fricatives are solely of two types: the voiceless /θ/ (without vocal cord vibration), and the voiced /ð/ (produced with vocal cord vibration). Both phonemes are under investigation in the present research.

Considering the frequency of appearance of these phonemes in the English language system, one can notice without hesitation that the voiceless interdental, compared to its counterpart, occurs in a greater number of words in all word positions, that is, word-initially (*think*), medially (*something*), and word-finally (*both*). Words containing /θ/ are usually lexical words. On the other hand, the voiced counterpart /ð/ is

much less frequent in regards to number of words. As Yavas (2007, p. 65) notes, there are "fewer than twenty words that begin with this sound".   Words with /ð/ word-initially are mostly restricted to grammatical morphemes such as personal pronouns (*they*, *thou*), demonstrative pronouns (*this*, *that*, *these*, *those*), the definite article (*the*), but also include some adverbs and conjunctions (*then*, *thus*, *though*). However, despite this sound's rarity in English, words that begin with the voiced interdental are of high frequency in use. In word-final position, /ð/ often occurs in verbs ending with the grapheme –*e*, such as *bathe*, *teethe*, *breathe*, *loathe*, *clothe*. Such words seem not to be so common in the day-by-day conversations of EFL learners, at least based on my personal experience in EFL teaching in Brazil and on the participants' report on such a frequency of use.

2.5.1 The interdental fricatives: articulatory features

In addition to the definition given above, Gimson (2001) gives a more phonetic explanation of the articulation of the interdental fricatives:

The soft palate being raised and the nasal resonator shut off, the tip and rims of the tongue make a light contact with the edge and inner surface of the upper incisors and a firmer contact with the upper side teeth, so that the air escaping between the forward surface of the tongue and the incisors causes friction. With some speakers, the tongue-tip may protrude through the teeth. For /θ/ the friction is voiceless, whereas for /ð/ there may be some vocal cord vibration according to its situation. The lip position will depend upon the adjacent vowel (p. 183-184).

In the same way that accents in general are subject to flexibility and variation (McMahon, 2002), articulation is also subject to variability. Variation can be inter and intra-speaker, as well as related to speech tempo and register (Gonet & Pietron, 2006, p. 2). That is to say that two different speakers, even following standard articulatory conventions for sound production, might not produce /θ/ and /ð/ equally. Furthermore, even the same speaker may not be able to produce the phonemes in exactly the same fashion when repeating them several times. In addition, variation may be affected by speed of

delivery, which is why in conversational contexts there is a greater level of confusability.

According to Giegerich (1992), the interdental fricatives are phonologically continuant and non-sonorant sounds. By the feature [+continuant] it should be understood that these phonemes, when produced, do not present a complete oral closure of the airstream, different, for instance, from the oral and nasal stops. Being [-sonorant] means that the partial obstruction of the air, characteristic of fricatives, "produces a phonetic effect independent of voicing" (Giegerich, 1992, p. 20). As already introduced in section 2.4, the interdental fricatives can be classified according to their place and manner of articulation: /θ/ and /ð/ are interdental (place of articulation), as well as fricatives (manner of articulation). In addition, /θ ð/ are [+consonantal] [+anterior], [+coronal] [-strident], and they differ in terms of voicing, /θ/ being voiceless and /ð/ voiced.

Taking into account the most commonly reported substitutes for the interdentals, it might be interesting to observe which features they share with /θ/ and /ð/. Table 2 [5] below shows some of these replacements and their feature specifications, such as place and manner of articulation, among others.

Table 2.   Feature specifications of /θ ð/ and their frequent substitutes

Feature	θ	t	f	s	ð	d	v	z
[Consonantal]	+	+	+	+	+	+	+	+
[Sonorant]	-	-	-	-	-	-	-	-
[Continuant]	+	-	+	+	+	-	+	+
[Anterior]	+	+	+	+	+	+	+	+
[Coronal]	+	+	-	+	+	+	-	+
[Strident]	-	-	+	+	-	-	+	+
[Voice]	-	-	-	-	+	+	+	+

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[5] Table retrieved from Reis (2006, p. 5), based on Giegerich (1992).

Comparing interdentals with their common replacements, it can be observed that the feature(s) that differentiate /θ ð/ from: (a) /t/ and /d/ is [-continuant], (b) /f/ and /v/ are [-coronal] and [+strident], and (c) /s/ and /z/ is [+strident]. By comparing the specific features shared and different for the target sounds and their variants, one may better comprehend the reasons for learners adopting them when not producing the interdentals accurately.

2.5.2 The interdental fricatives: acoustic features

Sounds are produced through a small variation in air pressure which happens in a very fast repeated sequence (Ladefoged, 2001). For the fricative sounds, "the airstream is forced through a narrow gap so that it becomes turbulent, with irregularly occurring peaks of pressure" (Ladefoged, 2001, p. 162). The turbulence characteristic of fricatives produces energy which is observed in the spectrogram as a "scribbly pattern, without regular horizontal or vertical lines" (Yavas, 2007, p. 107). For sibilant fricatives, such as /s z ʃ ʒ/, the noise produced is longer and stronger in amplitude, "marked by a rich, high frequency noise spectrum", which makes them easier to be visualized. For non-sibilants /f v θ ð h/, in which the interdentals are included, spectrogram reading becomes much more complex. For these sounds the turbulence noise is weak and the energy printed in the spectrogram is spread to very high frequencies, which makes these sounds very difficult to be distinguished.

Regarding the amplitude of frication noise, for sibilants it is around 58-68 dB whereas for non-sibilants it is 46-52 dB. Considering the frequency of the most intense part of the frication noise, for /θ/ it is around 7.000-8.000 Hertz (Hz). The fricative /f/ has a lower frequency, around 3.000-4.000 Hz. That is why, when attempting to differentiate these two sounds in the spectrogram, what may be helpful is to observe the neighboring vowels: if the fourth formant (F4) of the vowel is above 4.000 Hz, the previous phoneme is probably a /θ/; if it is lower than that, chances are that the sound observed is a/f/ (Yavas, 2007). Ladefoged (2001) explains that the voiced fricatives /v ð z ʒ/ follow similar patterns to their voiceless counterparts, with the addition of the vertical striations representative of voicing observed in the spectrogram.

In order to better visualize what we have been discussing, that is, the acoustic characteristics of the interdental fricatives, a spectrogram of the voiceless /θ/ and the voiced /ð/, respectively, is presented below.
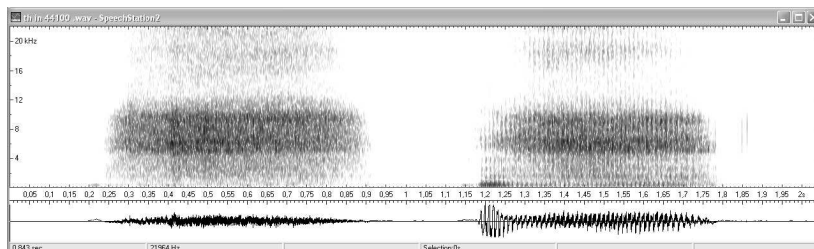
Figure 2.   Spectrogram of the voiceless and voiced interdental fricatives[6].

The greatest difference between /θ/ and /ð/ is that the latter presents a little more energy on the bottom of the spectrum, visualized by the slight dark bar which represents that /ð/ is voiced. Another point to be noticed is that the frication noise observed here is due to emphasis on the phonemes when the recordings were made. In conversational speech, visualization of the difference between the interdental fricatives is much more subtle than that. This is due to the fact that these sounds, as well as many others, tend to be reduced during fast speech, especially in unstressed positions.

If we are to contrast stops and fricatives in relation to duration of aperiodic noise, we might observe that fricatives have a longer noise and stops have a shorter one. For fricatives, this duration, called 'frication', is of 100-200 milliseconds while for stops the noise characterized by a 'burst' lasts only for a few milliseconds. If this longer noise were to be gradually removed from fricatives, what would appear is a voiced stop (Carden, Levitt, Jusczyk & Walley, 1981). That might explain why the

[6] Figure borrowed from Gonet and Pietron (2006, p. 3).

interdental fricatives might be commonly heard and replaced by the stops /t/ and /d/, for the voiceless and voiced interdentals, respectively.

Just for comparison, considering [f θ s ʃ], Ladefoged (2001, p. 182) explains that all these voiceless fricatives have "random energy distributed over a wide range of frequencies". And because of this random distribution of frequencies, it is particularly difficult to differentiate them from one another, especially [θ] from [f]. According to the researcher, if you take words such as *fie* and *thigh* to be visualized in the spectrogram, the only clue to differentiate the two fricatives is the slight movement of the second formant in the following vowel. While there is little movement from [f] to the vowel, in [θ] the second formant starts higher (at around 1,200 Hz) and then goes down. Due to such small differences, it is extremely difficult to distinguish the phonemes during communication under very noisy conditions. Thus, besides the voiceless stop [t], the voiceless interdental fricative is also very much confused with [f], a voiceless labiodental fricative.

Furthermore, for the voiced fricatives [v ð z ʒ] the patterns seem to be the same as the ones of their counterparts presented above. The only thing to be added, though, is that the voiced fricatives present "vertical striations indicative of voicing", which are observed throughout the articulation (Ladefoged, 2001: 183). Thus, by comparing [v] as in *ever* with [ð] as in *whether*, what will distinguish these two fricatives in the spectrogram is the formant of the adjacent vowel, which is higher for [ð] than for [v], similar to what was observed for [θ] and [f].

2.6 Markedness and language universals

The theory of markedness in the Prague School tradition was mainly interested in investigating binary oppositions. Therefore, some entities may be part of a binary paradigm (an opposition), having then opposite markedness values, while others may form a scalar paradigm (a gradation) with different degrees of markedness (Andersen, 2008). According to Battistela (1990), the principle of phonological markedness was extended in the 30s by Jakobson to oppositions between lexical and grammatical oppositions, in his aim to analyze the markedness relations in the Russian verbal system. Some examples of Jakobson's are given by Battistela (1990). For instance, in Jakobson's

'Markedness Values of the Russian Verbal Categories', Formal markedness is explained as "the relation between two opposed units of linguistic expression (…) [in which] the unmarked term is the basic one – that which is unaffixed (as opposed to affixed) or simple (as opposed to compound)" (Battistella, 1990, p. 34). In order to exemplify the idea of formal markedness, Jakobson makes a list with terms which he placed under the labels of 'unmarked' - *host, go, cat, see,* possible -, and 'marked' - *hostess, is going, cats, sees, impossible* (Battistella, 1990, p. 34).

It is commonly observed in the literature that the term markedness seems to be related to other terms considered synonyms. Thus, marked/unmarked is understood as more natural/less natural or more preferred/less preferred, for instance. Nonetheless, Andersen (2008) warns that 'naturalness' and 'markedness' should not be referred to as absolute synonyms for both naturalness and markedness are terms with their own specificities, with distinct meanings within their respective theories (p. 102). In addition, it is interesting to note that there probably are universal markedness values for every level of structure – phonology, syntax, lexicon, pragmatics, among others, but "the extent to which markedness values can be freely ascribed to elements of language remains an open question" (Andersen, 2008, p. 106).

Considering the plethora of terms that have been used as equivalent to markedness, Haspelmath (2006) overviewed the various uses of the terms 'marked' and 'unmarked' in the linguistics literature. The researcher distinguished twelve different senses for the terms and organized them into four main groups: markedness as complexity, markedness as difficulty, markedness as abnormality, and markedness as a multidimensional relation. For instance, regarding markedness as complexity, the researcher gives as an example, among others, the Trubetzkoyan markedness as specification of phonological distinction, "In German, the phonological opposition $t{:}d$ is neutralized syllable-finally in favor of t, which shows that d is the mark-bearing member of the opposition" (p. 27). For markedness as difficulty, one of the examples is related to phonetic markedness: "On the scale $b{>}d{>}g{>}G$, the consonants to the right are increasingly more marked" (p. 27). For markedness as abnormality, one of the illustrations is on typological markedness: markedness as typological implication or cross-language rarity. Here, the researcher exemplifies with the statement that "the syllable coda position is marked in contrast to the onset position" (p.

27). Finally, regarding the last class on Haspelmath's list, there is markedness as a multidimensional relation, which is exemplified by the following "The singular is more marked than the plural, and the plural is more marked than the dual" (p. 27). All in all, the major claim made by Haspelmath is that 'markedness' is a superfluous term. As he understands, the terms 'marked/unmarked' share the sense of everyday words such as "*uncommon/common, abnormal/normal, unexpected/expected*" (p. 65). He concludes stating that instead of using the term 'markedness' , the literature should try to find other terms and concepts which are "less ambiguous, more transparent and [that] provide better explanations for the observed phenomena" (p. 66). Therefore, keeping that in mind, one might agree that describing markedness seems to be easier than defining it (Battistella,1990). In spite of this difficulty, this thesis follows the example of most authors, using the term *markedness*, which, since it deals with position within the word, would have the meaning of *abnormality* or *cross-language rarity*, as described by Haspelmath.

The study of language universals consists of the examination of a wide range of languages and the observation of the characteristics these languages have in common. Language universals, or taxonomic universals, are of two types: absolute and implicational (Carlisle, 1994). Absolute universals account for properties that are inherent in all languages, for instance, the fact that all languages have oral vowels in open syllables (i.e., syllables containing a consonant (C) plus a vowel (V), henceforth CV syllables). Implicational universals, as the name already suggests, consider the conditional relationship in languages – if X then Y; for instance, if a language has voiced obstruents, then it will also have voiceless obstruents in its sound inventory. However, that is not true when reversed, that is, languages having voiceless obstruents may not have voiced ones.

In order to study the relationship of language universals and SLA, Eckman (1977) developed the Markedness Differential Hypothesis (MDH), which claims that "L2 learners will acquire less marked structures more readily than they will more marked structures" (p. 225). The MDH is of a crosslinguistic nature; that is, the markedness relationships were observed by comparing language A with language B. However, the main criticism of the MDH made by researchers at the time (Carlisle 1988; Hammarberg 1990, cited in Carlisle, 1994) was that the markedness relationships should not be considered only in terms of L1-L2 comparison, but also considering the markedness matters within

the L2. As a consequence of the criticism received, Eckman (1991) reformulated the MDH into the Structural Conformity Hypothesis (SCH), claiming that "the universal generalizations that hold for the primary languages also hold for the interlanguages" (p. 24). Hence, the SCH considers not only the markedness relationship between the L1 and the L2, but also the markedness constraints within the L2.

The universal markedness constraint has been widely investigated in a number of cross-linguistic studies. The study of the English final consonants has been a productive field for investigating the universal constraint of markedness together with phonological environment, for instance. Baptista and Silva Filho (1997, 2006) investigated the influence of voicing and sonority relationships on the production of English final consonants by Brazilian learners. They found an interaction between sonority and implicational markedness, given that the frequency of participants' production of paragoge was higher after final voiced obstruents than after final voiceless obstruents. This was explained in terms of markedness, since in final position the voiced obstruents are more marked than the voiceless obstruents. Besides markedness, the determiner of paragoge frequency was found to be the difference in degree of sonority across words.

Due to a universal preference for more simple syllables, of consonant + vowel (CV) over more complex syllables, CCV, CCCV, and so on (Carlisle, 1994), BP speakers usually overcome their difficulty for producing more complex English syllables by adding an extra vowel and simplifying the syllable in this way. Thus, BP learners would often produce the verb *speak* such as [ispik], and a word such as *street* would be either produced as [istrit] or as [istriti], in which the addition of a vowel would not only happen word-initially but also word-finally, characterizing the phenomenon observed as epenthesis (addition of an extra vowel), or more specifically named *prothesis* (when syllable-initial) and *paragoge* (when syllable-final). The modification of syllable structure in one's interlanguage, however, is not solely related to this universal preference for CV syllables. As Carlisle (1994) claims, transfer seems to be the primary process involved in this syllable structure alteration.

Regarding this interaction of syllable structure and the addition of an extra phoneme, Koerich (2002, 2006) investigated the perception and production of vowel paragoge by Brazilian EFL students, who were at the beginning of their learning process. Results of her study show a tendency: as rates of paragoge increased, participants' scores in the

perception test decreased. Learners' high use of paragoge was a result of L1 transfer since in Portuguese the CV syllables are preferable to the CVC syllables found in English. The production of epenthesis was explained to be most due to learners' low level of English exposure, since they were all EFL beginners.

Rebello (1997) and Rebello and Baptista (2006) investigated the influence of voicing and sonority relations on the production of initial /s/-clusters by Brazilian learners. Universal markedness in terms of voicing was found to influence the frequency of syllable simplifications more than markedness in terms of sonority relations. Results show that, in violation of the sonority sequencing principle (SSP), vowel epenthesis tended to be higher before the /s/ in the initial /s/-sonorant clusters /sm/, /sn/, and /sl/, than before the more marked /s/-stop clusters, /sp/, /st/, and /sk/. This was explained by the transfer of voicing assimilation, which is a common process in Brazilian Portuguese.

Rauber (2002, 2006b) investigated the influence of cluster length, sonority and environment in the production of initial /s/-clusters by speakers of Brazilian Portuguese and Argentine Spanish. The researcher observed the interaction between markedness and L1 transfer on cluster production. Results show that the Spanish speakers produced more epenthesis before the more marked /s/-obstruent clusters, and the BP speakers produced practically the same frequency of epenthesis in both cluster types, /s/-obstruents and /s/-sonorants. A possible explanation was that, perhaps due to the greater proficiency level of the participants (if compared to the subjects in Rebello's), the transfer of voicing assimilation was of lesser influence, that is, not strong enough to override the influence of sonority relations, but strong enough to neutralize it.

For the markedness relations between onset and codas, when length is held the same, onsets are less frequently modified than codas Carlisle (1994). That is to say that, since onsets are less marked, their production might be expected to be easier and more accurate than that of codas. Furthermore, in coda position, fricatives and stops (i.e., obstruents), tend to be more difficult to produce than sonorants (Vennemann, 1998). Due to being more marked and thus less readily acquired, the production of these sounds may suffer more variation when in the more marked coda position.

According to Gelderen (2006) and Maddieson (1994, cited in Jones, 2005), among the consonantal phonemes of the English language, the interdental fricatives /θ/ and /ð/ may be considered the most unusual ones, cross-linguistically uncommon, or less frequent in the languages of the world. In an observation of the consonant inventories of about 451 languages, /θ/ seems to occur in 18 of these languages and /ð/ in 21.

Considering onsets and codas[7] of different lengths, the markedness implication is that longer onsets/codas are more marked than shorter ones (Carlisle, 1994). Previously explained in more detail by Greenberg (1978), if a language has an onset or coda of length *n,* that means this language also has an onset or coda of *n-1.* In other words, if language A has an onset of the form CCC(V) (such as in the word *str*ike), this implies the existence of less complex onsets, such as CCV (*st*ove) and CV (*s*ay)*.* Greenberg (1978) also proposes more specific implicational universals concerning the consonants of clusters, such as the following: a) if a language has a word-final two-member coda consisting of a stop-stop, then it will also have one consisting of a fricative-stop; and b) if a language has a word-final two-member coda consisting of a fricative-fricative, then it will also have one consisting of a stop-fricative or a fricative-stop.

Because of the rarity of the interdental fricatives in the languages of the world, they are considered to be marked sounds (Eckman, 1977). In general terms, fricatives are more marked than stops, which are the least marked sounds found in all of the world's languages (Maddieson, 1984; Lombardi, 2000, cited in Lee & Cho, 2002). Furthermore,

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[7]According to Giegerich (1992), a syllable is formed by the onset and rhyme (peak plus coda). The **onsets** are the initial parts of a syllable consisting of the consonant(s) prior to the vowel (peak/nucleus of the syllable). For instance, in the following words, the onsets are the ones before the vowel (in italics and in bold): *c*ar, *cl*ub, and *scr*ibe. However, onsets are not mandatory in a word. Some words, such as *I* or *eye,* have no onset. The **coda** is part of the rhyme, and it represents the consonant(s) following the vowel (syllable nucleus). Codas are the 'final consonants' in a syllable, for instance: ca*r*, clu*b*, and sta*rt.*

affricates are more marked in relation to fricatives, and voiced obstruents are more marked in relation to voiceless obstruents (Eckman & Iverson, 1994). Hence, the sequence from more marked to the less marked sounds is: affricates >[8] fricatives > stops, and within each category, voiced sounds > voiceless sounds.

Eckman and Iverson (1994) also explain that problems in pronunciation may be not only due to the type of segment under investigation but also due to the position of that segment in the syllable. Because codas are more restricted than onsets, the researchers suggest two conclusions:

1) More problems are to be expected in codas than in onsets, and
2) although mastery of a segment in the coda position generally implies mastery of a segment in onset position, the converse is not true. (p. 263).

Thus, bearing in mind the statement above and the issues already discussed, the expectation of the present research is that more errors might occur for the production of /θ/ and /ð/ in word-final position.

For children learning English as their first language, the interdental fricatives are among the last consonants to be acquired (Gildersleeve-Neumann, et al., 2000; Vihman, 1996; Kent, 1992). It is after the age of six (Table 3) that the majority of English-speaking children seem to be able to produce the fricatives and affricates /s, tʃ, ʃ, z, dʒ, v, θ, ð, ʒ/.

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[8] The symbol > here means 'more marked than'.

Table 3. Age of Mastery of American English Consonants. Consonants are grouped according to the age of which 90% of children demonstrate mastery[9]

	3 years	4 years	6 years	Beyond 6 years
Stops	/p/	/b, d, g, k/	/t/	
Nasals	/m, n/		/ŋ/	
Glides	/w/	/j/		
Fricatives	/h/	/f/		/ s, z, ʃ, v, **θ, ð**, ʒ/
Affricates				/tʃ, dʒ/
Liquids			/r, l/	

Sound substitution is a common strategy used by speakers when acquiring the sound system of a given language. For any child learning his mother tongue, it is expected that, whenever a sound heard is not yet well articulated, some other sound will be used in order to compensate for his not-yet-developed articulatory ability. Sound substitution seems to be common for speakers learning any of the world languages. Thus, since all children learning their L1 go through this process of replacing one sound for another, this may be also expected for an adult speaker experiencing the same difficulty in the L2. Therefore, as some researchers advocate (Lee & Cho, 2002; Jenkins, 2000), sound substitution is a widely used strategy during the learning of the sound system of an L2 or FL.

2.7 Confusability: the interdental fricatives and common replacements

Because the interdental fricatives share some characteristics with other phonemes, such as other fricatives and some stops, confusability becomes a phenomenon to be observed. Jongman, Wang & Kim (2003, p. 1367) claim that "among fricatives, /f/ and /θ/ and /v/ and /ð/ are the most easily confused". That is because, according to the researchers,

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[9] Table 3 retrieved from Kent (1992, p. 75).

acoustic information will not help much in differentiating these sounds, since these phonemes have similar acoustic features; thus, in order to avoid confusability, the speaker will need to focus more attention on verbal context and visual information. Moreover, the perception of the /f/:/θ/ contrast is difficult for both children and adults (Vihman, 1996).

Regarding possible reasons for confusability, or more specifically, for segmental replacements to occur, it is important to acknowledge the existence of an 'intermediary grammar' for language learners, that is, the speaker's *interlanguage,*[10] which is in a continuous process of development. According to Jesney (2005), the fact that this intermediary grammar is always changing may allow choices of segmental substitutions to change through time. Perhaps, if that proposal can be generalized to the acquisition of the interdental fricatives, one may expect higher levels of accuracy after a great amount of contact with the L2, say after reaching proficiency in the language. However, from my own experience as an EFL teacher and comments heard from other teachers, this may not be true, at least when considering the phonemes here investigated. It seems that these phonemes are extremely complex for non-native speakers to articulate, and thus, articulation may be the most influential factor hindering the production of these segments.

2.7.1 The interdental fricatives: replacements in some L1 varieties of English

The strategy of sound substitution used by speakers in order to facilitate pronunciation seems not to be restricted to non-native speakers of a language. Some groups of speakers of English as an L1 also replace

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[10]The term *interlanguage*, henceforth IL, was coined by Selinker (1972). It refers to "the language system of a second language learner at any stage in the process of second language acquisition" (Ritchie & Bathia, 1995: 697). Because the interlanguage is in continuous process of changing, we say that it is the transitional system reflecting the learner's current knowledge on the L2.

the interdental fricatives by other sounds. For instance, speakers of Australian English may replace the interdentals by the labiodentals, [v] and [f] (Turner, 1994; cited in Gelderen, 2006). This is because, as Gelderen (2006, p. 256) explains, "some marked sounds in varieties of British and American English correspond to unmarked ones in other varieties and vice versa". The author also mentions other varieties of English in which the interdental fricatives are replaced, such as South Asian, Singaporian, Australian, and New Zealand English speakers. Besides these groups of speakers mentioned, Yavas (2007) reports that Southern Irish English speakers replace the interdental fricatives by stops, the voiceless /θ/ being replaced by /t/ and the voiced /ð/ by /d/.

Regarding New Zealand speakers, Wood (2003) investigated the pronunciation of the interdental fricatives by young non-professional native speakers of New Zealand English. The author speculates whether *th*-fronting, that is, the realization of the interdentals as labiodentals /f/-/v/, is becoming more prominent in New Zealand English (NZE), since only recent studies have reported such occurrence. Data for the analysis consisted of the transcription of 30 minutes of casual speech and a word list reading, containing the interdentals in word-initial, medial and final positions. The data was recorded in 1994 and 2002 and was part of the Corpus of the University of Canterbury. Participants were 4 males and 4 females (recorded in 1994), and 3 males and 3 females (recorded in 2002). After data analysis, results indicate that the interdentals are commonly replaced by /f/ and /v/, and that this happens more frequently in casual speech than in the word list reading. The author illustrates that with one of the speakers who produced the target word *with* as [wɪθ] in the word-list reading but produced it as [wɪf] in all instances of casual speech. Besides, the findings observed were that (a) speakers' f/v substitutions were not consistent; (b) substitutions occurred mostly in lexical words - "no substitutions in grammatical words, except from *through* and *with*" (p.55); and (c) *th*-fronting is more common word-finally. Finally, the author explains that, due to the small sample size of

the study, no conclusion can be reached to whether *th*-fronting is now becoming more prevalent for speakers of NZE.

Dubois and Horvath (2003) have investigated the variant pronunciations of the interdental fricatives in Cajun English[11]. According to the authors, the replacements for the interdental fricatives have followed a regular pattern in history, always maintaining the voicing distinction. According to Rubrecht (1971, cited in Dubois and Horvath, 2003), speakers of Cajun Vernacular English (CVE) realize the interdental fricatives as dental stops 47% of the time, the substitutes being usually the stops [t d], for the voiceless and voiced interdentals, respectively. Besides [t], the voiceless interdental fricative was also found to be replaced by [f] in word-final position, even though this type of replacement was not frequently observed.

Besides, Cheramie (1998) reports that one of the characteristics of Cajun English in phonetic terms is the replacement of the voiceless and voiced interdental fricatives by the voiceless and voiced alveolar stops /t/ and /d/. Dubois and Horvath (2003) report that [f, v], common substitutes for the interdentals, may be found in the speech of London Cockney (Wells 1982, cited in Dubois & Horvath, 2003). Besides, in Australian English the interdental fricatives seem to be replaced also by [f] and [v] in all word-positions. Furthermore, in some American dialects, such as Southern English, the strategy of replacement may also be observed, not only in the speech of black people, but also in that of white speakers.

Yavas (2007) reports on the characteristics of African American Vernacular English (AAVE), which is another variety of L1 English in which the interdental fricatives are replaced. For AAVE speakers, the voiceless and voiced interdentals are realized as alveolar stops in word-

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[11] Cajuns are Acadian French descendents from Canada who settled in Louisiana, United States of America. The variety of language spoken by this group is known as Cajun Vernacular English (CVE).

initial position (such as in *think* [tɪŋk], *they* [de]), but are realized as labiodental fricatives in intervocalic and postvocalic environments (nothing [nʌfiŋ], with [wɪf], mother [mʌvɚ], smooth [smuv]). Moreover, the researcher observes that in clusters with the voiceless interdental, the common replacement seems to be a labiodental fricative, that is, /θ/ before /r̥/, as in *three* is produced as [fr̥i].

2.7.2 The interdental fricatives: replacements for speakers of L1 variants

In this section, some relevant studies mainly regarding the production of the interdental fricatives are reviewed. The following paragraphs are organized by groups of L1 speakers and their specific variants for the interdentals' production (and perception) are introduced. It must be acknowledged that a great number of the studies presented here deal mostly with the voiceless interdental fricative in word-initial position. Thus, the present theoretical background lacks information on the production of /ð/ and the production of the interdentals in word-middle and final positions by some groups of speakers of English as an L2.

2.7.2.1 Korean speakers

Jesney (2005) investigated the production of the interdentals by Korean speakers and observed that there is a tendency for them to replace /θ/ mainly with /s/. Jesney's (2005) research is grounded on Optimality Theory (OT) and thus, the choice of replacements is explained in terms of the optimal choice being the phoneme incurring fewer violations. Thus, Koreans prefer to use /s/ instead of /ʃ/, for instance, to replace the voiceless interdental fricative because the former incurs fewer violations.

The researcher explains the choice of /s/ being more favorable because this phoneme seems to be 'more faithful' to the interdental than /ʃ/. When using /s/ as a substitute, the speaker only alters the sound feature [±strident] (being that /θ/ is identified as [-strident] and /s/ as [+strident]). The other 'candidate', /ʃ/, would incur in two violations; that is, besides violating the constraint previously mentioned

([±strident], changing from [-strident] to [+strident]), it would also violate another constraint, changing from [+anterior] to [-anterior]. That is the reason, according to Jesney, for one phoneme being preferred over another when replacing a target sound.

2.7.2.2 Dutch speakers

Besides Koreans, Dutch speakers also tend to replace the voiceless interdental with the sibilant fricative /s/. Even though the Dutch start learning English as a second language early in life, they often produce [s] instead of the target /θ/ (Collins and Mees, 1999, cited in Heeren 2004). Besides /s/, Dutch speakers may also use the alveolar stop /t/, though it is not so frequent (Gonet & Pietron, 2006).

As for the voiced interdental, James (1984, cited in Flege, 1995) reported that Dutch learners replace word-initial /ð/ by Dutch /d/, and word-final /ð/ with an alveolar fricative /z/ (Gonet & Pietron, 2006). In sum, the most common replacements for the interdental fricatives by Dutch speakers are /s, z/ for the voiceless and voiced phonemes respectively.

2.7. 2. 3 French speakers

Weinberger (1996) reports that speakers of Canadian French replace the interdental fricatives /θ ð/ with the stops /t d/, the voiceless and voiced phonemes, respectively. Brennen (2002) found different substitutes for speakers of European French. According to Brennen, European French speakers replace the interdental fricatives by other fricative phonemes. Thus, instead of the target /θ/, these speakers produce [s], and instead of /ð/, they produce [z].

The cross-sectional study of Gatbonton (1978) on the realization of L2 English interdental fricatives by L1 French speakers suggests that the markedness constraints regarding the phonological environment play a role in the speaker's pronunciation accuracy. Gatbonton investigated the production of word-initial /ð/, with preceding environments being consonants and vowels. What was observed is that the target phoneme was more accurately produced after a word-final vowel than after a consonant. This is because preceding environments formed by

consonant are more marked and thus more difficult to be articulated. Besides phonological environment, the author reported that more formal styles (such as minimal pair reading) would facilitate more target-like realizations of /θ ð/.

Finally, Flege (1995, p. 269) observes that "'schooled' native French speakers of English substitute [s] for /θ/, whereas 'unschooled' native French subjects substitute [t]". The researcher argues that perhaps L2 experience or proficiency may, with time, alter "the metric" used to calculate this cross-linguistic distance.

2.7. 2. 4 Russian speakers

Russian speakers are known to replace the voiceless interdental fricative most commonly by the alveolar stop [t] (Weinberger, 1996). Flege (2003, p. 322) cites a study carried out by Michaels (1974), in which the researcher investigated the perception of the interdental fricatives by Russian and Japanese listeners. The observation was that there was a tendency for Russians to perceive /θ/ as [t] and Japanese listeners to perceived /θ/ as [s]. Considering both phonemes, /t/ and /s/ are present in both the Russian and the Japanese sound inventories, Michaels hypothesized that the different L1s might have different distinctive features considered as more important, and that might explain why Russians perceived 'non-stridency' as a more relevant feature of English /θ/ (and thus used [t] as a replacement) while the Japanese listeners, differently, have the 'continuancy' feature as more important (and thus had [s] as the replacement for /θ/). Therefore, this difference of relative importance of features across languages may explain the different substitutes for the L2 sounds being acquired.

2.7. 2. 5 Japanese speakers

As mentioned above, Michaels (1974, cited in Flege, 2003) observed that Japanese listeners most commonly use /s/ as a substitute for /θ/. Also investigating L2 segmental perception, Lambacher, Martens, Nelson and Berman (1997) conducted a study in order to observe the way native Japanese listeners perceived the English voiceless fricatives. It was verified that the fricative most subjects had

problems in identifying was /θ/. Usually, Japanese listeners confused /θ/ with [s], which was justified by the phonemes' "proximity within the spatial representation" of the Japanese perception of these sounds (Lambacher et al., 1997, p. 190). For word-initial position, a tendency was found for Japanese to perceive /θ/ as [f], which was explained by the acoustic similarity between these two phonemes – they are among the lowest intensity phonemes of English. L1 influence was said to be (in part) responsible for the confusability between /θ/ and /s/, because the Japanese sound inventory has less fricatives than the English one.

2.7. 2. 6 Polish speakers

Segal-Seiden (1997) investigated the perception and spelling of the word-initial and word-final variants of the voiceless /θ/ by 35 adult Polish-Canadian speakers of English as an L2. Besides the Polish speakers, 35 adult native speakers of English participated as a control group. Since the first group varied a lot in terms of age of arrival in Canada, length of residence and number of years of formal English instruction, the criterion for deciding their level of English proficiency was their raw score from the Listening Comprehension TOEFL[12] test. Instruments for gathering data were four types of Auditory Discrimination tests: (a) Real Word Auditory Discrimination; (b) Pseudoword Auditory Discrimination; (c) Pseudoword Spelling; and (d) Pseudoword Spelling Selection. Overall, results show that word-final /θ/ tended to be more accurately identified than word-initial /θ/. Besides, /θ/ was not only perceived as /t/ but also as /d/, /f/ and /s/. The study also shows that "L2 learners are sensitive to perceptual differences between word initial (shorter) and word final (longer) allophone of the phoneme /θ/" (p. 48). The study supports the moderate Critical Period Hypothesis (CPH), since it confirms that adult L2 learners are still able to learn the phonology of an L2, even though not reaching native-like

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[12] TOEFL stands for Test of English as a Foreign Language.

competence. The finding of /θ/ being perceived as /d/ is not accounted forby the markedness differential hypothesis. The researcher believes that, in order to explain this finding, the entire syllable environment should be investigated.

In addition, Gonet and Pietron (2006) report that Polish speakers of English are known to inaccurately produce the interdental fricatives and often replace these phonemes with 11 different sounds: [t, d, f, v, s, z, ts, dz, ĉ, dẑ, tx] (Gonet, 1982, cited in Gonet & Pietron, 2006, p. 1). Due to such a great number of substitute candidates, the researchers conducted a study to understand more about the choice of replacements and verify whether there was some type of systematicity of occurrence.

In their study, Gonet and Pietron observed /θ ð/ in the speech of 14 Polish teenage (17 years of age) students of English at an intermediate level of proficiency. The instrument for data gathering was a sentence-reading task which contained the target phonemes in initial, medial and final-word positions, considering vowels and consonants as previous phonological environments. The researchers found that for the Polish speakers, the voiceless fricative seems to be most often replaced by [f], in cases where it occurs before a vowel (*thank*), word-finally (*growth*), or in a cluster with a sonorant (*health*). It is replaced by [t] in more difficult clusters, such as *bad thrill*. In addition, the voiced interdental fricative is more often replaced by [d] before vowels and by [v] before consonants, being often devoiced to [θ] and realized as [f] in word-final position.

2.7. 2. 7 Hungarian speakers

In a study with Hungarian speakers of English as an L2, Nemser (1971, cited in Leather & James, 1991) observed that speakers perceived and produced the interdental fricatives in different ways. The tendency was that the English interdentals were perceived as labial fricatives, produced as stops and imitated as either sibilants, stops or fricatives. With this observation, the researcher argues against the existence of simple L1-L2 transfer and for the possibility of a dissociation of perceptual and productive patterns.

2.7.2. 8 Italian speakers

Flege, Munro and MacKay (1996) investigated the factors affecting the production of word-initial consonants in L2. The study investigated the production of the English word-initial consonants /p t θ ð/ by 240 native Italian speakers with different ages of arrival in Canada. Besides the native Italian (NI), a group of 24 native English speakers was used as a control, and 10 native speakers of Canadian English served as listeners to rate the degree of foreign accent of the Italians productions. The native Italian subjects had immigrated to Canada between the ages of 3 to 21 years old. The instruments for data gathering were a language background questionnaire and a written word list. Subjects first heard a target word in the carrier phrase (_*is the next word*) and they were recorded speaking the given word in another carrier phrase (*Now I say_*). A total of 25 words were recorded by each participant and 8 of these were analyzed: *pick, peak, tack, tag, they, then, thought, thief*. Because the Italian language does not have /θ/ and /ð/ in its sound inventory, the hypothesis was that these phonemes would be produced more accurately than /p/ and /t/, phonemes which are also present in the Italian inventory.

Overall, results showed that the age of beginning to learn English affected on consonant production. Considering the interdentals, NI speakers who began learning English as children (ages of 3, 5 and 7) produced /θ/ and /ð/ more accurately, similar to the native English group. After that age, and especially after the age of 11, accuracy levels decreased and the tendency was that subjects produced the voiceless interdental as /t/ and the voiced as /d/. As for the stops, when compared to the native English speakers, the NI speakers who begun learning English after the age of 15 produced /p/ and /t/ with shorter voice onset time (VOT) values. The authors explain that the most important factor affecting L2 consonant production was age, followed by language use factors and motivation, which might have also influenced on participants' performance.

2. 7. 2. 9 Taiwan Mandarin speakers

Lu (2008) investigated the adaptation of English interdental fricatives by speakers of Taiwan Mandarin. In his study, the researcher

observed another type of production which had not been previously reported: the substitution of the voiced /ð/ by /l/. Besides, he argues that the choice of substitutes used by certain L1 speakers is related to a combination of factors and not solely to the phoneme inventories of the languages in contact, as some researchers believe (Brown, 1998).

The participants in Lu's (2008) study are four native speakers of Taiwan Mandarin, two males and two females, with ages ranging from 23 to 26. Data consisted of a list of words to be read in the carrier sentence "*Say _____ again*". The target words contained the voiceless and voiced interdentals in the three positions – initial (*think, this*), middle (*author, weather*), and final (*teeth, breathe*). There were three words for each interdental in each word-position (18 target words total). Each participant read each carrier phrase five times, though for the analysis, only the three middle target words were considered. Results of the experiment show that: (a) participants sometimes replaced /ð/ by /l/; (b) the voiceless /θ/ was more accurately produced than /ð/; (c) substitutions of /θ/ were more consistent and there was more variation for /ð/ substitutions; (d) replacements were more frequent in onset position (either word-initial or medial position) than in coda position (word-final), for both /θ/ and /ð/. Lu questions the fact that the appearance of /l/ as a substitute cannot be justified by the previously used explanation of 'emergence of the unmarked', pointing out examples of languages that also do not have the interdentals and replace /ð/ either by the unmarked place alveolar /z/ or by the unmarked manner stop /d/. Besides, the author mentions that the higher difficulty in producing the voiced interdental may be due to voicing combined with place of articulation, given that in Taiwan Mandarin consonants do not have voicing contrasts. Finally, contrary to perceptual accounts, the participants in the experiment grasped more the coda interdentals than the onset ones. Lu (2009: 2) explains that "these patterns cannot be explained simply on the basis of the phoneme inventory, native language feature marking, or perceptual similarity"; according to the author, a combination of factors should be taken into account.

2.7. 2. 10 Brazilian Portuguese speakers

This section about Brazilian Portuguese speakers includes studies about perception, production, and effects of training, which are based on various theoretical paradigms, from markedness to phonetic categories, to optimality theory. The comparisons observed in the studies include the voiced versus the voiceless interdentals, the positions within the syllable or the word, levels of task formality, training versus instruction, and perception versus production.

Jorge (2003) investigated the production of the voiceless interdental /θ/ by three groups of Brazilian EFL students with different levels of L2 experience. Participants were fifteen learners, divided into three groups of five with 0 to 2 years of experience, 2 to 4 years, and 4 to 6 years. The voiceless interdental was investigated in word-initial position, word-final position and in a cluster as in the word *three*. Overall, results showed that intermediate and advanced learners had more accurate productions of /θ/ while the beginners had more inaccurate productions. Beginners produced /θ/ accurately only 7% of the time in word-initial position and 3.3% in final position; intermediate and advanced learners produced /θ/ accurately with a frequency of 70% for both word-initial and final positions. The voiceless interdental was more frequently replaced by /t/ in word-initial both in simple and complex positions, and by /f/ in word-final position. The researcher concluded that "it is at an intermediary level [of L2 learning] that the acquisition of the English interdental fricatives happens[13]" (p.46)

Cruz (2005), who investigated the adequacy of minimal pairs for the investigation of meaning confusion, found the following for the minimal pair /θ/-/t/: the only sample in which it occurred was "I had three dogs and the first". Although the participant produced the word

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[13] [My translation]. From the original: "é no nível intermediário que se faz a aquisição das interdentais do Inglês" (Jorge, 2003, p. 46).

three [θri] as *tree* [tri], none of the British listeners wrote it or understood it as being the word *tree*. Only 5 samples containing words which formed minimal pairs were under analysis. The words analyzed were: *live* (distinguished from *leave*), *sit* (distinguished from *seat*) and *three* (distinguished from *tree*). As for the conclusion, Cruz explained that none of the analyzed words which form minimal pairs seem to have caused the predicted misunderstanding. Because of the limited sample under analysis, she states that no generalization can be made in order to answer that minimal pairs are not suitable to illustrate meaning confusion. The author also advocates for raising learners' awareness for the linguistic context, since it may reduce confusion of pairs that tend to be more easily confused.

Reis (2006) investigated the perception and production of the interdental fricatives by BP learners of EFL. Questions guiding the research aimed at observing: (a) the pattern of replacement of the interdental fricatives; (b) whether English language experience influenced perception; (c) whether participants perceived when the target phonemes were replaced by the common variants; (d) whether one phoneme was more difficult than the other, in terms of perception and production; (e) whether there was a correlation between perception and production; and finally (f) the effect of the different test styles on the production of the interdentals by the subjects.

The participants in Reis' study belonged to two different groups: one at a pre-intermediate level (12 learners with one and a half years of experience) and one at an advanced level (12 learners with five years of experience). Learners attended instructional classes in English at the Extracurricular Language Program at UFSC. The instruments for collecting data were three production and three perception tests, as well as two questionnaires, used for obtaining participants' personal information and language experience. Production tests consisted of reading a text, retelling the story of the text and reading a list of sentences. The perception tests were a general pronunciation error perception test, a Categorical Discrimination test and an Alternative Forced Choice Identification test (for more information on the tests, see Reis, 2006, p. 36–44). The target words used in the tests contained the voiceless and the voiced interdentals in word-initial position.

What Reis observed in terms of production in all 3 production tests was that (a) most speakers commonly used [t] as a substitute for /θ/ and [d] as a substitute for /ð/; (b) the voiced /ð/ was more difficult to

produce than /θ/; (c) language experience seemed to have affected only the production of the voiceless /θ/ and not that of /ð/; and (d) more formal tests yielded fewer production errors than less formal tests, as advocated by Beebe (1987) and other researchers.

In the sentence reading test, the intermediate learners produced word-initial /θ/ with 22% accuracy and /ð/ with only 1% accuracy; the advanced learners produced /θ/ with 45% accuracy and /ð/ with only 20% of accuracy. Besides the substitutes [t] and [d] for the voiceless and voiced interdentals, respectively, which were common to all learners, other production types were also observed: (a) intermediate learners also produced [t], [tʰ] [f], [d], [tʃ] and only rarely [s] as replacements for /θ/; and (b) the advanced learners replaced /θ/ only by [t], [f], [tʰ], [d], and rarely by [tʃ].

Considering perception, Reis found language experience to have only a slight and statistically non-significant influence on the perception of the voiceless phoneme. Additionally, the voiced /ð/ was found to be more difficult to perceive than the voiceless /θ/. Findings also point to the inexistence of a correlation between perception and production of the interdentals. Reis (2006, p. 95) explains that "the target phonemes may have been perceived through the L1 sieve", as claimed by Wode (1995) and Rochet (1995), and that "/θ/ seems to have been attracted to the prototype /t/, and /ð/ to the prototype /d/". In addition, Reis suggests that problems in the production of the interdentals may be caused by articulatory difficulties since the production of these 'new' sounds may require the formation of new motoric habits by the BP speakers.

Also investigating Brazilian learners, Leitão (2007) investigated the acquisition of the interdental fricatives in the light of the Connectionist Optimality Theory[14]. One of the aims was to determine

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[14] Optimality Theory (OT) has been employed by a growing number of researchers, especially in studies developed in the south of Brazil. OT is a linguistic model that understands the language output to derive from

the substitutes Brazilians use for /θ/ and /ð/, as well as to verify participants' differences in performance for monitored and free speech, and to observe the role of the lexicon in the acquisition of the interdentals. The study hypothesized that (a) learners would replace /ð/ and /θ/ by /d/, /f/, /s/ and /t/; (b) spontaneous and monitored speech would provide different outputs for the L2 learners; and (c) the role of lexicon is present in the process of the phonemes' acquisition. Participants were (a) seven undergraduate students from the 6th semester of the Letras Course at Universidade Federal de Santa Maria (UFSM); (b) learners from the extracurricular English program at UFSC, either from the 3rd or from the 10th semester of English. Regarding hypothesis (b) above, the researcher used the data collected by Reis (2006). The data borrowed from Reis (2006) consists of the reading of a text, the oral report of the text read and the reading of a sentence list, as already mentioned in the beginning of this subsection. The data gathered with the undergraduate students from Santa Maria consists of oral narratives from a silent movie watched by the participants.

The results showed that at an intermediate level of L2 acquisition most learners still replace /θ/ with [t] and /ð/ with [d]. Contrary to Reis' (2006) and other researchers' findings (e.g., Tarone, 1979; Beebe, 1987; Schmidt, 1987; Major, 1994, cited in Reis, 2006), regarding the type of test applied, "the freer the production is, the higher the chances for the learner to get the pronunciation of the interdental fricatives

the interaction between conflicting constraints. It explains, through the hierarchy of restrictions, the grammar of the learners' interlanguage systems. Its focus, thus, is on the output. In OT, "the grammar is represented by the universal restrictions organized according to a given hierarchy" (McCarthy, 2002, cited in Leitão, 2007, p. 46) [My translation]. For the Connectionist OT (Bonilha, 2004), used by Leitão (2007, p. 74), in order to acquire an L2 the learner needs "to acquire the hierarchy of restrictions referent to this L2 as well as to acquire the L2 restrictions which are not part of the L1 grammar". [My translation] Since this is not within the scope of the present study, more info on OT can be found in Leitão (2007) or Bonilha (2004).

accurate, choosing the L2 vocabulary which has been previously acquired correctly and which is more familiar to him/her[15]" (Leitão, 2007, p. 89). Leitão suggests that the features that interact in the BP speakers' interlanguage, following the faithfulness[16] constraints of the OT, are Ident[continuat], Ident[strident], Ident[coronal], as well as markedness constraints. Furthermore, the researcher points out the central role assumed by the lexicon in L2 phonological acquisition. Therefore, the observation is that learners who have not yet attained an ultimate level of phonological acquisition in the L2 may produce the interdentals as [t] and [d], instead of the voiceless and voiced interdentals, respectively.

Reis and Koerich (2007), after reviewing the pronunciation manual *Guia de Pronúncia do Inglês para Brasileiros* (Schumacher, White & Zanettini, 2002), carried out a study using the exercises on the interdentals from the book to investigate the effect of instruction. Results of the experiment demonstrate that, in general, the participants of the experimental group showed some improvement in performance regarding the voiceless interdental fricative. Besides, the substitutes observed for /θ/ were more frequently [t] than [f]. For the voiced interdental, not much improvement was observed and the substitute employed was [d]. The control group showed no improvement in performance for neither /θ/ nor /ð/, the accuracy level was 0% from beginning to end. Reis explains, based on Ellis (1994) and Yule and Macdonald (1994), that gains or improvement in performance might be

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[15] [My translation]. Originally: "Quanto mais livre for a produção, maior a chance do aprendiz acertar a pronúncia das fricativas interdentais, escolhendo o vocabulário da L2 já adquirido corretamente e que lhe é familiar" (Leitão, 2007, p. 89).

[16] In OT, the faithfulness constraints require similarity between the input and the output representations, or, as McCarthy and Prince (1995, p. 3) put it "constraints of faithfulness demand that the output be as close as possible to the input, along all the dimensions upon which structures may vary".

actually observed only after some time after the treatment, and not immediately after. Furthermore, more improvement seems to be observed in segments which are less marked, such as the case of the voiceless interdental. Based on their experiment and use of the book, they conclude with an evaluation of the book, pointing out it can be used as a complementary tool in contextualized pronunciation classes in order to reach intelligibility, which is, as she states, the main objective of pronunciation instruction.

Trevisol (2007) conducted a small scale study in order to investigate the production of the voiceless interdental fricative by EFL learners from the south of Brazil. The voiceless /θ/ was investigated in word-initial and word-final positions. The participants of the study were ten EFL intermediate learners from the Extracurricular English Program at UFSC, with about three years of EFL instruction. The instrument for data collection was a sentence reading test. The test included fifteen sentences containing the voiceless interdental in word-initial and fifteen sentences in word-final position, as well as ten distracter sentences. Sentences were randomized and participants individually read and recorded them.

Regarding word-initial /θ/, the most frequent production type observed in Trevisol's (2007) was that of [t], with 87,33% frequency; the accurate [θ] production was observed in 10,66% of the word-initial instances, and [f] appeared as a substitute 1,33% of times. Furthermore, the target token /θ/ was omitted in word-initial position with a frequency of 0,66%. Considering word-final /θ/, the accurate production [θ] occurred in 44% of the instances. The most common replacement type was once again [t], which occurred with almost the same frequency as [θ]: 44,66%. Furthermore, there were other replacements: [f] with 7,33%, [s] with 0,66%; omission occurred with a frequency of 3,33%. These results can be understood to suggest, at least regarding production of the voiceless interdental and the participants of the given study, that word-final position might have been easier to the participants of the study, somehow contradicting predictions made according to the markedness hypothesis (Eckman, 1977) which claims word-final obstruents to be more difficult to produce than word-initial obstruents. In addition, the fact that [t] was the most frequently employed substitute for word-initial position corroborates Reis (2006), which also found the voiceless stop to be the favored replacement by her intermediate and advanced participants.

Rodrigues (2008) investigated, under the theoretic background of the OT, the production of /θ/ and /ð/ in word-initial, medial and final positions, by advanced BP learners of English in the south of Brazil. Participants were sixteen advanced EFL learners (ages ranging from 15 to 25 years of age) who had been studying English for 4 years in a private language course in Porto Alegre, Rio Grande do Sul. Instruments of data gathering consisted of a text reading task and a free conversation task, which were both recorded on video. Overall, results showed that the voiceless /θ/ was often replaced by [t] and [f] and the voiced /ð/ was replaced by [d] most frequently. The use of substitutes was much more frequent than accurate production, especially for the voiced interdental phoneme. In the text reading activity the researcher found more accurate realizations of [θ] in word-final position than in other positions. The approximate percentage of accuracy in production for /θ/ was of 2% in word-initial and 26% in word-final position; and for /ð/ 0,6 % in word-initial and 1,8% in word-medial position (no percentage is given for word-final position). For the free conversation task, fewer instances of the target words were observed, though overall /ð/ was produced as [d] and /θ/ was usually replaced by [f] or [t]. The analysis revealed that markedness was the constraint which had the highest rank over faithfulness for the [t] production, while faithfulness outranked markedness for the [f] substitution. The researcher explains that the BP learners tended to replace the interdentals by those phonemes which were more similar to but less marked than the target ones.

Reis (2008) investigated perception of /θ/ by speakers of English, German, Canadian and European French, and BP. The most commom replacements for these L1 groups are considered to be the following: [s] for German (Hancin-Bhatt, 1994) and for European French speakers (Brannen, 2002), and [t] for Canadian French (Brannen, 2002) and for BP speakers (Reis, 2006; Leitão, 2007). For the investigation, the researcher had the stimuli recorded by a female native speaker of English. The stimuli contained twelve CV syllables with the probable given consonants /θ, f, t, s/ and vowels /i, a, u/. Three types of perception test were used in the experiment: (a) an assimilation test; (b) an AB discrimination test; and (c) a transcription test, which showed identification. Results demonstrate that the English speakers assimilated

/θ/ as /θ/, and the other groups of speakers – German, Canadian French, European French and BP – assimilated /θ/ as /f/. This was explained by to the similarities between /θ-f/ in acoustic terms. In addition, Reis also observed low scores for discrimination of the contrast /θ-f/ discrimination among the four groups, different from the high discrimination scores for the /θ-t/ and /θ-s/ contrasts. Finally, the researcher also found the spellings used for the transcription of /θ/ to be mainly *f, t* and *s*: English speakers transcribed /θ/ either as *th* or *f*, Brazilians as *f*, Germans as *f, ph* and *s*, and French speakers as *f, t*, and *s*, preferably.

Osbourne (2008) investigated the systematic differences between standard English and the interlanguage phonology of a Brazilian learner of English. The focus of her study was on the production of the consonantal sounds of English. The participant was a middle-aged woman, residing in New York for six years prior to data gathering. At that time, the participant had had around 96 hours of formal English instruction, but most of her learning was taking place in a naturalistic fashion. Data was gathered though the recording of spontaneous speech, in which the participant was invited to talk about a subject of her preference for twenty minutes. Only the first seven minutes of the speech were analyzed in the study. In general, differences from Standard English pronunciation were observed in the production of final obstruents, some consonant clusters in initial and final positions, as well as the interdentals, among other aspects investigated. Regarding the English interdental fricatives /θ ð/, the participant systematically replaced the voiceless interdental /θ/ by [t] and the voiced /ð/ by [d], with 100% frequency. Osbourne (p. 129) explains that "BP speakers may perceive stops and interdentals as similar sounds, and, therefore, they employ stops (and not other sounds such as fricatives, for example)" as substitutes for the interdentals. Furthermore, she states that the use of stops for the English interdentals, even though it might cause miscommunication in some instances, might not be seen as a major problem, even though it might cause miscommunication in some instances, considering the existence of some English dialects (AAVE, for instance) that have [t], [d], [f], and [v] as replacements.

Ruhmke-Ramos (2009) investigated the effects of training and instruction on the perception of the interdentals with BP learners. The participants for the study were 53 pre-intermediate learners of English

who were divided into two treatment groups: the training group (TG), which received perceptual training, that is, implicit teaching or practice without explicit instruction; and the instruction and perceptual training group (ITG), which worked on verbal awareness of the target sounds followed by practice. The main goals of the research were to observe to what extent each treatment would enhance the learners' perception of the items in word-initial position and which treatment would prove to be more effective in the end. The instruments of the study were a questionnaire, a categorical discrimination test prior to treatment, then the treatment and afterwards a categorical discrimination post-test. Results suggest that both treatments might be effective in leading to some degree of improvement in perception; however, the only statistically significant improvement was for the ITG on the [θ]–[s] contrast. Finally, the researcher claims that both instruction and training could be important tools to be used in pronunciation classes, and that explicit information on the item observed may prove to be particularly effective.

Ruhmke-Ramos and Delatorre (2009) investigated the effects of training on the production of the English interdental fricatives by Brazilian EFL speakers. The participants were adult learners of English, at the beginner level (level 2), with around 80 hours of instruction. They were enrolled in the Extracurricular English Program at the Universidade Federal de Santa Catarina (UFSC). Two groups participated in the study: one training group (TG), with ten participants; and a control group (CG) with five participants. The instruments for gathering data were a questionnaire and a sentence reading test. The questionnaire informed about the participants' personal information as well as their contact with the English language, regarding hours of formal instruction, use of English in trips abroad, among other aspects. The sentence reading test contained 14 sentences with the interdentals (7 with /θ/ and 7 with /ð/) in word-initial position, as well as 16 distracter sentences. The total of 30 sentences was read and audio recorded by each of the participants in the language laboratory at UFSC. The instrument was applied as a pre-test and also as a post-test.

The pre-test was applied one week before the treatment was given to the TG. The CG received no treatment, that is, no type of training. For the TG, a 45-minute session was given so that the participants could be trained on the perception and production of the target phonemes, with no explicit information on how the sounds were produced. For the training session, a pronunciation manual was used: *Pronunciation in*

Use (Hancock, 2005). The post-test was applied a week after the training session.

In the pre-test, the CG produced more accurate productions than the training group, showing that the two groups differed from the start: the CG produced the accurate [θ] with 31,42% frequency, and [ð] with 42,85% frequency; while the TG produced the accurate [θ] with 12,85% frequency, and [ð] with 5,71% frequency. Regarding the post-test, the CG accurately produced [θ] with 37,14% and [ð] with 14,28% frequency, and the TG accurately produced [θ] with 15,71% and [ð] with 11,41% frequency. What can be observed, by comparing the pre-test with the pos-test numbers is that, even though the CG had higher accurate percentages, its production accuracy in the post-test decreased; on the other hand, the TG improved its performance from the pre to the post test. These results suggest a possible positive change for the training group, even though non-significant in statistical terms, on the production of the interdentals from the pre-test to the post-test. The researchers conclude that, in general, the accurate production of the interdentals by Brazilians tends to be quite low. Furthermore, they explain that these results might have been affected by the short period used for the treatment (only 45 minutes); participants might still be absorbing the information received during the training practice and a longer treatment might render different results. In addition, the type of treatment employed might have influenced as well as the characteristics of the sounds investigated.

Barbosa (2009) conducted a small scale exploratory study to observe whether four teenage learners from a private school in the northeast of Brazil (Jequié – Bahia) could improve their production of the voiceless /θ/ after a pronunciation training experiment. The 2 elementary and 2 intermediary learners participated in activities that involved mostly minimal pair drills, as well as listening, bingo and text readings containing the interdental fricative. The researchers explain that overall, at the end of the two months of training, three of the participants made some improvement in their /θ/ production, even though they still occasionally realized the interdental either as [f], [t] or [s]. The authors believe this type of experiment was valuable to the learners because it made them aware of novel L2 sounds and their own pronunciation errors; this way, some were able to monitor their performance and attempt to produce /θ/ adequately afterwards.

Peleias (2009) investigated the production and perception of the voiceless interdental fricative by Brazilian EFL learners. The major aim of her study was to observe, through an acoustic and phonetic analysis, whether or not there is a relationship between production and perception of /θ/ by the group of Brazilian learners investigated. The participants were 3 Brazilian EFL learners, all females with ages ranging from 20 to 22 years. Regarding age of first contact with the English language, the first subject, named SNB1, started studying English at 11-12 years of age; SNB2 started at 13-14 years of age, and SNB3 at 16-17 years of age. In addition to the three Brazilians, one native American female also participated as a control for the study, recording the sentences which were to be used in the investigation, as well as 31 native American subjects who judged the participants' performance. The instruments for gathering data were: (a) a production test with 38 randomized sentences, with the target words containing /θ/, in syllable-initial and final positions, or other minimal pairs serving as distracters; and (b) a perception identification test, in which the participants were required to listen to the 38 sentences (recorded by the control) and identify which sound was being heard.

Results show that, overall, the Brazilian learners perceived /θ/ as [θ] with a frequency of 53.3%, and /θ/ as [t] with a frequency of 40%. In the production test, results differed among the three participants, only SNB1 approaching the native English speaker in terms of accuracy in production. SNB2 and SNB3 tended to perceive and produce /θ/ as [t] (p. 106). The researcher then explains that, for the participants in the given sample, there seems to be a relationship between perception and production of [θ], since they behave in such a way that their perception and production correspond, either accurately (as SNB1) or using a single substitute (as SNB2 and SNB3). The higher accurate production by SNB1 is attributed to the fact that this participant started his/her contact with English before the other learners, which probably allowed him/her to create a new L2 category for /θ/. As for SNB2 and SNB3, it seems likely that they assimilated the interdental into a single L1-L2 category based on their L1, Portuguese, not forming a new L2 category for /θ/ (p. 107). Finally, based on the investigation, Peleias advocates for the existence of a perception-production relationship regarding the pronunciation of the voiceless interdental fricative, for she concluded that what the participants perceived influenced on what they produced.

Reis (2010) investigated the perception and production of the English /θ/ by speakers of European French (EF) and Brazilian Portuguese (BP). The participants were 20 native European French speakers and 21 Brazilian Portuguese speakers. Instruments for gathering data were the tests evaluating: (a) production; (b) perceptual assimilation; (c) discrimination; (d) auditory identification; and (e) audiovisual identification. Seventeen native British English speakers were part of the control group, taking the first three perception tests mentioned. Data was interpreted based on the Perceptual Assimilation Model (PAM, Best, 1995, cited in Reis, 2010, p. 203) and its expanded version on second language perceptual learning (PAM-L2, Best & Tyler, 2007).

In the production test, the EF and BP participants had to read the carrier phrase "I say ____". The words in the blank space were one of these: (a) thought, fought, taught, sought; (b) thin, fin, tin, sin; (c) thigh, fie, tie, sigh. The stimuli used for the perception tests were vowel-consonant-vowel (VCV) nonwords, in which the consonants were one of these - /θ, f, t, s/ - preceded and followed by one of the vowels /i, a , u/. In the Perception Assimilation test, each consonant was to be labeled either as *F, T*, or *S* and then rated as for goodness-of-fit to the chosen L1 category. In the Discrimination test participants had to indicate the odd item in a three-item trial, with /θ/ contrasting with one of the other consonants. The Identification tests, which had the stimuli presented in Auditory and Audiovisual modes, had the twelve nonwords appearing once in six trials, and the participants had to label them as *F, T, S*, or *none of the consonants*.

In general terms, Reis' (2010) results suggest that differential substitution may have an underlying perceptual cause, which was more evident with the French European speakers. Nonetheless, "for both EF and BP speakers, production of /θ/ is not clearly related to its perception" (p. 200), that is, having an accurate perception does not necessarily mean having an accurate production, and vice versa. The researcher explains that a higher number of participants might have rendered different results, perhaps showing whether a relationship existed between the two variables, perception and production.

Considering only production, the EF speakers produced /θ/ in an accurate fashion in 32.48% of the cases, while the BP speakers produced /θ/ accurately in 68.25% of the times (p. 208). Results also showed that:

(a) /θ/ is assimilated as both /f/ and /s/ by the EF speakers, and as /f/, /t/ or /s/ by the BP speakers; (b) neither EF nor BP speakers assimilated /θ/ as F more than as T or as S, as predicted; (c) the pattern of assimilation for the /θ/-/t/ and /θ/-/s/ contrasts was 'very good', while for the /θ/-/f/ contrast discrimination was 'good'; (d) both EF and BP groups of speakers labeled /θ/ as *none of the consonants*, different from predictions; and (e) when /θ/ was replaced, the pattern of assimilation was [f] and [s] by the EF group, and mainly [t] by the BP group, being that the latter group also assimilated /θ/ as /f/, /t/ and /s/ less frequently.

2.7. 2. 11 Summary of L2 replacements of the English interdentals

Taking into consideration what has been discussed in this chapter, one can understand the process of learning another language as a demanding and complex one, especially if the learner has started venturing into L2 acquisition in adulthood. In this case, it is all the more likely for his/her accent to sound a little different from that of a native-speaker, at times hindering the overall intelligibility in communication.

The studies reviewed here have improved our comprehension of how speakers of different L1s perceive and produce the sounds of English as an L2 and the possible reasons for the difficulties faced throughout the process. There has been a growing interest in the investigation of the way EFL learners produce and identify the interdental fricatives. From models of speech perception, to markedness constraints and OT analysis, among others, the literature has enriched the understanding of the interdentals and the learners' behavior during the acquisition process of these phonemes.

Finally, the recent proliferation of studies of the interdentals demonstrates the increased importance given to these phonemes, mainly because of the greater difficulty of mastering these sounds and their importance for avoiding social stigma, despite the lack of communicative importance.

CHAPTER 3

METHOD

3.1 Introduction

This chapter describes the experiment conducted in the present study in order to investigate the production of the interdental fricatives in two different word positions, word-initial and word-final position. In order to better organize the content here presented, the chapter is divided into five sections: section 1 presents the Research Questions (RQs) and Hypotheses (Hs) that guided the study; section 2 reveals information about the participants; section 3 introduces the instruments used for data gathering; section 4 explains the procedures for data collection; and finally, section 5 shows the procedures for the analysis of the present data.

3.2 Research Questions and Hypotheses

In order to investigate the production of the interdental fricatives in both word-initial and final positions, the following Research Questions (RQs) and Hypotheses (Hs) were proposed so as to guide the study:

RQ1. What is the pattern of production of /θ/ in word initial and final positions?
H1. The participants will produce the non-native replacement [t] for /θ/ more frequently than the other substitutes in word-initial position (Reis, 2006).
H2. The participants will also produce the non-native replacement [t] for /θ/ more frequently than the other substitutes in word-final position.

H1 is based on Reis (2006), who investigated the production of the interdental fricatives by Brazilian EFL learners and found that [t] was the most common sound learners used as a substitute for the voiceless fricative in word initial position. For word-final position, the prediction is the same as for word-initial, since this position is expected to cause more errors in production due to its more marked status.

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RQ2. What is the pattern of production of /ð/ in word initial and final positions?

H3. The participants will produce the non-native replacement [d] for /ð/ more frequently than the other substitutes in word-initial position (Reis, 2006).

H4. The participants will produce the non-native replacement [d] for /ð/ more frequently than the other substitutes in word-final position.

RQ3. Does word-position affect accuracy in the production of /θ/ and /ð/?

H5. The participants will produce the accurate [θ] for /θ/ in word-initial position more frequently than in word-final position.

H6. The participants will produce the accurate [ð] for /ð/ in word-initial position more frequently than in word-final position.

For H5 and H6, some assumptions are made: first, it is considered not only for these hypotheses but also in the whole investigation, that the interdental fricatives are marked phonemes in the world's languages, and that "marked elements are distinguished by greater complexity" (Battistella, 1990, p. 49). In addition, we are considering Eckman's (1977) Markedness Differential Hypothesis (MDH) to be valid, that is, the interdentals, which are understood as being marked segments, are to be less readily acquired and in this case produced by the participants in the study. Finally, specifically related to H5 and H6, it is assumed that segments in word-final position are more marked, and therefore more complex to produce in this position if compared to word-initial segments. Thus, the expectation is that the participants in the present study will produce more accurately and therefore more frequently the voiceless and the voiced interdentals in word-initial position.

3.3 Participants

For the present study, eleven Brazilian EFL learners accepted to participate in the experiment, eight women and three men, aged from 20 to 37 (mean age of 24). Besides the BP participants, one native speaker of British English was also invited to be a control for the study. The native speaker is a 47 year-old male who was born and resides in

England, and who speaks no other language besides English. All participants self reported normal hearing and speaking capacities.

The paragraphs that follow inform about the eleven participants' personal information and language contact, based on their completion of the research questionnaire after the production test had been applied (see Appendix C for questionnaire table of results). Participants here are represented by P1, P2 and so on.

Eight of the subjects are undergraduate language students from the Letras English Course at Universidade Federal de Santa Catarina - UFSC and the three other subjects are former English teachers who had worked in language schools in the south of Brazil. These participants were chosen because they were considered to be in an advanced level of English, either due to the fact that they were studying the language to be English teachers, or given that some had also experienced the teaching of the language. The expectation was that this group of participants could produce the target sounds with a greater level of accuracy[17]. Therefore, all of the participants were considered to be advanced English users, with an L2 experience of about 9 years (minimum of 4 and maximum of 20 years).

Regarding place of residence, the eight undergraduate learners of English were currently residing in Florianópolis, Santa Catarina, and the three former English teachers reside in Toledo, Paraná. At the time of data gathering, the undergraduate learners were enrolled in the seventh semester of the Letras English Course. The Letras English Course takes eight semesters to be completed, that is, a total of four years to receive a diploma for teaching English. The Course encompasses disciplines that go from linguistics to English literature. Among the disciplines, there are specific ones which develop the comprehension and written production of the English language, as well as the oral production and

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[17]In the present study, a sound is considered accurate when it is produced in a native-like fashion. Thus, in terms of accuracy, the interdental /ð/ would be realized as a voiced (inter)dental fricative and the /θ/as a voiceless interdental fricative.

pronunciation, from beginner to advanced levels. Most subjects are taught in English. In the eighth semester, learners complete 144 class hours of teaching training/practice in English (Estágio supervisionado). The three former EFL teachers completed their 5 years of English studies at a franchise language school in their hometown and, after that, taught English for at least 3 years either privately or in language schools. They have degrees in areas other than Letras: chemical engineering, biomedicine and business administration.

Age of first contact with the English language varied considerably among the participants, from early childhood (around 7 years of age) to late puberty (after 15 years of age). Most participants reported having continued the study of English after that first contact, without interruption, from three to fourteen years. Time for studying English at home was about two hours a week for the majority of the learners. The two participants who reported more than ten hours of English home study explained that, as teachers of English, they considered 'time of study' the hours spent to prepare classes, correct activities, and speak to their students in the foreign language. Finally, considering language experience and use apart from formal classroom study, participants reported frequently being in contact with the language, in situations which involved class preparation, academic readings or pastime activities, such as movies, internet and music, this latter being reported to be present for at least one hour in participants' daily routine.

Spending time abroad in an English-speaking country was an experience reported by five of the participants, who have stayed abroad from four to twelve months, either in Canada or in the United States of America (USA). None of them had been in an English-speaking country in the twelve months prior to the data gathering. Purposes for traveling were mainly study, work and/or tourism. The majority of participants claimed to have spent more time in contact with native speakers of English when traveling. Only one participant reported being more in contact with Brazilian speakers, thus using more Portuguese than English, when abroad.

Pronunciation was considered an important aspect of communication by all the advanced learners except one, who rated this language feature as being indifferent.

The final part of the questionnaire was designed to investigate whether participants might feel any difficulty when producing the interdentals, which word-position might be easier for them to produce

and whether they had formally learned about these sounds and could verbalize something about them. All participants reported having received formal instruction on the target phonemes.

Regarding word position for the *th*-words, participants were asked about whether they intuitively found it easier to pronounce the *th* at the beginning or at the end of the word. This question aimed at discovering whether learners could consciously perceive any difficulty in terms of articulation when producing these phonemes in each word-position. Four participants responded that they noticed no difference in production difficulty between the words *thanks* and *bath*; that is, they believe they produced them with the same degree of difficulty/facility. Five participants reported finding the production of word-initial '*th*' easier, and two participants found it easier to produce *bath*, with a word-final interdental fricative. Difficult articulation was the main reason for the difficulty for producing the *th*-words. Besides that, a single participant mentioned that this difficulty was also related to the fact that these phonemes don't exist in Portuguese.

Since all learners had received some type of formal instruction on the interdentals, the final question motivated them to explain or comment on some characteristics of these sounds, using their own words. In general, responses were similar, mostly referring to the place of articulation of the target sounds. For illustration, P1 explained that these sounds "*can be voiced or not. There is more than one way of articulating, being one with the tongue between the teeth; and some people articulate it with the tongue at the alveolar area*". Some teachers-to-be even reported how they would go about explaining the production of these sounds to their own learners, such as P2: "*I tell my students the phonetic symbol is like a tongue between the teeth, so we should pronounce it like that; or we can imitate a person with a lisp – that's the same sound*!." This may illustrate how some of these participants, future teachers of English, view the importance of pronunciation and pronunciation instruction, as a relevant aspect of the language that might be given some attention in class, especially if the sounds under discussion might cause learners difficulty in production.

3.4 Instruments

In order to observe the production of the interdental fricatives in both word-initial and word-final position, two instruments were used:

the production test, applied first, and the questionnaire. The following subsections present more information on each instrument.

3.4.1 Production Test: sentence reading

The sentence reading test encompassed a total of 120 sentences that each participant was asked to read in order to be audio and video recorded. The following paragraphs will better explain the design of the sentences as well as the reasons for the choice of the target words used in the experiment.

A total of 60 sentences were constructed for the production test and every participant read each sentence twice. Of these 60 sentences, 20 were distracters and 40 contained the target phonemes: 10 had /θ/ in word-initial position and 10 had /θ/ in word-final position, and the same was done for /ð/, which appeared 10 times word-initially and 10 word-finally. Sentences were randomized so that any order effect could be avoided. Table 4 below displays the target words used in the production test. See Appendix F for the test sentences.

Table 4. Target words for the Production Test: /θ/ and /ð/ in word-initial and final positions

Initial /θ/	thanks, thanksgiving, things, think, thunder, theater, theme, therapy, thick, thin.
Final /θ/	path, south, death, tablecloth, breath, math, bath, both, truth, faith.
Initial /ð/	that, they, this, those, there, these, the, then, they, than.
Final /ð/	bathe, smooth, breathe, loathe, teethe, breathe, with, soothe, with, smooth

Although *with* was included with the words with a voiced final interdental, the voiced and voiceless interdentals occur in both free and contextual variation among native speakers; thus, a production with the voiceless interdental cannot be considered inaccurate.

Regarding the construction of the sentences for the production test, the environments were carefully controlled, with two types of environment for each position within the word. For **word-initial position**, the interdentals were either: (a) sentence-initial, such as in the

sentences *Th*ank you for the help and *Th*is is my husband, where /θ/ and /ð/ are preceded by silence; or (b) preceded by a vowel sound, such as in *It's a mov**ie**-**th**eater* and *Can you pl**ay** **th**ese instruments?*, in which /θ/ and /ð/ are preceded by the vowels /i/ and /eɪ/, respectively. For **word-final position**, the target phonemes were: (a) sentence-final, such as in *Keep to the pa**th*** or in *On hot days we often go to the river to ba**the***, where /θ/ and /ð/ are followed by silence; or (b) in the middle of the sentence followed by a vowel sound, such as in *He takes a cold ba**th** **e**very morning* and in *It's good to brea**the** **i**n fresh air*, in which /θ/ and /ð/, respectively, are followed by the vowels /ɛ/ and /ɪ/. Sentences were not numbered in order to avoid the pronunciation of any other phoneme prior to the *th*-words in sentence-initial position. Besides, the choice of not having previous and following consonantal environments was because these, either voiceless or voiced, would have influenced the production of the interdentals, probably making them more difficult to be realized. For that reason, consonantal environments were avoided.

It is necessary to mention a flaw during data gathering, which was perceived only during data analysis: one of the target sentences, precisely the one *Come wi**th** us*, was not present in the production test of six of the participants, thus conferring 12 tokens less of /ð/ in word-final position. Thus, while the other target words with the word-final voiced interdental had 22 tokens to be analyzed, the word *with* was left with only 10 tokens for the analysis.

3.4.2 Questionnaire

A questionnaire was used to gather participants' personal information and to learn about their experience with the English language (Appendix A for Portuguese and Appendix B for English version). In addition to more general personal information, it provided information about language experience: their first contact with the language, the amount of time spent in uninterrupted study of the language, the amount of time spent in daily contact with English (through music or other sources of contact), whether or not they had had the experience of living abroad and having contact with native English speakers, and whether they had a foreign language other than English that was commonly used for communication at home. In addition, participants had the opportunity to comment on the importance they

gave to the linguistic aspect of pronunciation and to factors they might have noticed as affecting their performance (such as articulation, among others) regarding the production of the English interdental fricatives (Appendix C for table of results).

3.5 Procedures

Data were collected in June and July 2009 through the use of the two instruments described above: the production test and the questionnaire. Most of the data were gathered in a quiet room at the Centro de Comunicação e Expressão at UFSC, but the data of the three participants from Paraná were collected in a quiet room in the researcher's home.

All of the participants formally agreed to be part of the research (Appendix D, E). However, the research objectives were not revealed to them, since that might have interfered in their performance. Subjects were also told their names would not be revealed.

The recordings were made in audio and video, using a laptop Itautec Infoway Note W7635 with a webcam (Philips model SPC620NC) and a microphone (Satellite model AE666). The video recording program used was Capture Flux 5.2, designed by Paul Glagla[18]. The reason for the use of video was to help the raters better identify the target sounds, since they had the image as an extra clue to visualize the sound articulation in addition to hearing the sound being produced.

Each subject took the test individually. First, he/she was asked to sign the consent form, then he/she received instructions for reading and recording the production test sentences, and after recording the sentences, he/she completed the questionnaire (section 3.3.2). The consent form and questionnaire were in the subjects' native language, Portuguese. The production test contained instructions and sentences in English, the language in which the subjects were being assessed.

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[18] Capture flux 5.2 is available at http://paul.glagla.free.fr/captureflux_en.htm.

For the production test participants were asked to read a set of 120 sentences in English (section 3.3.1), out of which 80 sentences contained the interdental fricatives in word-initial and word-final positions. While reading the sentences, participants had their voice and image recorded. Participants were also instructed that they would be receiving feedback on the results of the study. The participants were again contacted for feedback on the data provided in February, 2010.

3.6 Data analysis

The data of the present study were analyzed through the statistical analysis of 866 tokens of the interdental fricatives: (a) 220 tokens of /θ/ in word-initial position and 220 tokens of /θ/ in word-final position; (b) 220 tokens of /ð/ in word-initial position and 208 tokens of /ð/ in word-final position. Only the production of the target phonemes, /θ/ and /ð/ was considered, no attention being given to whether the following/previous part of the word was accurately produced or not.

The participants' audio and video recordings were transcribed by the researcher and another experienced rater. Both raters had perfect auditory and visual abilities. Regarding data transcription, raters individually heard (and visualized) all tokens at least twice and then transcribed what was perceived onto a rating transcription sheet (Appendix G). Afterwards, when all participants' productions had been transcribed, raters compared the ratings for each token. Of the total of 866 tokens analyzed, the percentage of agreement for transcriptions was 85% (735 tokens). For the other 131 tokens, raters listened again, this time together, a couple of times until reaching an agreement. Only one sentences had to be excluded from the analysis due to misreading: in the sentence *This will help to* **soothe** *our sunburn,* P11 produced a completely different word for the target word in bold.

It is interesting to note that the raters found the video element together with the audio recording to be very helpful for the analysis, because through the video, the articulation of the target phonemes could be observed. Acoustic analysis was not included as an instrument for data analysis due to the fact that the researcher found spectrogram analysis not to be helpful for the accurate identification of the phonemes, especially the distinction between the interdentals and the labiodentals. This is supported by Ladefoged (2001), who explains that

the pairs /f/-/θ/ and /v/-/ð/ are very similar in acoustic terms, being thus very difficult to differentiate in a spectrogram analysis.

3.6.1 Statistical Analysis

The statistical analysis of the production of the English interdental fricatives in word-initial and final positions covered the 866 tokens produced by the participants. The software used for the statistical analysis was SPSS for Windows – version 16.0, and the level for statistical significance (alpha level) was set at .05.

When testing the normality of the data set, through the observation of skewness and kurtosis, descriptive statistics revealed the sample not to be normally distributed. For this reason the tests used in the statistical analysis of the present study were the non-parametric tests: (a) the k-related Friedman test, for within-group comparison of means, and (b) the two-related Wilcoxon test, as a *post hoc* test to verify the relation between the paired variables that reached statistical significance in the Friedman test, and (c) the Mann Whitney test.

CHAPTER 4

RESULTS AND DISCUSSION

This chapter reports and discusses the results of the production test of the English voiced and voiceless interdentals, in word-initial and word-final position, performed by the eleven participants of the study. The results discussed here consist of the participants' production of the interdentals in a sentence-reading test which was audio and video recorded. For the analysis, participants' productions of the target phonemes were considered accurate when the /θ/ was realized as a voiceless interdental fricative, and the /ð/ was realized as a voiced interdental fricative.

The results and discussion are organized following the research questions and hypotheses, first discussing the voiceless interdental fricative and its production in the two word-positions (4.1), then its voiced counterpart in the same two positions (4.2), and finally the comparison of the two phonemes.

4.1 The voiceless interdental fricative

As presented in Chapter 3, the first research question (RQ1) designed for the study aims at identifying the pattern of production for the voiceless interdental fricative in word-initial and final positions. The hypotheses are that the participants of this study will produce /θ/ more frequently as [t] than as the other replacements in word-initial (H1) and also in word-final position (H2).

4.1.1 The voiceless interdental fricative: word-initial position

Bearing in mind that each participant produced 20 tokens of /θ/ in word-initial position, Table 5 shows the individual raw scores for the sounds produced for /θ/ and the corresponding percentages for each production type. In addition, it displays the descriptive statistics of the production of the voiceless interdental fricative and the replacements, displaying the mean (M) percentage of the types of production and the standard deviation (SD), considering the total of 220 tokens produced by the eleven participants (N = 11).

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Table 5. Individual production of word-initial /θ/

| (N = 20) | Production of /θ/ as | | | | | |
| | [θ] | | [t] | | [f] | |
Participant	Raw	%	Raw	%	Raw	%
P1	18	90	0	0	2	10
P2	20	100	0	0	0	0
P3	18	90	2	10	0	0
P4	19	95	1	5	0	0
P5	20	100	0	0	0	0
P6	15	75	4	20	1	5
P7	16	80	4	20	0	0
P8	20	100	0	0	0	0
P9	17	85	2	10	1	5
P10	17	85	3	15	0	0
P11	17	85	3	15	0	0
Total/Mean%	197	89.55	19	8.64	4	1.82
SD		8.50		8.09		3.37

As the table shows, for the productions of the word-initial interdental, all learners realized the voiceless interdental mostly as [θ], that is, in an accurate fashion. Three of the learners (P2, P5 and P8) produced [θ] with 100% accuracy and the minimum percentage for accurate production of /θ/ was 75%. Besides the accurate realization of the voiceless interdental fricative, two other production types were observed: [t] and [f] in word-initial position. Seven learners (P3, P4, P6, P7, P9, P10, P11) occasionally replaced /θ/ with [t] (in a total of 8.6% of the tokens) and only three subjects (P1, P6, P9) occasionally (in a total of 1.8% of the tokens) used [f] as a replacement for /θ/.

A Friedman test was run revealing the differences in frequency among the three realizations of word-initial /θ/ to be statistically significant (X2, (2, N=11) = 19.463, p = .000). Afterwards, a Wilcoxon Signed Ranks test was used as a *post hoc* test for within-group analysis. The Wilcoxon test with Bonferroni correction (alfa: .05/03 = .017) was run for all three pairs in word-initial position: [θ]-[t], [θ]-[f], and [t]-[f]. Results for the *post hoc* reveal the differences to be statistically significant for all three pairs of realizations: for [θ]-[t] (Z = -2.943, p. =

.003), for [θ]-[f] (Z = -2.947, p. = .003), and for the last pair [t]-[f] (Z = -2.046, p. = .041). In other words, although the participants had a high accuracy rate for word-initial /θ/, when they did not produce [θ] accurately, there was a definite pattern to the substitutions: the most frequent replacement was [t], with [f] appearing in only a few instances.

Bearing in mind the first part of RQ1, asking about the pattern of production for /θ/ in word-initial position, it was observed here that the accurate realization of word-initial /θ/ as a voiceless interdental fricative was reasonably consistent and thus can be said to be the general pattern. In addition, H1 has been confirmed, since [t] was the most frequently used replacement for /θ/ in word-initial position.

Thus, the findings corroborate previous research (Reis, 2006), even though the participants in the present study may apparently be more advanced -around 9 years of length of learning (LOL) - than the advanced group in Reis (LOL of 5 years), at least in terms of pronunciation. In Reis' study the advanced group produced [t] with 40% frequency in the sentence reading test as well as with about the same frequency in the story telling and retelling tests. Overall, [t] was the most frequent replacement with a frequency of 40% in all the advanced learners' productions.

4.1.2 The voiceless interdental fricative: word-final position

Table 6 below shows the individual raw scores and percentage for the production of word-final /θ/ by the participants. Each participant produced 20 tokens of /θ/ (N = 20), and production types were [θ], [t], [tʃ], [f] and [d] for this word-position.

Table 6. Individual production of word-final /θ/

| N = 20 | Production of /θ/ as | | | | | |
| | [θ] | | [t] | | Other replacements | |
Participant	Raw	%	Raw	%	Raw	%
P1	19	95	0	0	1	5
P2	20	100	0	0	0	0
P3	19	95	1	5	0	0
P4	17	85	2	10	1	5
P5	20	100	0	0	0	0
P6	19	95	0	0	1	5
P7	18	90	0	0	2	10
P8	20	100	0	0	0	0
P9	20	100	0	0	0	0
P10	18	90	2	10	0	0
P11	20	100	0	0	0	0
Total/Mean%	210	95.45	5	2.27	5	2.27
SD		5.222		4.101		3.371

As displayed in the table, the most frequent production type observed was the accurate realization of [θ] for word-final /θ/, with 95.45% of frequency. Five participants (P2, P5, P8, P9, P11) produced [θ] accurately in all twenty instances. In addition, /θ/ was also replaced variously with: (a) [t] five times total by three participants (P3, P4, P10); (b) [tʃ] two times by one participant (P7); (c) [f] two times total by two participants (P1, P6); and [d] one time by one participant (P4). Because the production of the substitutes [tʃ], [f] and [d] overall rendered small percentages, these three replacement types are grouped as 'Other replacements' in Table 6.

A Friedman test revealed the differences to be statistically significant (X2 (2, N = 11) = 18.615, p = .000). A *post hoc* Wilcoxon with Bonferroni correction (alfa: .05/03 = .017) confirmed the differences to be statistically significant between accurate production and the replacement [t] (Z = -2.966, p = .003); and between accurate

production and other replacements (Z = -2.971, p = .003), but not between the replacement [t] and other replacements (Z = .000, p = 1.000).

Thus, the advanced learners in this study did not have much difficulty producing the final /θ/ since the accurate realization of [θ] was the predominant pattern of production for this position. However, when participants did not produce the accurate [θ], they did not follow a consistent pattern of replacement for word-final /θ/. Thus, H2, which predicted [t] to be the most frequent replacement, was not confirmed in the statistical test. Nonetheless, the notably high rate of accurate realizations observed must be taken into consideration here. Whereas [t] did yield the greatest number of realizations, the very small number of inaccurate realizations made it very difficult for the difference to reach significance. A less proficient group of learners might have produced different results.

4.1.3 The voiceless interdental fricative: word-initial versus word-final positions

In order to anticipate the discussion of the effect of word-position on the production of the interdentals, this section will tap the issue of accuracy regarding word-position. Keeping in mind the claim made by Eckman (1977) that marked phonemes would be produced with greater difficulty when in word-final position than word-initially, what was expected in the present research (H5 and H6) was that the interdentals would follow the same behavior. Thus, since in this section we are only dealing with the voiceless interdental, H5 predicted that the participants would produce the accurate [θ] for /θ/ in word-initial position more frequently than in word-final position.

Table 7 illustrates the differences in performance for the production of /θ/ in the two word-positions. Participants' raw scores for initial and final /θ/ productions are displayed, as well as percentages of individual phoneme accuracy for the 220 tokens contrasting each word-position. Since only accuracy is being evaluated here, only the values for accurate [θ] production appear in the table.

Table 7. Comparison of the accurate production of initial and final /θ/

Production	Word-initial /θ/ as [θ]	word-final /θ/ as [θ]
Raw score	197	210
M%	89.55	95.45
SD	8.501	5.222

Considering accuracy in all realizations of all /θ/ tokens (see Tables 5 and 6), in word-initial position three of the participants (P2, P5, P8) managed to produce the voiceless interdental with 100% accuracy. In word-final position, five of the participants (P2, P5, P8, P9, P11) accurately produced /θ/ in all twenty tokens. The overall percentage of accuracy for the realizations of [θ] was 95.45% in word-final and 89.55% in word-initial position.

Thus, contrary to expectations, not only did more participants obtain 100% accuracy in word-final position, but the overall percentage of accuracy was greater in word-final position. With the exception of those who obtained 100% accuracy in both, all participants but one obtained accuracy rates for [θ] in final position at least 5 percentage points higher than in initial position. For four participants (P6, P7, P9, P11) this difference was 10 percentage points or more. Three participants (P2, P5, P8) obtained 100% accuracy in both initial and final position. Only one participant (P4) produced more accurate tokens of /θ/ in word-initial (95%) than in word-final position (85%).

These differences appear to give an advantage to word-final position. However, a Mann-Whitney test revealed these differences to be non-significant ($Z = -1,697$, p. = .90). Therefore, it cannot be stated that there was a difference in the accurate realizations of /θ/ between the two word positions, confirming neither that word-initial position would be easier - nor its opposite, that word-final position was easier. Thus, H5 is not confirmed since it cannot be stated that word position affected the production of the voiceless interdental at all. In fact, the tendency went in the other direction, that is, for better production in word-final position.

4.2. The voiced interdental fricative

The second research question for the study (RQ2) investigates the pattern of production for the voiced interdental fricative in word-initial and final positions. The hypotheses are that the participants will produce the non-native replacement [d] for /ð/ more frequently than the other replacement types in word-initial (H3) as well as in word-final position (H4).

Under analysis were twenty sentences with word-initial /ð/ and twenty sentences with word-final /ð/. Following the organization from section 4.1, the first part of the discussion in this section will consider the voiced interdental in word-initial (4.2.1), then in word-final position (4.2.2), and finally a comparison of the realizations of /ð/ in each word-position is made (4.2.3).

4.2.1 The voiced interdental fricative: word-initial position

The production of the twenty word-initial /ð/ tokens by the eleven participants is displayed by Table 8 below. Participants' raw scores, individual percentages of production as well as the mean percentages and standard deviations are shown.

Table 8. Individual production of word-initial /ð/

(N = 20)	[ð]		[d]	
Participant	Raw	%	Raw	%
P1	11	55	9	45
P2	19	95	1	5
P3	17	85	3	15
P4	12	60	8	40
P5	19	95	1	5
P6	4	20	16	80
P7	5	25	15	75
P8	19	95	1	5
P9	4	20	16	80
P10	0	0	20	100
P11	3	15	17	85
Total/Mean%	113	51.36	107	48.64
SD		36.81		36.81

As the table illustrates, participants produced word-initial /ð/ either as [ð] or as [d]. No other replacement for the voiced interdental was observed in word-initial position. Individual percentages for accurate [ð] production varied from 0 to 95%. Three participants (P2, P5, P8) produced [ð] with 95% accuracy and only a single participant (P10) produced the interdental as the non-native replacement in all instances. The realization as [d] was almost as frequent as [ð]. Every participant employed the replacement at least once. For /ð/ realized as [ð], the mean percentage was 51.36% and for /ð/ realized as [d], the mean was 48.64%.

The Wilcoxon test showed the differences between the correct production of the voiced interdental and its realization as [d] to be statistically non-significant (Z = -.312, p = .755). Therefore, it cannot be stated that participants followed a defined pattern for their productions. Rather, the two realizations were equally frequent. Once again, it can be noticed that the accurate production of the voiced interdental was more frequent in this study than in Reis (2006), probably

because of the present participants' higher level of L2 experience and proficiency.

The voiced *th*-words in word-initial position are known to be very frequent in spoken and written English (Leech, Rayson & Wilson, 2001) and, due to that, it is common to have them in early stages of EFL acquisition. It was observed in the participants' productions that both realizations of [ð] or [d] were used with almost the same frequency, without a specific pattern of production to be followed. For instance, the words *that*, *they*, *these, those, than* and *there* were realized as [ð] in 11 instances and as [d] in 11 instances as well. A little higher were the accurate productions observed in the target words *they* and *then* with 15 and 13 instances of [ð], respectively, and the lowest accurate production was observed for the definite article *the* (7 realizations of [ð] and 15 of [d]).

The difficulty in mastering the voiced interdental in the word *the* may be due to the fact that this is one of the most frequent words in English (Leech, Rayson & Wilson, 2001) and it appears right when EFL learning commences, probably when learners are not yet phonologically aware of its correct articulation and how it differs from his/her L1 sounds. A possible explanation for this difficulty is that those words learned at the beginning phases of EFL acquisition might become automatized with the inaccurate realization (Flege et al., 1996). Later, the accurate realization of the words is then learned (through instruction, perhaps) which makes the learner able to produce them right whenever he/she is focusing on pronunciation. However, when he/she is concentrated on the content of the words, the automatized (inaccurate) realization arises. It seems to be common practice to attend to the importance of pronunciation in the classroom only after the learners have already acquired some fluency in the L2. As Baptista (1995) advocates, possible reasons for this are the beliefs that focusing on pronunciation at an early stage might interfere in fluency acquisition, and that the objective of pronunciation instruction is to correct previously acquired mispronunciation 'habits'. As a consequence of this misleading practice, not only teachers but also learners feel success to be quite unattainable and pronunciation to be quite impossible to be taught.

According to Flege (1987), due to a mechanism named 'equivalence classification', L2 sounds which might be similar to L1 sounds are usually identified with the L1 sounds. Consequently, as

Flege (1987) explains, sounds of the L1 seem to influence the sounds produced in the L2. That might be the case for the replacements observed in the study, especially because the phonemes under investigation are more marked in the world's languages. Thus, learners might have formed two categories for the /ð/ phoneme: a new sound category, [ð], and a category which is influenced by BP, his/her L1, [d]. At least some of the participants of this study appeared to use the two categories interchangeably and at random.

Therefore, bearing in mind the first part of RQ2, which investigated the pattern of production for /ð/ in word-initial position, it can be said that for the participants in this study, there was not a consistent pattern of production for word-initial /ð/. Both the accurate production and the realization of [d] were observed with approximately equal frequency. However, the hypothesis (H3) that participants would produce [d] as the most frequent replacement for word-initial /ð/ is confirmed, because this was the only replacement observed. Hence, the findings corroborate the findings of Reis (2006), which found [d] to be the most frequent replacement for initial /ð/. Besides, in Reis's study, [d] was also the most frequent production type observed in all production tests, for the intermediate and for the advanced groups. For the advanced group, [d] was produced with a frequency of 80% in the sentence reading test, 95% in the story telling test, and 98% in the report of the story.

Reis explains that, for the participants in her study, language experience did not seem to significantly influence the production of the interdental fricatives and that perhaps "more language experience would be necessary than that of the advanced group of this study to show any positive effect" (Reis, 2006, p. 58). As previously discussed, the more frequent productions of [ð] here might have been due to the general greater L2 experience and proficiency of the subjects, especially because the participants in the present study were either completing their undergraduate program in the Letras English Course or were already involved in teaching the language and using it daily with greater frequency.

4.2.2 The voiced interdental fricative: word-final position

For word-final /ð/, each participant produced 20 tokens of /ð/ (N = 20), and production types varied from the accurate [ð] to seven different non-native replacement types. Since some target words were skipped by the some of the participants during the test, a couple of tokens were excluded from the analysis. Thus here we are considering a total of 208 tokens analyzed, as already mentioned in section 3.5. Table 9 shows the individual raw scores and percentage for the production of word-final /ð/. It also illustrates the mean percentage of productions and the standard deviations.

Table 9. Individual production for word-final /ð/

N = 20	Production of /ð/ as							
	[ð]		[θ]		[d]		Other replacements	
Participant	Raw	%	Raw	%	Raw	%	Raw	%
P1	5	28	11	61	1	6	1	6
P2	11	61	7	39	0	0	0	0
P3	6	33	12	67	0	0	0	0
P4	11	61	2	11	4	22	1	6
P5	4	20	16	80	0	0	0	0
P6	4	22	8	44	6	28	1	6
P7	0	0	19	95	0	0	1	5
P8	8	40	12	60	0	0	0	0
P9	2	10	16	80	2	10	0	0
P10	0	0	19	95	0	0	1	5
P11	2	11	16	89	0	0	0	0
Total/Mean%	53	26.0	138	65.5	13	5.96	5	2.55
SD		21.4		26.2		10.0		2.94

Note: P = participant; R = raw data; M% = mean percentage; SD = standard deviation.

As displayed by the table, there was great variation in the production types of word-final /ð/. Because of that, Table 9 illustrates those most frequent types and groups as 'other replacements' those production types which occurred in few instances. Overall, productions types included the accurate [ð], as well as [θ], [d], [v], [f], [t], [tʰ] and

omission (∅). A token was considered omitted (∅) when the speaker produced the target word but omitted the target phoneme. The only target phoneme omitted was the one in the word *with*, in which the participant (P4) pronounced [wɪ] neither realizing the interdental /ð/ nor any other phoneme at the end.

In terms of frequency, the voiceless interdental fricative was the most frequently phoneme replacing /ð/, even more frequent than the accurate realization. The second most frequent production was the accurate realization of [ð] and then the voiced plosive [d]. The other production types - [v], [f], [t], [tʰ] and ∅ - appeared only once each.

Considering the accurate production of the final /ð/, only two participants produced more instances of [ð] than any other phoneme: P2 and P4 realized [ð] eleven times (N = 18). The general tendency for production was the realization of [θ] in the place of /ð/. All of the participants, except the two just mentioned, seem to have 'devoiced' /ð/ into [θ] in word-final position. This is related to the fact that word-final position is marked and so are voiced obstruents (Eckman, 1977); therefore, there is a universal tendency for devoicing final voiced obstruents.

According to Table 9, the mean percentage for accurate [ð] was 26% in word-final position, which represents the second highest production type for word-final /ð/. The voiceless [θ] was the most common replacement, employed with a frequency of 65%. The mean for [d] was 5.9%; the 'other replacements' appeared in a total of 2.55%.

A Friedman test yielded statistically significant differences (X2 (7, N = 11 = 52.796, p = .000). A *post hoc* Wilcoxon test with Bonferroni correction (alfa: .05/06 = .008) revealed differences to be statistically significant for all the /θ/ and /ð/ pairs. However, for the other pairs, differences were not statistically significant.

Considering the voiceless /θ/, the differences were statistically significant for the pairs: (a) [θ]-[f] (Z = -2.937, p = .003); (b) [θ]-[v] (Z = -2.937, p = .003); (c) [θ]-[d] (Z = -2.847, p = .004); (d) [θ]-[t] (Z = -2.936, p = .003); (f) [θ]-[tʰ] (Z = -2.936, p = .003); (g) [θ]- ∅ (Z = -2.937, p = .003). Therefore, considering that [θ] was the most produced phoneme for this position, this statistically confirmed difference

supports the fact that the participants in the present study used [θ] in fact as the predominant pattern for the production of the voiced interdental.

Now considering the voiced /ð/ productions, results were statistically significant for the pairs: (a) [ð]-[θ] (Z = -2.180, p = .029); (b) [ð]-[f] (Z = -2.670, p = .008); (c) [ð]-[v] (Z = -2.668, p = .008); (d) [ð]-[d] (Z = -2.380, p = .017); (e) [ð]-[t] (Z = -2.703, p = .007); (f) [ð]-[tʰ] (Z = -2.703, p = .007); (g) [ð]- ø (Z = -2.666, p = .008). Given the fact that the accurate realization [ð] was the second most used realization for the production of final /ð/, the statistical differences above confirm that participants did use [ð] as a second pattern of production. Therefore, H4 – which expected [d] to be the most frequent replacement for final /ð/ - is not confirmed, since [d] was not the most frequent sound used for word-final /ð/. As observed in Table 9 above, [d] was the second most frequent replacement for word-final /ð/ and the third most used production type in this word-position.

As the results show, the participants in the present study had the voiceless interdental fricative as the predominant pattern for the production of word-final /ð/. Even though the majority of productions were not accurate, that is, realized as [ð], learners still maintained their interdental production, but devoicing the target token. It seems that the participants are aware of the fact that the English *th*-phonemes are sounds that differ from any L1 sound (because few productions were of [d], [t], [f], [v], for instance, which are sounds also existent in BP); however, it may still be difficult for them to maintain the voicing effect in word-final position.

One of the possibilities for explaining their difficulty in accurately producing final /ð/ might be the lack of familiarity with the voiced *th*-words in word-final position. Words such as *loathe*, *soothe*, *teethe*, and *bathe* may not be commonly used by learners in their ordinary conversations. And given that the words *teeth* and *bath*, with final /θ/, might be more common to them, one of the strategies used for the production of the voiced *th*-verbs was to realize them as [θ]. In order to further investigate that, participants were informally contacted (Appendix D and E) to report whether or not the words with final /ð/ frequently appeared in their speech. In general, the participants who

responded the informal questionnaire reported that the final /ð/ verbs were a little familiar to them; the voiced *th*-words in the production test were reported to have been previously seen in terms of reading and hearing mostly. Overall, the subjects reported not to use them frequently in their daily conversations. For instance, P1 mentioned to have probably heard them in movies or TV series, and P5 mentioned *breathe*, *bathe* and *soothe* to be a little common to her due to motherhood and house chores. P3 reported, on the other hand, that *soothe* and *loathe* were not common words to him even though they sounded familiar.

It might be interesting to notice that the native-speaker of English who accepted to participate in the experiment produced the interdental fricatives accurately in all instances, both in initial and final positions. For final /ð/ production, since this seems to be the most difficult phoneme to be produced not only by BP speakers but also by speakers of different L1s, and especially in word-final position, the native-speaker realized every target phoneme with the final voicing contrast, that is, with the accurate [ð]. While for a native speaker these phonemes are acquired during childhood when going through the process of L1 learning, for EFL learners the acquisition of these phonemes seems to be much more complex. It may involve especially the conscious noticing (Schmidt, 1990) of these target sounds which appear in early stages of FL learning. If no selective attention is given to these phonemes right at the beginning, learners might automatize their incorrect productions (Flege et al., 1996).

Besides lack of word familiarity, this difficulty may also be due to the fact that BP allows few consonants in word-final position, and even these are marginal. In BP the segments usually permitted in this position, according to Cristófaro-Silva (1999), are the phonemes /r/ (which she refers to as "R forte") and /l/ and the archiphonemes /S/[19]

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[19] An archiphoneme is "a unit found in a position of neutralization […] it is composed of all the properties which the neutralized phonemes have in common, but not the properties which typically distinguish them"

and /N/. For instance, (a) word-final /r/ is found in verbs (in the infinitive form) such as *caminhar* (to walk)*, viver* (to live)*, cair* (to fall) - where it is often deleted, and in some nouns like *mar*; (b) final /l/ – as in *sol* (sun) –is usually vocalized as [u] or [w] in BP, (c) the final archiphoneme /S/ is found in plural words such as *portas* (doors)*, momentos* (moments) and realized variously as [s, z, ʃ, ʒ], depending on region and phonological context; and (d) the nasals are only actually realized as [n] and [m] or [ⁿ] and [ᵐ] when the next word or syllable begins with a [t] or [p], respectively. All in all, what should be kept in mind then is that word-final obstruents in general are marked and final voiced obstruents are more marked than voiceless obstruents. Hence, there is transfer from BP combined with this concept of markedness of final obstruents, which all together render the complexity in production observed.

4.2.3 The voiced interdental fricative: word-initial versus word-final positions

As previously mentioned in the discussion of the voiceless interdental productions, the third research question (RQ3) investigates whether word-position affects accuracy in the production of /θ/ and /ð/. The hypotheses here (H5 and H6) are based on Eckman (1977) and, considering now only the voiced interdental, what was expected (H6) is that the participants would produce the accurate [ð] for /ð/ in word-initial position more frequently than in word-final position.

Table 10 illustrates the differences in performance for the production of /ð/ in each word-position. The table shows the raw scores for initial and final /ð/ productions considering the total number of tokens analyzed (N = 220 for initial /ð/, N = 208 for final /ð/), the mean

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(McMahon, 2002, p. 60). The symbol used to represent an archiphoneme is a capital letter.

percentages for accurate production and the standard deviations for the phoneme in each word-position.

Table 10. Comparative table for the accurate production of /ð/ in word-initial and final position

Production	Word-initial /ð/ as [ð]	word-final /ð/ as [ð]
raw score	113	53
M%	51.36	26.06
SD	21	21.44

According to the table, the accuracy rate for word-initial realizations of [ð] was quite a bit higher than the accurate word-final productions: 51.36% and 26.06% respectively.

A Mann-Whitney test revealed the differences to be statistically non-significant (Z = -1,417, p. = .156). Thus, it can not be assumed that one position rendered more difficulty in production than the other word-position. In addition, the low accuracy rate for word-final /ð/ productions might be partially attributed to the fact that the participants were not familiar with some of the words in the production test, such as most of the verbs ending with the –e grapheme: *bathe*, *loathe*, *teethe*, *soothe*. The use of the voiceless version of the interdental, thus, might have been due to analogy to the nouns related to some of the target verbs (*bath*, *teeth*), the nouns being certainly more familiar to them. Lack of familiarity of the words being tested is an important issue to be considered, according to Flege (1987). The researcher explains, based on studies of L1 acquisition, that word familiarity may affect segmental articulation and phonetic perception. In spite of the researcher's previous awareness of this, it was not possible to avoid the use of these words in the production test because other possible words were thought to be even less familiar.

Considering the discussion above, in addition to the lack of statistical significance not allowing confirmation of H6 – that the voiced interdental phoneme was more difficult to produce in word-final position than in word-initial position – even the apparent tendency in this direction might have nothing to do with word position but with lack of familiarity. Thus, no claims can be made at all regarding the influence of markedness on these results.

4.3 Summary of results

The study which motivated the present research, Reis (2006), investigated, among other questions, the pattern of replacement for /θ/ and /ð/ in word-initial position. Reis' results suggest the pattern of replacement for the voiceless interdental to be [t] and for its voiced counterpart to be [d], the latter being even more frequent than accurate productions.

In the present experiment, considering word-initial productions, (a) the predominant pattern of production for /θ/ was the accurate realization of [θ] with 89.55% frequency, with [t] as the most frequent replacement (8.64%); (b) for /ð/ there was no consistent pattern, since [ð] and [d] were produced with statistically equal frequency (51.36% and 48.64%, respectively). If we compare the results reported by Reis (2006) with those of the present study, regarding only the sentence reading test data, what may be observed is a quite higher rate of accurate production of initial /θ/ and /ð/ by the participants of the present study. It must be kept in mind, though, that the comparison made is just speculative: despite the similarity of the production test employed (sentence reading test), no greater generalizations can be made because of the differences - in terms of number of tokens analyzed and number of participants, for instance – included in Reis' and in the present study. Nonetheless, it seems that the present findings corroborate Reis' finding in that [t] and [d] are the most common replacements observed for the voiceless and voiced interdentals, respectively, in word-initial position.

Participants in this experiment were all undergraduate teachers-to-be of English or former language teachers who had worked in language schools in the south of Brazil. The level of L2 experience of the participants was considered high, due to the fact that most received not only formal instruction on the language itself but also on how to teach the language. The reported average of L2 experience given by the participants was of 9 years. This is the most likely explanation for the difference in accuracy rates between the two studies, especially referring to the voiceless interdental phoneme.

Regarding H2, for the voiceless /θ/ in word-final position, the pattern of production verified was the accurate realization of [θ], even

more frequent than in initial position: Other productions were [t], the most frequent replacement, with 2% frequency, followed by [f], [d] and [tʃ], each with less than 1%. Differences were found to be statistically significant between the accurate pattern and the other production types. The finding of this high percentage of correct productions was unexpected. Considering that, due to markedness, consonants in word-final position tend to be more difficult (more marked) than consonants word-initially, the results for final /θ/ were quite surprising. However, given the fact already mentioned that the participants are teachers-to-be (or former English teachers) and have had their attention called to the interdental phonemes at some point of their learning experience, the high rate of accurate productions might not be surprising. Furthermore, perhaps /θ/ in word-final position might have been more salient for these learners, since very few consonants occur in final position in BP. Possibly a larger-scale study can shed more light on this question.

For the voiced /ð/, RQ2 investigated its pattern of production in word-initial and final positions. Based on Reis (2006), the hypothesis (H3) was that the Brazilian learners would mostly produce [d] as a replacement for /ð/ in word-initial position. Actually, considering word-initial position, the predominant pattern of production for /ð/ was the accurate [ð], which appeared in 51% of participants' production. The most frequent replacement, however, was in fact [d], which was produced in 48% of all instances. Since the two production types were very close to each other in number, the differences observed were statistically non-significant. Thus, there was not a single predominant pattern for the production of initial /ð/, but H3 can be considered confirmed because [d] was the most frequent replacement, significantly more frequent than the others.

RQ2 also investigated the pattern of production for the voiced interdental in word-final position. Results showed [θ] to be the most frequent realization for final /ð/, with 65% of participants' productions, even more frequent than the accurate realization, which occurred in 26% of the productions, the second most frequent realization. The other replacements observed were the [d] with 10%, finally [f], [v], ø, [t] and [tʰ], with little more than 1% each. Thus, H4 was disconfirmed: [d] was not the most frequent replacement, but there may have been an

intervening variable here. The probable explanation for the higher number of [θ] productions is word familiarity (or lack of it). Most of the voiced *th*-words used in the production test were verbs which were not frequently encountered by the participants; that might have caused confusion, making them produce the corresponding and more familiar nouns instead of the verbs. Markedness may also have played a role, however: it may be difficult for Brazilian speakers (as many other language groups) to maintain voicing of consonants at the end of a word (especially when followed by silence), since both voicing and word-final position are universally marked features of consonants.

Finally, RQ3 investigated whether word-position affects accuracy in the production of the interdental fricative phonemes. The hypotheses (H5 and H6) were based on the universal markedness proposition (Eckman, 1977) that word-final consonants are more difficult to produce than word-initial consonants. Hence, what was predicted is that participants would produce accurate [θ] (H5) and [ð] (H6) in word-initial position more frequently than in word-final position.

Considering the voiceless interdental fricative, the comparison of the accuracy of /θ/ in word-initial and final positions reveals differences to be statistically non-significant; that is, word-position might not have had any significant effect on production accuracy of this phoneme. Thus, at least for /θ/ in the two word-positions investigated, no claim can be made in terms of which position might have been easier to produce. However, even though the statistical analysis yields non-significant results ($p = 0.7$), it seems participants actually tended to realize the final /θ/ with less difficulty, given the fact that almost 96% of the target phonemes were produced accurately and the results came close to a 0.5 level of significance. But although a larger-scale study might yield significance, this is only speculation, so from this study it must be maintained that the two positions were produced with a similar degree of difficulty and that accuracy was not affected by word-position in this context.

For the voiced interdental, on the other hand, no claims can be made about the effect of word-position on the accurate production of the target phonemes. Not only were differences between word initial /ð/ and word final /ð/ found to be non-significant, but the apparent tendency toward greater difficulty of the phoneme in final position may have been due more to word (in)frequency than to word position of the target

consonant. Thus, H6 cannot be supported for the voiced interdental production: it cannot be claimed that word-final /ð/ was truly more difficult than word-initial /ð/.

Summarizing, of the six hypotheses, only H1 and H3 are confirmed: the most frequent replacements observed in the present study were [t] and [d] for the voiceless and voiced interdentals in word-initial position. H2 and H4 – which predicted [t] and [d], respectively, to be the most frequent replacements for word-final position – were not confirmed. On the other hand, it is probably not possible to disconfirm H2 either, since no statistically significant result could be reached with the number of accurate productions so close to ceiling. In addition, although a tendency was observed for the most frequent replacement for final /ð/ to be [θ], thus contradicting H4, this tendency was not significant and quite likely due more to lack of knowledge than to difficulty of realization. Finally, H5 is not confirmed: (a) word-position might not be said to have affected the production of /θ/, since word-initial and word-final position yielded similarly high rates of accurate production and the tendency was contrary to the hypothesis; and (b) H6 is not confirmed either: although there was a tendency for accurate [ð] productions to be more frequently observed in word-initial position than in word-final position, the results were non-significant and quite likely due to an intervening variable. Word (in)frequency or lack of familiarity by participants might have played a more important role, meaning that the word-final [ð] may not have been actually more difficult to produce, but rather more difficult to recognize and know when to produce.

CHAPTER 5

CONCLUSION

5.1 Summary and overall results

The present thesis investigated the production of the interdental fricatives in word-initial and final positions. Participants of the study were eight Brazilian undergraduate learners of the Letras English Course and three former English teachers from the south of Brazil. For the investigation, three research questions and five hypotheses were proposed. Mainly, the RQs and Hs aimed at investigating the patterns of production for /θ/ and /ð/ in each word-position, initial and final, and the most frequent phonemes used as non-native replacements. An additional aim was to observe whether one word-position would yield more a higher rate of accurate production than the other position for both the voiceless and the voiced interdental phonemes. The instruments used were a questionnaire and a production test. The paragraphs that follow summarize the main findings considering the RQs and Hs.

RQ1 investigated the pattern of production for word-initial and word-final /θ/. For word-initial /θ/, the predominant pattern observed was the realization as the voiceless interdental fricative, with almost 90% of accuracy. H1 was confirmed: [t] was the most frequently used replacement for word-initial position when production was not accurate. The production of [t] was observed in 8% of the 220 tokens investigated for this position. That corroborates the findings of Reis (2006), who also found [t] to be the most commonly used replacement for word-initial position in the production of her participants. H2 is not statistically confirmed: [t] was not statistically more frequent than the other replacements for /θ/ in word-final position. However, H2 cannot be categorically disconfirmed either: due to the surprisingly high number of accurate productions for /θ/ in word-final position, near ceiling, it would have been very difficult to find a statistically significant pattern of replacement in the few inaccurate realizations. The predominant pattern for word-final /θ/ was the realization as the voiceless interdental fricative, with 95.45% accuracy.

RQ2 investigated the pattern of production for word-initial and final /ð/. For word-initial /ð/, no consistent pattern of production was observed: participants produced the accurate voiced interdental fricative and the non-native replacement [d] with approximately the same frequency. However, H3 was confirmed: [d] was not only the most frequently used replacement but also the only replacement observed for /ð/ in word-initial position. These results also corroborate Reis (2006), who found [d] to be the most frequent sound employed in the place of the voiced interdental. For word-final /ð/, the predominant pattern of production was the voiceless interdental fricative, realized in 65.56% of all productions, followed by the accurate voiced interdental, with 26%. Thus, H4 was not confirmed: [d] was only the third most frequent production type observed, with 5.96% and not significantly more frequent than the other four replacements. Lack of familiarity with the words with word-final /ð/ may have been an intervening variable, causing the realization of the wrong interdental fricative. Thus, H4 cannot be considered to be disconfirmed either.

RQ3 investigated whether one word-position might imply a higher frequency of accurate productions than the other word-position, regarding both /θ/ and /ð/. H5 was not confirmed: the accurate realization of /θ/ was not more frequent in word-initial position, and the difference in accuracy rate between the two word positions was not significant, meaning word-position cannot be said to have affected the production of /θ/. H6 is not confirmed either: there was no significance in the difference between the two word positions. Also, although the tendency was in the expected direction, it must be acknowledged that this result might have been more due to lack of word-familiarity than due to markedness itself.

5.2 Theoretical implications

From its first proposition in the 30's by Trubetzkoy and Jakobson, the term *markedness* has been expanded in the literature to different contexts related to both L1 and L2 acquisition, and has been used with different connotations (Haspelmath, 2006). In the present investigation, the markedness factor employed was based on the MDH proposition by Eckman (1977), which claimed that L2 learners would

acquire less marked structures more readily (easily) than they would more marked structures. Transferring this to the phonemes under investigation, the general understanding was that the interdentals in word-initial position would be produced with more accuracy than in word-final position. That was the motivation for investigating both initial and final positions.

However, it was observed in this investigation that markedness related to word-position does not seem to have influenced the production of the interdentals, at least for the participants in this study. Here, only the voiced interdental tended to be affected by this constraint, and even this cannot be confirmed because word (in)frequency may have been a greater influence. For the voiceless interdental, both word-positions had unexpectedly high accuracy rates, with no significant advantage for either, which might be explained by the high LOL and frequency of language contact of the participants.

Putting word (in)frequency aside, the difficulty of producing the interdentals, which in this study was high only for the voiced pair, may be due to the greater articulatory demands of these sounds. As Humes (2003, p. 5) explains, "greater articulatory complexity correlates with increased markedness". Articulatory difficulty was one of the reasons most frequently pointed out by the participants for not being able to produce the interdentals accurately. Furthermore, Reis (2006) had also observed that the degree of difficulty of articulation of these sounds might be an explanation for their difficulty of production.

The unexpected observation in the present investigation of the overall high performance of the participants might be explained by their close relation with the English language, which they used not only for academic and study matters, but also for work, mainly teaching related. Due to that, it is believed these participants have developed a higher sense of awareness of the importance of pronunciation, among other linguistic aspects, and that might have motivated them not only to search for a more native-like speech pronunciation but also to be better able to communicate this importance to their future pupils.

5.3 Pedagogical implications

Even though the present investigation did not deal with pronunciation teaching in particular, this researcher understands the importance of giving EFL learners the opportunity for greater awareness of the cross-linguistic differences between English and BP. More

research on these differences is also necessary in order to develop pronunciation materials and improve pronunciation teaching techniques.

Some researchers such as Mariano (2009) and Ruhmke-Ramos (2009) have investigated the issue of which type of pronunciation instruction might be best for learners' improvement not only on the perception of a given sound but also on its production, pronunciation training and/or pronunciation formal instruction, with the addition of awareness raising of the specific phonetic and phonological features of the language. Overall, these researchers advocate for pronunciation teaching, since they observe that it is essential to the better understanding of the language to be learned and thus should be considered by teachers in the EFL classrooms.

For the participants of the present study, the fact that some undergraduate students of the Letras English Course may have had the chance of taking English Phonetics and Phonology during their course might have aided them to get to their proficiency level at the time of data collection. Thus, having been exposed to pronunciation training/instruction in the FL classroom, chances are greater that these learners will be teachers who put this into practice.

When dealing with pronunciation in their classes, EFL teachers might perhaps give more attention to the interdentals, as well as other consonants, in word-final position because there seems to be less freedom for consonants to occur in coda position in the world's languages (Eckman and Iverson, 1994).

5.4 Limitations of the study and suggestions for further research

The present study, due to its small scale, has several limitations. The first limitation to be acknowledged is the limited number of participants and the lack of random selection. That rendered a modest quantity of data to be analyzed, and because of that no general claims can be made since the numbers here cannot be assumed to be representative of Brazilian EFL students. Possibly, with a greater group of subjects and more data available a different picture might have emerged.

Another limitation, which was only attended to after the data collection process was finished, was the reduced number of token-and distracter sentences in the production test. This may have opened up the possibility for the participants to pay more attention to 'form', that is, to concentrate more on pronunciation accuracy in general. Further studies

might take this into consideration and develop a more extensive list of target sentences, as well as other production test types, to observe how production differs from one to another.

Also, a flaw already mentioned (Chapter 3) was the omission of one target sentence (with the voiced interdental in word-final position) in some of the participants' production test. Even though the overall results of word-final /ð/ suggest the influence of word-(in)frequency, and thus few accurate realizations were observed in this position, perhaps the missing token might have rendered an interesting point for investigation, since the word *with* (missing token) seems to be very common to learners in general. On the other hand, the fact that this word can be produced with the voiced or voiceless interdental may also have interfered in the results. Last but not least, the impracticality of using acoustic analysis was also a limitation, although an unaivoidable one, which was overcome to some extent by the use of the video recording device during the production test and by having a second listener.

Further studies might consider the limitations acknowledged here and investigate also the English interdental fricatives not only in word-initial and final positions, but also in word-medial position and in clusters. Also, perception may be investigated in different word-positions so that we may comprehend which one renders more difficulty for learners and listeners in general. In this way, a better understanding of the whole picture of the interdental fricatives in L2 English may be constructed with further studies and then teachers and learners may benefit from that and improve the quality of instruction in their EFL classrooms in Brazil and abroad.

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APPENDIXES

Profile Questionnaire – Portuguese version

Universidade Federal de Santa Catarina
Centro de Comunicação e Expressão
Curso de Pós-Graduação em Inglês e Literaturas Correspondentes
Mestranda: Juliane Regina Trevisol
Orientadora: Bárbara O. Baptista

QUESTIONÁRIO SOBRE PARTICIPANTES DE PESQUISA DE CAMPO

Por favor, responda às perguntas abaixo. Este questionário visa somente obter informações que serão utilizadas para direcionar a análise dos dados da pesquisa conduzida pela aluna acima citada. Em nenhuma hipótese os nomes dos participantes serão divulgados, pois se trata de uma pesquisa quantitativa. Solicito informar nome e telefone somente para, no caso de necessitar alguma informação adicional, poder entrar em contato com você posteriormente.

Nome: _____ e-mail_____
Data_____/_____/2009
1. Idade _____ 2. Sexo: ( ) masculino ( ) feminino
3. Já morou em país de Língua Inglesa? ( ) não ( ) sim, Qual?_____
3.1. Se sim, por quanto tempo? _____
3.2. Quantos anos você tinha? _____
3.3. Qual o motivo de sua viagem?
( ) turismo/passeio;
( ) estudo;
( ) trabalho;
( ) outro: _____
3.4. Neste país, você costumava passar mais tempo com:
( ) falantes nativos de Inglês;
( ) falantes de outras línguas (estrangeiros);
( ) Brasileiros;
( ) em outra comunidade não-brasileira: _____

4. Quantos anos você tinha quando teve seu primeiro contato com o Inglês?

( ) menos de 7;

( ) entre 7 e 10;

( ) entre 10 e 15;

( ) entre 15 e 20;

( ) outra idade: _____

4.1. Você continuou estudando Inglês deste período em diante?

( ) não ( ) sim

4.2. Há quanto tempo estuda Inglês regularmente, ou seja, sem interrupção?

( ) menos de 6 meses;

( ) entre 6 meses e 1 ano;

( ) entre 1 ano e 1 ano e meio ;

( ) entre 1 ano e meio e 2 anos;

( ) entre 2 e 3 anos;

( ) entre 3 e 4 anos;

( ) entre 4 e 5 anos;

( ) entre 5 e 6 anos;

( ) outro:_____

4.2.1. Considerando seu contato com o Inglês, quantos anos de experiência você acredita ter? _____

4.3. Além das aulas (da UFSC), quanto tempo você aproximadamente gasta estudando Inglês (sozinho, em casa) por semana?

( ) Eu não estudo;

( ) menos de 1 hora;

( ) entre 1 e 2 horas;

( ) entre 2 e 3 horas;

( ) outro:_____

5. Você já fez algum teste de Proficiência?

( ) não ( ) sim

( )Cambridge   ( )Trinity

( ) TOEFL   ( ) IELTS

( ) Outro_____

Qual foi sua pontuação?_____

6. Você tem o hábito de ouvir música em Inglês? ( ) não ( ) sim

6.1. Você tenta cantar junto com a música? ( ) não ( ) sim

6.2. Quanto tempo você gasta nesta atividade, diariamente?

( ) menos de 1 hora;

( ) mais de 1 hora;

( ) mais de _____ horas;

( ) outro: _____

7. Você fala outra língua fluentemente, além do Português e do Inglês?

( ) não ( ) sim; Qual? _____

8. Em casa com sua família, você fala alguma outra língua estrangeira?

( ) não ( ) sim; Qual? _____

9. De onde você é/vem?

( ) Florianópolis ( ) outro Cidade/estado_____

10. Há quanto tempo mora em Florianópolis? _____

11. Numere os itens em **negrito** de acordo com o nível de importância que você dá a estes aspectos (você pode repetir o número se necessário):

1- Essencial 2- Importante   3- Indiferente   4- Irrelevante

Comunicação em língua estrangeira: _____ **Gramática:** _____

Pronúncia: _____   **Vocabulário:** _____

12. Você apresenta algum problema ou dificuldade auditiva?

( ) não; ( ) sim. Se sim, descreva: _____

13. E algum problema ou dificuldade relacionada à fala?

( ) não; ( ) sim. Se sim, descreva: _____ _____

14. Se você sente dificuldade em produzir o som do 'th', qual seria a razão, segundo sua opinião?

( ) Tenho dificuldade em articular este som;

( ) Parece-me um som ridículo e infantilizado;

( ) Eu não faço questão de produzí-lo corretamente, não me importo;

( ) É irrelevante;

( ) Outro motivo: _____

15. Em sua opinião, ao falar, por exemplo, estas palavras isoladas – *thanks* / *bath* – você acharia mais '**fácil**' produzir qual delas?

( ) *Thanks* – onde o 'th' está no início da palavra;

( ) *Bath* – onde o 'th' está no final da palavra;

( ) Não faz diferença pra mim, produzo as duas com a mesma facilidade.

16. Você alguma vez já recebeu instrução formal sobre os sons do 'th' do Inglês? ( ) não   ( ) sim

17. Se não recebeu, gostaria de ter aprendido mais sobre os sons do 'th'?

( ) não   ( ) sim

18. Descreva, com as suas palavras, o que você sabe sobre os sons do 'th' (como articulamos este som, etc.).

_____
_____
_____

Profile Questionnaire – English version

Universidade Federal de Santa Catarina
Centro de Comunicação e Expressão
Curso de Pós-Graduação em Inglês e Literaturas Correspondentes
Mestranda: Juliane Regina Trevisol
Orientadora: Bárbara O. Baptista

Questionnaire about the participants in this study

Please, answer the questionnaire below. This questionnaire will only get information to help in the analysis of the data collected by the researcher mentioned above. Participants' names will not be revealed, since this is a quantitative research. Extra info, such as name, e-mail address, and telephone number is required in case any complementary information is necessary, so that the researcher will be able to contact you.

Name: _____ e-mail_____
Date_____/_____/2009
1. Age _____ 2. Gender: ( ) male ( ) female
3. Have you ever lived in an English speaking country? ( ) no ( ) yes
Which one? _____
3.1. How long have you lived there? _____
3.2. How old were you? _____
3.3. What was the purpose of your trip?
( ) tourism;
( ) study;
( ) work;
( ) other: _____
3.4. In this country you used to spend more time with:
( ) native speakers of English;
( ) native-speakers of different L1s (foreigners);
( ) Brazilians;
( ) in other non-Brazilian community: _____
4. How old were you when you had your first contact with the English language?
( ) less than 7;
( ) within 7 and 10;

( ) within 10 and 15;
( ) within 15 and 20;
( ) another age: _____
4.1. Did you continue your English studies since that period?
( ) no ( ) yes
4.2. How long have you been studying English regularly, approximately, that is, without interruption?
( ) less than 6 months;
( ) within 6 months and 1 year;
( ) within 1 year and 1 and a half years;
( ) within 1 year and a half and 2 years;
( ) within 2 and 3 years;
( ) within 3 and 4 years;
( ) within 4 and 5 years;
( ) within 5 and 6 years;
( ) other:_____
4.2.1. Considering L2 experience, how many years of English experience do you believe to have?
_____
4.3. Apart from the classes (at UFSC) how much time do you approximately spend studying by yourself at home weekly?
( ) I do not study;
( ) less than 1 hour;
( ) within 1 and 2 hours;
( ) within 2 and 3 hours;
( ) other:_____
5. Have you done any English proficiency test?
( ) no ( ) yes
( ) Cambridge   ( ) Trinity
( ) TOEFL   ( ) IELTS
( ) Other_____
What was your score?_____
6. Do you have the habit of listening to English songs? ( ) no ( ) yes
6.1 Do you try to sing with the singer?
 ( ) no ( ) yes
6.2. How much time do you spend in this kind of activity, daily?
( ) less than 1 hour;
( ) more than 1 hour;
( ) more than _____ hours;
( ) other: _____

7. Are you fluent in another language rather than Portuguese and English?
( ) no ( ) yes; Which language? _____
8. Do you speak another foreign language at home with your family?
( ) no ( ) yes; Which language? _____
9. Where are you from?
( ) Florianópolis ( ) other City/state_____
10. How long have you been living in this city? _____
11. In your opinion, what is the level of importance you give for the following aspects of communication in a foreign language (you can repeat your evaluation if necessary):
1- Essential   2- Important   3- Indifferent   4- Irrelevant
Communication: _____**Grammar:** _____
Pronunciation: _____**Vocabulary:**_____
12. That you know, do you have any auditory problem or difficulty?
( ) no ( ) yes. If yes, describe it: _____
13. That you know, do you have any speaking problem or difficulty ( ) no ( ) yes. If yes, describe it: _____
14. If you have difficulties to produce the "th" sound, what would be the reason?
( ) I have difficulty with the articulation of this sound;
( ) It sounds like a ridicule and infantilized sound;
( ) I don't care if I produce it correct or not;
( ) It is irrelevant to me;
( ) Another reason: _____
15. In your opinion, when speaking the words *thanks* and *bath,* do you find one easier than the other in terms of pronunciation difficulty?
( ) *Thanks* – with the 'th' in word-initial position;
( ) *Bath* – with the 'th' in word-final position;
( ) It makes no difference to me, I produce both with the same easiness.
16. Did you receive formal instruction about the English *th*-words?
 ( ) no ( ) yes
17. If you haven't, would you like to learn more about the English *th*-sounds? ( ) no   ( ) yes
18. Describe, with your words, what you know about the English *th*-sounds (how we articulate it, etc).
_____
_____
_____
_____

Appendix C

Summary of Questionnaire results

Questions from 1 to 3.4
1. Age
2. Gender: F (female); M (male)
3. Have you ever lived in an English speaking country? When?
3.1. How long have you lived there (months)?
3.2. How old were you?
3.3. What was the purpose of your trip?
3.4. In this country you used to spend more time with... (Language setting)

Table C1. Participants' personal information and experience abroad

Participant	Q. 1	Q. 2	Q. 3	Q. 3.1	Q. 3.2	Q. 3.3	Q. 3.4
P1	22	F	ENG	4	19	study	Foreign speakers
P2	28	F	ENG 2004	12	23	study/ tourism	Foreign speakers
P3	21	M	X	X	X	X	X
P4	22	M	USA 2007	9	20	Work/ tourism	English speakers
P5	37	F	ENG 1990	12	19	study	British/Foreign speakers
P6	22	M	X	X	X	X	X
P7	22	F	X	X	X	X	X
P8	20	F	X	X	X	X	X
P9	22	F	USA 2006	4	18	Work/ tourism	Brazilian speakers
P10	25	F	X	X	X	X	X
P11	26	F	X	X	X	X	X

Note: Q= question

Questions from 4 to 8

4. How old were you when you had your first contact with the English language?

4.1. Did you continue your English studies since that period?

4.2. How long have you been studying English regularly, approximately, that is, without interruption?

4.2.1. Considering L2 experience, how many years of English experience do you believe to have?

4.3. Apart from the classes (at UFSC) how much time do you approximately spend studying by yourself at home weekly?

5. Have you done any English proficiency test?

6. Do you have the habit of listening to English songs?

6.1. Do you try to sing with the singer?

6.2. How much time do you spend in this kind of activity, daily? (hours/day)

7. Are you fluent in another language rather than Portuguese and English?

8. Do you speak another foreign language at home with your family?

Table C2. Participants' English learning experience

Participant	Q.4	Q.4.1	Q.4.2	4.2.1	Q.4.3	Q.5	Q.6	Q.6.1	Q.6.2	Q.7	Q.8
P1	10-15	yes	5-6	13ys	1-2	yes	yes	yes	+1	no	no
P2	15-20	yes	14 ys	14ys	+10h	yes	yes	yes	+3	no	no
P3	7-10	no	3-4	4ys	1-2	yes	yes	yes	+1	no	no

P4	P5	P6	P7	P8	P9	P10	P11
- 7	- 7	15-20	15-20	7-10	10-15	7-10	7-10
yes	yes	yes	yes	yes	yes	yes	yes
5-6	15ys	3-4	4-5	10 ys	4-5	4-5	5-6
6ys	20ys	4ys	5ys	11ys	8ys	8ys	6ys
1-2	2-3	1-2	no	+10h	1-2	-1h	1-2
no	yes	yes	yes	yes	yes	yes	yes
no	yes	yes	yes	yes	yes	yes	yes
yes	yes	yes	yes	yes	yes	yes	yes
+1	- 1	- 1	- 1	+1	+1	- 1	- 1
no	German	no	Spanish	no	no	no	Spanish
no	German	no	no	no	no	no	no

Note: Q= question; ys = years.

Questions from 9 to 14
9. Where are you from?

10. How long have you been living in this city? (years)

11. In your opinion, what is the level of importance you give for the following aspects of communication in a foreign language (you can repeat your evaluation if necessary) [only the importance given to **pronunciation** is considered here]:

1- essential	2- important	3- indifferent	4- irrelevant

grammar	pronunciation	vocabulary

12. That you know, do you have any auditory problem or difficulty?
13. That you know, do you have any speaking problem or difficulty?

Table C3. Participants' origin, importance given to pronunciation, auditory and speaking capacity

Participant	Q. 9	Q.10	Q.11	Q.12	Q.13
P1	Florianopolis-SC	X	important	X	X
P2	Sao Paulo-SP	6	important	X	X
P3	Florianopolis-SC	X	essential	X	X
P4	Florianopolis-SC	X	important	X	X
P5	Sao Paulo-SP	6	important	X	X
P6	Porto Belo-SC	4	important	X	X
P7	Toledo-PR	X	important	X	X
P8	Curitibanos-SC	3½	important	X	X
P9	Florianopolis-SC	X	indifferent	X	X
P10	Toledo-PR	X	important	X	X
P11	Toledo-PR	9	essential	X	X

Note: Q= question

Questions from 14 to 19
14. If you have difficulties to produce the "th" sound, what would be the reason?
15. In your opinion, when speaking the words *thanks* and *bath,* do you find one easier than the other in terms of pronunciation difficulty? (*thanks* – 'th' in word-initial position; *bath* – 'th' in word-final position; or no difference at all.)
16. Did you receive formal instruction about the English *th*-words?
17. If you haven't, would you like to learn more about the English *th*-sounds?
18. Describe, with your words, what you know about the English *th*-sounds.

Table C4. Participants' responses related to the *th*-sounds

Participant	Q. 14	Q.15	Q.16	Q.17	Q.18
P1	Difficult articulation	No difference	yes	X	"These sounds can be voiced or not. There is more than one way of articulating, being one with the tongue between the teeth; and some people articulate it with the tongue at the alveolar area*"*
P2	X	No difference	yes	X	"There are two forms of pronouncing such phoneme: /θ/ as in 'thanks' (I tell my students the phonetic symbol is like a tongue between the teeth, so we should pronounce it like that; or we can imitate a person with a lisp – that's the same sound!). The other sound is /ð/ like in 'this', a more sibilant sound."
P3	difficult articulation	*bath*	yes	X	"The 'th' is an English interdental fricative that can be either unvoiced (without vocal cord vibration) or voiced (with vibration)."
P4	Inexistent in Portug.	*thanks*	yes	yes	"That is the inter-dental sound produced in between the teeth."
P5	X	No difference	yes	X	"Put the tip of the tongue in between the teeth and produce the sound letting the air out through the top of the tongue."

P6	difficult articulation	*thanks*	yes	X	"The tongue touches the upper front teeth. There can be vocal cord vibration or not."
P7	Difficult articulation	*thanks*	yes	X	"Diferença de pronúncia de acordo com as letras que seguem. Posição da língua e som desejável da pronúncia."
P8	X	No difference	yes	X	"Interdental (place of articulation), fricative (manner of articulation). It can be voiced or voiceless: /ð/ [like in] think/bath; /θ/ [like in] that/loathe."
P9	Difficult articulation	*thanks*	yes	X	"It is a voiceless phoneme"
P10	difficult articulation	*thanks*	yes	X	"Um som que tive sempre muita dificuldade de pronunciar, pois não temos na língua portuguesa. Um som que deve ser pronunciado com a língua entre os dentes."
P11	difficult articulation	*bath*	yes	X	"As palavras com 'th' devem ser pronunciadas com a língua entre os dentes."

Note: Q= question

Appendix D

Informal Questionnaire
(Portuguese version only)

Questions e-mailed to the participants for further information:
1. As palavras *breathe, bathe, teethe, soothe, loathe* são comuns para você?
Por exemplo, você já havia lido/ouvido estas palavras antes?
Você usa estas palavras em conversas com freqüência?
Já havia pronunciado alguma delas antes (da atividade de coleta de dados)?

2. Se você tivesse que dar uma média de anos para a sua experiência/contato com Inglês, qual seria?
Por exemplo, considerando o tempo de estudo da língua, aulas que você ministra, momentos em que você está falando/ouvindo/lendo algo em Inglês - quantos anos de contato/experiência você acredita ter?
3. Atualmente você dá aula de Inglês?
Aula particular, em escola de idiomas, outro contexto?
Se não, já deu aula anteriormente?
4. Você se sente motivado a aprender/ensinar Inglês?
Acha motivação um fator importante? Por quê?

Appendix E

Informal Questionnaire - Responses

P1

1- Sim, são familiares para mim, penso que tive contato freqüente com elas como ouvinte (em seriados e filmes, também quando estive na Inglaterra) e vez ou outra as utilizo sim.

2- Tenho contato com a língua inglesa desde os 12 anos.

3-Não dou aula atualmente; lecionei um ano pelo PET Letras, um ano de aula particular para uma criança e um semestre para o Extra.

4-Não me sinto motivada para aprender/ensinar inglês como um fim em sim mesmo. Para mim, o inglês é um meio para diversos fins, dentre os quais destaco a leitura de literatura de língua inglesa, acessibilidade a textos e mídias diversas disponíveis no mundo, contato com diversas culturas.

P2

(No response from this participant).

P3

1. Sim, as palavras breathe, bathe e teethe são bastante comuns pra mim, já soothe e loathe um pouco menos... De qualquer forma, lembro de tê-las usado anteriormente sim, principalmente as 3 primeiras.

2. Acredito que 3 anos, 3 anos e meio seria a minha média de contato com a língua inglesa.

3. Não atualmente, mas já dei aulas de inglês num colégio estadual anteriormente.

4. Sim, me sinto motivado e acho que é um aspecto importante em todo professor.

P4

(No response from this participant).

P5

1. Sim, são palavras que ouço e leio, não com muita freqüência, mas me são familiares.

As que uso com certa freqüência são: breathe, bathe e soothe. Teethe e loathe são mais raras. Como mãe e dona de casa elas me são conhecidas!

2. Tive dois anos de contato intenso, morei em Londres e no primeiro ano que morei na Suíça só me comunicava em inglês. Depois desse período sempre dei aulas, leio sempre alguma coisa em inglês, acesso notícias em inglês pela internet, fora filmes, musicas, conversas com amigos, etc.

3. Atualmente trabalho com tradução e dou aulas particulares de inglês.

4. Acho a motivação crucial para qualquer tipo de aprendizado, chego à não aceitar alunos que não tenham uma motivação forte para aprender inglês.

P6

(No response from this participant).

P7

1. Ouvido creio que sim, mas pronunciado acho que não, pelo menos das cinco palavrinhas, duas delas já ouvi e falei com freqüência, mas as outras não.

2. Bem, agora meu inglês está focado só para o lado científico, no sentido de que os artigos os quais preciso ler são todos em inglês. Na época em que estive em contato (diariamente) com o inglês acho que me daria uma média de 9,5 - falava o dia todo, ouvia muito, praticava bastante, tinha bastante contato com minhas teachers pra conversar e praticar...
mas agora, acho que um 7,5 - 8,0 já estaria bom demais.

3. Atualmente não estou lecionando, mas já tive a experiência de sala de aula!

4. Sem motivação não tem como, não é?! Se fosse hoje, considerando todas as dificuldades em dar aula, principalmente em escola pública, onde a maioria dos alunos não tem a "tal da motivação", onde a maioria entende que o inglês é apenas mais uma matéria na grade curricular, eu não me arriscaria a tentar novamente.

P8

1. Sim, são comuns para mim, e as utilizo sempre que necessário.

2. 11 anos, desde que eu tinha 10.

3. Atualmente apenas dou aulas de português para estrangeiros (por isso, tenho muito contato com eles em inglês também). Porém, já dei aulas de inglês por 1 ano.

4. Sim, sou motivada e sinto que isso é um fator importante. Já tive minha prática de ensino dentro do estágio obrigatório, e sinto que tenho "jeito para a coisa". O único ponto negativo seria a baixa remuneração...

P9

1. Sim, são comuns para mim, mas são palavras que não estão em minhas conversas com freqüência.

2. Entre 7-8 anos.

3. Atualmente não, mas trabalhei como professora de inglês durante os anos de 2006-2008 em diferentes escolas e cursos de idiomas e ano passado dei aulas particulares.

4. Sinto-me motivada quando em atividade com a língua, quando surge o interesse: com filmes, músicas e leituras.

P10

1. Essas palavras eu já li, ouvi e pronunciei, porém as usei e as uso muito pouco.

2. Desde inicio de estudo até aula uns 8 anos que foram com mais intensidade.

3. No momento não dou aula. Mas já dei aula em escola de idiomas por 5 anos. Somente uso o inglês agora para ler alguns textos científicos e fazer meus abstracts de artigo.

4. Sim, me sinto muito motivada. Adorava ser teacher e aluna também. Motivação é importantíssimo por que nos dá força e empenho pra aprender.

P11
(No response from this participant).

Appendix F

Permission Form – Portuguese version

Universidade Federal de Santa Catarina
Centro de Comunicação e Expressão
Departamento de Língua e Literatura Estrangeiras
Programa de Pós-Graduação em Letras/Inglês e Literatura Correspondente

FORMULÁRIO DE AUTORIZAÇÃO PARA PARTICIPAÇÃO EM PESQUISA

Prezado participante,

Meu nome é Juliane Trevisol e sou aluna do programa de Mestrado da Pós Graduação em Inglês e Literatura Correspondente – UFSC. Gostaria de convidá-lo a participar de minha coleta de dados. Infelizmente, os objetivos da pesquisa não podem ser revelados uma vez que poderiam interferir no seu desempenho e, assim, nos resultados desta pesquisa. Os resultados daqui obtidos serão a base de minha dissertação, a ser defendida em Dezembro de 2009.

Procedimentos:
Como participante voluntário deste estudo, você realizará - em horário extra-classe a ser combinado com o pesquisador - um *teste de produção* (a ser gravado, individualmente, em áudio e vídeo) e responderá a um *questionário*. As informações contidas no questionário irão direcionar as análises dos dados da pesquisa, mas de forma alguma os nomes dos participantes serão divulgados, uma vez que se trata de uma pesquisa de cunho quantitativo. Por fim, será fornecida uma declaração de participação na pesquisa, providenciada pelo DLLE, contendo descrição da atividade e carga horária utilizada para a realização da mesma.

Desde já, agradeço sua atenção e colaboração.

Nome:_____
Assinatura: _____
Florianópolis, ___ de Junho de 2009.

Permission Form – English version

Universidade Federal de Santa Catarina
Centro de Comunicação e Expressão
Departamento de Língua e Literatura Estrangeiras
Programa de Pós-Graduação em Letras/Inglês e Literatura
Correspondente

PERMISSION FORM

Dear participant,

My name is Juliane Trevisol and I am a student from the Master program at Pós Graduação em Inglês e Literatura Correspondente, here at UFSC. I would like to invite you to participate from my data collection. The research goals cannot be revealed, unfortunately, since that might interfere in your performance and thus in the results of my study. The data obtained from here will be the base for my Master thesis to be defended in December, 2009.

Procedures:
As a volunteer in this study, you will need to answer a questionnaire and take a production test (individually recorded in áudio and vídeo), on a special day to be decided between you and the researcher. The information of the questionnaire will guide the analysis of the data, however no names will be revealed since this is a quantitative research. Finally, you will receive from DLLE a paper declaring your participation in the research; the declaration will inform the activity you did and the amount of hours used in this data collection procedure.

In advance, I would like to thank you for accepting to take part in this research.

Name:_____
Signature: _____
Florianópolis, June _____ 2009.

Appendix H

Production Test Sentences

<table>
<tr><td rowspan="2">Word-Initial /θ/</td><td>

1. ***Thank*** you for the help.
2. ***Thanksgiving*** is an American holiday.
3. ***Things*** are going from bad to worse.
4. ***Think*** about it.
5. ***Thunder*** storms may be dangerous.
6. It's a movie-***theater***.
7. Listen to my ***theme*** song.
8. She's into radio-***therapy***.
9. It's a very ***thick*** book.
10. That ice is too ***thin*** to stand on.

</td><td rowspan="2">Word-Final /θ/</td><td>

1. Keep to the ***path***.
2. The window faces ***south***.
3. You're drinking yourself to ***death***.
4. Mom bought a nice ***tablecloth***.
5. Hold your ***breath***.
6. I can't stand ***math*** and physics.
7. He takes a cold ***bath*** every morning.
8. She speaks ***both*** English and Spanish.
9. There's no ***truth*** in what he says.
10. Put your ***faith*** in God.

</td></tr>
</table>

	Word-Initial /ð/		Word-Final /ð/
	1. ***That's*** a nice hat. 2. ***They*** are from Hollywood. 3. ***This*** is my husband. 4. ***Those*** boys are my friends. 5. ***There's*** no reason to go. 6. Can you play ***these*** instruments? 7. She did not lend me ***the*** money. 8. We were living in Hawaii ***then***. 9. The coffee ***they*** serve is great. 10. I'd rather stay ***than*** go.		1. On hot days we often go to the river to ***bathe***. 2. That cream left her skin really ***smooth***. 3. The suit was so tight that I could hardly ***breathe***. 4. Waiting for people is something I really ***loathe***. 5. The baby has started to ***teethe***. 6. It's good to ***breathe*** in fresh air. 7. Come ***with*** us. 8. This will help to ***soothe*** our sunburn. 9. Mix blue ***with*** orange and you get purple. 10. Her skin is as ***smooth*** as a baby's bottom.

Distractor sentences:

1. Have an awesome day!
2. I very much appreciate your participation.
3. I hope you're not too tired!
4. What's the time?
5. Remember what I told you before.
6. Have you ever been in love?
7. Maria taught German at school.
8. I need a new pair of sunglasses.
9. All stores are giving discounts.
10. I can dance well but I cannot paint.
11. Apples grow on trees.
12. It is very nice to meet you.
13. Come over here for a second, please.

14. My friends are coming over for dinner.
15. How would it feel to be free?
16. Forget about your problems and focus on what you can do.
17. Kids love to play outdoors.
18. Summer is the best season of the year.
19. She said she would fight for her kids.
20. I just love to be up in the mountains.

Appendix I

Production Test – Example

• Read and record the following sentences.
• Do not read or rehearse them before recording.
• Please speak clearly and audibly.
• Do not repeat words or sentences that you believe having made mistakes.
• Try to follow your own pace, without interruption and repetition.

Think about it.
How would it feel to be free?
I can't stand math.
Listen to my theme song.
The suit was so tight that I could hardly breathe.
She said she would fight for her kids.
It's a movie-theater.
Keep to the path.
Summer is the best season of the year.
Thanksgiving is an American holiday.
On hot days we often go to the river to bathe.
I'd rather stay than go.
Kids love to play outdoors.
That ice is too thin to stand on.
Waiting for people is something I really loathe.
Forget about your problems and focus on what you can do.
Things are going from bad to worse.
She's into radio-therapy.
He's better off now that she's gone.
Thunder storms may be dangerous.
It's a very thick book.
They are from Hollywood.
My friends are coming over for dinner.
That's a nice hat.
You're drinking yourself to death.
Come over here for a second, please.

That cream left her skin really smooth.
This will help to soothe our sunburn.
I just love to be up in the mountains.
This is my husband.
It is very nice to meet you.
The coffee they serve is great.
The baby has started to teethe.
Apples grow on trees.
Can you play these instruments?
I can dance well but I cannot paint.
Mom bought a nice tablecloth.
All stores are giving discounts.
The window faces south.
Thank you for the help.
I need a new pair of sunglasses.
There's no reason to go.
Maria taught German at school.
He takes a cold bath every morning.
Have you ever been in love?
She speaks both English and Spanish.
Remember what I told you before.
It's good to breathe in fresh air.
There's no truth in what he says.
Mix blue with orange and you get purple.
Those boys are my friends.
What's the time?
Put your faith in God.
I hope you are not too tired!
Hold your breath.
Her skin is still as smooth as a baby's bottom.
We were living in Hawaii then.
She did not lend me the money.
I very much appreciate your participation.
Have an awesome day!

Appendix J

Table of Ratings

	P1	Rater 1		Rater 2		Agreed on	P2	Rater 1		Rater 2		Agreed on
1	**these**	ð	ð	ð	ð		**smooth.**	θ	θ	θ	θ	
2	**soothe**	θ	θ	θ	θ		**bathe.**	ð	ð	ð	ð	
3	**smooth.**	θ	ð	θ	ð		**death.**	θ	θ	θ	θ	
4	**death.**	θ	θ	θ	θ		**thin**	θ	θ	θ	θ	
5	**That**	d	ð	ð	ð	d	**thick**	θ	θ	θ	θ	
6	**They**	d	ð	d	ð		**teethe.**	θ	θ	θ	θ	
7	**thick**	θ	θ	f	θ	f	**they**	ð	d	ð	ð	ð
8	**teethe.**	θ	θ	f	θ	f	**these**	ð	ð	ð	d	d
9	**they**	d	ð	d	ð		**Thunder**	θ	θ	θ	θ	
10	**This**	d	ð	d	ð		**soothe**	ð	ð	ð	ð	
11	**Thunder**	θ	θ	θ	θ		**therapy**	θ	θ	θ	θ	
12	**therapy**	θ	θ	θ	θ		**theater**	θ	θ	θ	θ	
13	**Things**	θ	θ	θ	θ		**loathe.**	ð	ð	θ	ð	θ
14	**loathe.**	ð	ð	d	d	ð d	**Things**	θ	θ	θ	θ	
15	**thin**	θ	θ	θ	f	f	**That**	d	d	ð	ð	ð ð
16	**than**	d	d	ð	d	d	**than**	d	d	ð	ð	ð ð
17	**bathe.**	ð	ð	v	θ	ð θ	**Thanksgiving**	θ	θ	θ	θ	
18	**Thanksgiving**	θ	θ	θ	θ		**path.**	θ	θ	θ	θ	
19	**path.**	θ	θ	θ	θ		**breathe.**	ð	ð	ð	ð	
20	**theater**	θ	θ	θ	θ		**They**	d	d	ð	ð	ð ð
21	**breathe.**	ð	ð	ð	ð		**theme**	θ	θ	θ	θ	
22	**theme**	θ	θ	f	θ	θ	**This**	d	ð	ð	ð	ð
23	**math**	θ	θ	θ	θ		**truth**	θ	θ	θ	θ	
24	**Think**	θ	θ	θ	θ		**tablecloth.**	θ	θ	θ	θ	
25	**the**	d	d	d	ð	ð	**the**	d	d	ð	ð	ð ð
26	**then**	ð	ð	ð	ð		**then**	d	d	ð	ð	ð ð
27	**smooth**	θ	θ	θ	θ		**bath**	θ	θ	θ	θ	
28	**breath**	θ	θ	θ	θ		**breath.**	θ	θ	θ	θ	
29	**faith**	θ	θ	θ	θ		**south.**	θ	θ	θ	θ	
30	**Those**	ð	ð	ð	ð		**faith**	θ	θ	θ	θ	
31	**with**	θ	θ	θ	θ		**math**	θ	θ	θ	θ	
32	**truth**	θ	θ	θ	θ		**There**	ð	ð	ð	ð	
33	**breathe**	θ	θ	θ	θ		**Those**	ð	ð	ð	ð	
34	**both**	θ	θ	θ	θ		**with**	ð	ð	ð	ð	
35	**bath**	θ	θ	f	f	θ θ	**breathe**	ð	ð	ð	ð	
36	**There**	d	d	d	d		**both**	θ	θ	θ	θ	
37	**Thank**	θ	θ	θ	θ		**Think**	θ	θ	θ	θ	
38	**south.**	θ	θ	θ	θ		**smooth**	ð	θ	θ	θ	θ
39	**tablecloth.**	θ	θ	θ	f	f	**Thank**	θ	θ	θ	θ	
40												

	P3	Rater 1		Rater 2		Agreed on	P4	Rater 1		Rater 2		Agreed on	
1	**soothe**	θ	θ	θ	θ		**smooth.**	ð	ð	ð	ð		
2	**Think**	θ	θ	θ	θ		**death.**	t	θ	θ	θ	θ	
3	**death.**	θ	θ	θ	θ		**They**	d	d	d	d		
4	**than**	ð	ð	ð	ð		**thick**	θ	θ	t	θ	t	
5	**Things**	θ	θ	θ	θ		**Things**	θ	θ	θ	θ		
6	**They**	ð	ð	ð	ð		**teethe.**	ð	ð	ð	ð		
7	**thick**	θ	θ	θ	θ		**they**	d	d	ð	ð	ð	ð
8	**teethe.**	ð	ð	ð	ð		**bathe.**	ð	ð	ð	ð		
9	**they**	d	ð	ð	ð	ð	**This**	d	d	ð	ð	ð	ð
10	**faith**	θ	θ	θ	θ		**Thunder**	t	θ	θ	θ	θ	
11	**That**	ð	ð	ð	ð		**That**	ð	d	ð	d		
12	**bathe.**	θ	θ	θ	θ		**these**	d	d	ð	d	ð	
13	**loathe.**	ð	ð	θ	θ	θ θ	**soothe**	θ	θ	θ	θ		
14	**thin**	θ	θ	θ	θ		**therapy**	θ	θ	θ	θ		
15	**these**	ð	d	ð	ð	ð	**Thanksgiving**	θ	t	θ	θ	θ	
16	**path.**	θ	θ	θ	θ		**loathe.**	d	d	d	ð	ð	
17	**theater**	θ	θ	θ	t	t	**thin**	θ	θ	θ	θ		
18	**Thunder**	θ	θ	θ	θ		**than**	ð	d	ð	ð	ð	
19	**breathe.**	ð	ð	ð	ð		**path.**	θ	t	θ	θ	θ	
20	**This**	ð	ð	ð	ð		**theater**	t	t	θ	θ	θ	θ
21	**theme**	θ	θ	θ	θ		**breathe.**	d	ð	ð	ð	ð	
22	**math**	θ	θ	θ	θ		**theme**	θ	θ	θ	θ		
23	**therapy**	θ	t	θ	t		**math**	θ	θ	θ	θ		
24	**smooth**	θ	ð	θ	ð		**Think**	t	t	θ	θ	θ	θ
25	**smooth.**	θ	ð	θ	θ	θ	**the**	d	d	d	ð	ð	
26	**Thanksgiving**	θ	θ	θ	θ		**then**	d	d	d	d		
27	**There**	ð	ð	ð	ð		**smooth**	d	d	d	d		
28	**tablecloth.**	θ	θ	θ	t	t	**breath.**	θ	θ	θ	θ		
29	**Those**	ð	ð	ð	d	d	**faith**	θ	θ	d	θ	d	
30	**bath**	θ	θ	θ	θ		**tablecloth.**	t	t	t	t		
31	**south.**	θ	θ	θ	θ		**with**	ð	Xø	ð	Xø		
32	**with**	θ	θ	θ	θ		**truth**	θ	θ	θ	θ		
33	**then**	ð	ð	ð	ð		**breathe**	ð	d	ð	d		
34	**truth**	θ	θ	θ	θ		**south.**	θ	θ	θ	θ		
35	**both**	θ	θ	θ	θ		**both**	θ	θ	θ	θ		
36	**breathe**	ð	ð	θ	ð	θ	**bath**	θ	θ	θ	θ		
37	**Thank**	θ	θ	θ	θ		**Thank**	θ	θ	θ	θ		
38	**breath.**	θ	θ	θ	θ		**There**	ð	d	ð	ð	ð	
39	**the**	d	d	d	d		**Those**	ð	d	ð	d		
40													

Note: Xø = token was not produced; it was omitted by the participant even though the target word was produced.

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	P5	Rater 1		Rater 2		Agreed on	P6	Rater 1		Rater 2		Agreed on
1	these	ð	ð	ð	ð		Thank	t	θ	t	t	t
2	soothe	ð	ð	ð	θ	θ	This	d	ð	d	ð	
3	smooth.	θ	θ	θ	θ		smooth.	θ	θ	θ	θ	
4	death.	θ	θ	θ	θ		soothe	ð	ð	ð	ð	
5	That	ð	ð	ð	ð		death.	θ	θ	θ	θ	
6	They	ð	ð	ð	ð		That	d	d	d	d	
7	thick	θ	θ	θ	θ		these	d	d	d	d	
8	teethe.	ð	ð	θ	θ	θ θ	they	d	ð	d	ð	
9	they	ð	ð	ð	ð		They	ð	ð	d	ð	d
10	This	ð	ð	ð	ð		thick	θ	θ	θ	θ	
11	Thunder	θ	θ	θ	θ		teethe.	θ	θ	θ	θ	
12	therapy	θ	θ	θ	θ		therapy	θ	θ	θ	θ	
13	Things	θ	θ	θ	θ		Thunder	t	t	θ	θ	θ θ
14	loathe.	ð	ð	θ	θ	θ θ	loathe.	ð	ð	d	d	d d
15	thin	θ	θ	θ	θ		Things	θ	θ	θ	θ	
16	than	ð	ð	ð	ð		bathe.	ð	ð	d	d	d d
17	bathe.	ð	ð	θ	θ	θ θ	than	d	ð	d	d	d
18	Thanksgiving	θ	θ	θ	θ		thin	θ	θ	θ	f	f
19	path.	θ	θ	θ	θ		Thanksgiving	t	t	t	t	
20	theater	θ	θ	θ	θ		path.	θ	θ	θ	θ	
21	breathe.	ð	ð	ð	θ	θ	theater	θ	θ	θ	θ	
22	theme	θ	θ	θ	θ		breathe.	d	ð	ð	ð	d
23	math	θ	θ	θ	θ		both	θ	θ	θ	θ	
24	Think	θ	θ	θ	θ		theme	θ	θ	θ	θ	
25	the	ð	ð	ð	d	d	the	d	d	d	d	
26	then	ð	ð	ð	ð		Those	d	d	d	d	
27	smooth	ð	ð	θ	θ	θ θ	There	d	d	d	d	
28	breath	θ	θ	θ	θ		math	θ	θ	θ	θ	
29	faith	θ	θ	θ	θ		Think	θ	θ	θ	θ	
30	Those	ð	ð	ð	ð		bath	θ	θ	θ	θ	
31	with	ð	ð	θ	θ	θ θ	smooth	θ	θ	θ	θ	
32	truth	θ	θ	θ	θ		then	ð	ð	d	ð	d
33	breathe	θ	θ	θ	θ		breath.	θ	θ	θ	θ	
34	both	θ	θ	θ	θ		faith	θ	θ	f	θ	f
35	bath	θ	θ	θ	θ		truth	θ	θ	θ	θ	
36	There	ð	ð	ð	ð		tablecloth.	θ	θ	θ	θ	
37	Thank	θ	θ	θ	θ		south.	θ	θ	θ	θ	
38	south.	θ	θ	θ	θ		with	θ	θ	θ	θ	
39	tablecloth.	θ	θ	θ	θ		breathe	ð	ð	v	ð	v
40												

	P7	Rater 1		Rater 2		Agreed on	P8	Rater 1		Rater 2		Agreed on
1	**they**	ð	ð	ð	ð		**tablecloth.**	θ	θ	θ	θ	
2	**thin**	θ	θ	θ	θ		**these**	ð	ð	ð	ð	
3	**bathe.**	θ	θ	θ	θ		**smooth.**	θ	θ	θ	θ	
4	**soothe**	ð	ð	θ	θ	θ θ	**soothe**	ð	ð	ð	ð	
5	**That**	d	d	d	d		**death.**	θ	θ	θ	θ	
6	**They**	ð	ð	ð	d	d	**That**	ð	ð	ð	ð	
7	**thick**	θ	θ	θ	θ		**thick**	θ	θ	θ	θ	
8	**path.**	θ	θ	θ	θ		**They**	ð	ð	ð	ð	
9	**breathe.**	ð	ð	θ	θ	θ θ	**teethe.**	ð	ð	θ	θ	θ θ
10	**teethe.**	θ	θ	θ	θ		**they**	ð	ð	ð	ð	
11	**This**	d	d	d	d		**This**	ð	ð	ð	ð	
12	**Thunder**	θ	θ	θ	θ		**with**	ð	ð	ð	ð	
13	**death.**	θ	θ	θ	θ		**Thunder**	θ	θ	θ	θ	
14	**with**	ð	ð	θ	θ	θ θ	**Things**	θ	θ	θ	θ	
15	**therapy**	θ	θ	θ	θ		**therapy**	θ	θ	θ	θ	
16	**Things**	ð	θ	t	θ	t	**loathe.**	ð	ð	θ	θ	θ θ
17	**loathe.**	θ	tʰ	θ	tʰ		**thin**	θ	θ	θ	θ	
18	**than**	d	d	d	d		**bathe.**	ð	ð	ð	θ	θ
19	**these**	d	d	d	d		**Thanksgiving**	θ	θ	θ	θ	
20	**Thanksgiving**	t	t	t	t		**than**	ð	ð	ð	ð	
21	**bath**	θ	θ	θ	θ		**path.**	θ	θ	θ	θ	
22	**theater**	θ	θ	θ	θ		**theater**	θ	θ	θ	θ	
23	**math**	θ	θ	θ	θ		**breathe.**	ð	ð	θ	θ	θ θ
24	**There**	ð	ð	ð	d	d	**math**	θ	θ	θ	θ	
25	**Think**	θ	θ	θ	θ		**theme**	θ	θ	θ	θ	
26	**the**	d	d	d	d		**Think**	θ	θ	θ	θ	
27	**theme**	θ	θ	θ	θ		**the**	ð	ð	d	ð	d
28	**then**	d	d	d	d		**then**	ð	ð	ð	ð	
29	**smooth**	θ	θ	θ	θ		**smooth**	θ	θ	θ	θ	
30	**breath.**	θ	θ	θ	θ		**faith**	θ	θ	θ	θ	
31	**with**	ð	ð	θ	θ	θ θ	**breath.**	θ	θ	θ	θ	
32	**Those**	ð	ð	ð	d	d	**both**	θ	θ	θ	θ	
33	**truth**	θ	θ	θ	θ		**Those**	ð	ð	ð	ð	
34	**Thank**	θ	θ	θ	t	t	**truth**	θ	θ	θ	θ	
35	**breathe.**	ð	ð	θ	θ	θ θ	**with**	ð	ð	θ	ð	θ
36	**smooth.**	θ	θ	θ	θ		**Thank**	θ	θ	θ	θ	
37	**south**	θ	θ	θ	θ		**breathe**	ð	ð	ð	ð	
38	**tablecloth.**	tʃ	tʃ	tʃ	tʃ		**bath**	θ	θ	θ	tʃ	
39	**both**	θ	θ	θ	θ		**south**	θ	θ	θ	θ	
40	**faith**	θ	θ	θ	θ		**There**	ð	ð	ð	ð	

	P9	Rater 1		Rater 2		Agreed on	P10	Rater 1		Rater 2		Agreed on
1	**with**	d	d	d	d		**they**	d	d	d	d	
2	**death.**	θ	θ	θ	θ		**thin**	θ	θ	θ	θ	
3	**thin**	θ	θ	f	θ	f	**bathe.**	θ	θ	θ	θ	
4	**bathe.**	θ	θ	ð	θ	ð	**soothe**	θ	θ	θ	t	t
5	**teethe.**	θ	θ	θ	θ		**That**	d	ð	d	d	d
6	**Thunder**	t	t	t	t		**They**	d	d	d	d	
7	**They**	d	d	d	d		**thick**	θ	θ	θ	θ	
8	**therapy**	θ	θ	θ	θ		**path.**	θ	θ	θ	θ	
9	**loathe.**	ð	ð	θ	θ	θ θ	**breathe.**	θ	θ	θ	θ	
10	**theme**	θ	θ	θ	θ		**teethe.**	θ	θ	θ	θ	
11	**thick**	θ	θ	θ	θ		**This**	d	ð	d	d	d
12	**theater**	θ	θ	θ	θ		**Thunder**	θ	θ	θ	θ	
13	**they**	d	d	ð	d	ð	**death.**	θ	θ	θ	θ	
14	**Things**	θ	θ	θ	θ		**with**	θ	θ	θ	θ	
15	**smooth.**	θ	θ	θ	θ		**therapy**	θ	θ	θ	t	t
16	**soothe**	ð	θ	θ	θ	θ	**Things**	θ	θ	θ	θ	
17	**these**	d	d	d	d		**loathe.**	θ	θ	θ	θ	
18	**than**	ð	d	ð	d		**than**	d	d	d	d	
19	**That**	ð	d	ð	d		**these**	d	d	d	d	
20	**breathe**	ð	θ	ð	θ		**Thanksgiving**	θ	θ	θ	θ	
21	**path**	θ	θ	θ	θ		**bath**	θ	θ	θ	θ	
22	**breathe.**	θ	θ	θ	θ		**theater**	θ	θ	θ	θ	
23	**Thanksgiving**	θ	θ	θ	θ		**math**	θ	θ	θ	θ	
24	**truth**	θ	θ	θ	θ		**There**	d	d	d	d	
25	**There**	d	d	d	d		**Think**	θ	θ	θ	θ	
26	**math**	θ	θ	θ	θ		**the**	d	d	d	d	
27	**south.**	θ	θ	θ	θ		**theme**	t	t	t	θ	θ
28	**Think**	θ	θ	θ	θ		**then**	d	d	d	d	
29	**the**	d	d	ð	d	ð	**smooth**	θ	θ	θ	θ	
30	**faith**	θ	θ	θ	θ		**breath.**	θ	θ	θ	θ	
31	**Thank**	θ	θ	θ	θ		**with**	θ	θ	θ	θ	
32	**Those**	d	d	d	d		**Those**	d	d	d	d	
33	**with**	θ	θ	θ	θ		**truth**	θ	θ	θ	θ	
34	**smooth**	θ	θ	θ	θ		**Thank**	t	θ	t	θ	
35	**breath.**	θ	θ	θ	θ		**breathe.**	θ	θ	θ	θ	
36	**both**	θ	θ	θ	θ		**smooth.**	θ	θ	θ	θ	
37	**bath**	θ	θ	θ	θ		**south**	t	t	t	t	
38	**then**	d	d	d	d		**tablecloth.**	θ	θ	θ	θ	
39	**tablecloth.**	θ	θ	θ	θ		**both**	θ	θ	θ	θ	
40	**This**	d	d	d	d		**faith**	θ	θ	θ	θ	

	P11	Rater 1		Rater 2		Agreed on			
1	**they**	d	d	d	d				
2	**thin**	θ	θ	θ	θ				
3	**bathe.**	θ	θ	θ	θ				
4	**soothe**	XXX		XXX		XXX			
5	**That**	d	d	d	d				
6	**They**	d	d	d	d				
7	**thick**	θ	θ	θ	θ				
8	**path.**	θ	θ	θ	θ				
9	**breathe.**	θ	θ	θ	θ				
10	**teethe.**	ð	ð	θ	θ	θ θ			
11	**This**	d	d	d	d				
12	**Thunder**	t	t	t	t				
13	**death.**	θ	θ	θ	θ				
14	**with**	ð	ð	ð	ð				
15	**therapy**	θ	θ	θ	t	t			
16	**Things**	θ	θ	θ	θ				
17	**loathe.**	ð	ð	θ	θ	θ θ			
18	**than**	d	d	d	d				
19	**these**	ð	ð	d	ð	d			
20	**Thanksgiving**	θ	θ	θ	θ				
21	**bath**	θ	θ	θ	θ				
22	**theater**	θ	θ	θ	θ				
23	**math**	θ	θ	θ	θ				
24	**There**	d	d	d	d				
25	**Think**	θ	θ	θ	θ				
26	**the**	d	d	d	d				
27	**theme**	θ	θ	θ	θ				
28	**then**	ð	ð	ð	ð				
29	**smooth**	θ	θ	θ	θ				
30	**breath.**	θ	θ	θ	θ				
31	**with**	ð	ð	θ	θ	θ θ			
32	**Those**	d	d	d	d				
33	**truth**	θ	θ	θ	θ				
34	**Thank**	θ	θ	θ	θ				
35	**Breathe.**	ð	ð	θ	θ	θ θ			
36	**smooth.**	θ	θ	θ	θ				
37	**south**	θ	θ	θ	θ				
38	**tablecloth.**	θ	θ	θ	θ				
39	**both**	θ	θ	θ	θ				
40	**faith**	θ	θ	θ	θ				

Note: XXX represents tokens that were removed from the analysis due to mispronunciation (participant produced a completely different word other than the target one).

Appendix K

Table of Productions per word-unit

Table K1. Productions of word-initial /θ/ in sentence-initial position

Target word	Word-initial /θ/	
	Environment: /θ/ in sentence initial	
	Accurate production	Replacement
Thank	18	4 [t]
Thanksgiving	18	4 [t]
Things	21	1 [t]
Think	22	0
Thunder	18	4 [t]

N = 22 (total of 22 productions of the target word – 11 x 2).

Table K2. Productions of word-initial /θ/ in after-vowel position

Target word	Word-initial /θ/	
	Environment: /θ/ after vowel	
	Accurate production	Replacement
theater	21	1 [t]
theme	21	1 [t]
therapy	19	2 [t]
thick	20	1 [t] + 1 [f]
thin	19	3 [f]

N = 22 (total of 22 productions of the target word – 11 x 2).

Table K3. Productions of word-final /θ/ in sentence-final position

Target word	Word-final /θ/	
	Environment: /θ/ at the end of the sentence	
	Accurate production	Replacement
path	22	0
south	20	2 [t]
death	22	0
tablecloth	16	3 [t] + 1 [f] + 2 [tʃ]
breath	22	0

N = 22 (total of 22 productions for each target word – 11 x 2).

Table K4. Productions of word-final /θ/ in before-vowel position

Target word	Word-final /θ/	
	Environment: final /θ/ followed by a vowel	
	Accurate production	Replacement
math	22	0
bath	22	0
both	22	0
truth	22	0
faith	20	1 [d] + 1 [f]

N = 22 (total of 22 productions of the target word – 11 x 2).

Table K5. Productions of word-initial /ð/ in sentence-initial position

Target word	Word-initial /ð/	
	Environment: /ð/ in sentence initial	
	Accurate production	Replacement
That	11	11 [d]
They	11	11 [d]
This	12	10 [d]
Those	11	11 [d]
There	11	11 [d]

N = 22 (total of 22 productions of the target word – 11 x 2).

Table K6. Productions of word-initial /ð/ in after-vowel position

Target word	Word-initial /ð/	
	Environment: /ð/ after vowel	
	Accurate production	Replacement
these	11	11 [d]
the	7	15 [d]
then	13	09 [d]
they	15	07 [d]
than	11	11 [d]

N = 22 (total of 22 productions of the target word – 11 x 2).

Table K7. Productions of word-final /ð/ in sentence-final position

| Target word | Word-final /ð/ | |
	Environment: /ð/ at the end of the sentence	
	Accurate production	Replacement
bathe	7	13 [θ] + 2 [d]
smooth	3	19 [θ]
breathe	10	11 [θ] + 1 [d]
loathe	3	14 [θ] + 4 [d] + 1[tʰ]
teethe	4	17 [θ] + 1 [f]

N = 22 (total of 22 productions for each target word – 11 x 2).

Table K8. Productions of word-final /ð/ in before-vowel position

| Target word | Word-final /ð/ | |
	Environment: final /ð/ followed by a vowel	
	Accurate production	Replacement
breathe	8	12 [θ] + 1 [d] + 1 [v]
with*	4	04 [θ] + 2 [d]
soothe**	8	11 [θ] + 1 [t]
with	4	17 [θ] + 1 ø
smooth	1	19 [θ] + 2 [d]

Note: N = 22 for all tokens except *with** and *soothe*** (total of 22 productions of the target word – 11 x 2).
* Due to a problem during data collection, the '*with*' token (in the sentence *Come with us*) was present at the production test of only 5 of the participants, that is P7, P8, P9, P10 and P11. The other participants did not have this sentence in their test. Thus, N = 10 for this target word.
** Two tokens of *soothe* were excluded from the analysis due to mispronunciation.