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The L2 English production of [ð] in word-initial onset and intervocalic onset position – A pilot study

In this study I investigate the production of the English interdental fricative [ð] in word-initial onset and intervocalic onset position by Russian, Mongolian, Thai, and Amharic learners of English. Eight participants completed word and story reading tasks. The results show that all of these learners produce [ð] at a high rate in intervocalic onset (V.CV) position while often substituting [d] for [ð] in word-initial onset (.CV) position, illustrating one example of the universal process of spirantization, in this case stop to fricative spirantization: /d/ → [ð]. Data from the Russian, Mongolian, Thai and Amharic learners of English are argued to be exemplars of the emergence of the unmarked, a process in which L2 learners utilize a process that is underdetermined in the L1 or L2. The interlanguage data are analyzed and discussed within the framework of Optimality Theory. Within this framework, it is shown that these language learners rank a constraint prohibiting stops in intervocalic onset position higher than markedness constraints prohibiting interdental fricatives altogether.

Keywords: interdental fricative, L1 transfer, markedness, spirantization, intervocalic, differential substitution, Optimality Theory, emergence of the unmarked

1. Introduction

The central question this paper seeks to answer is whether second language learners of English (L2ers) have access to the universal process of /d/ → [ð] spirantization when acquiring the English segment [ð]. Spirantization, operable in many languages (Kirchner, 1998), is a type of lenition (or weakening) in which a stop becomes a fricative or approximate. Below are selected examples of stops becoming fricatives in Badimaya (Australian), Dahalo (Afro-Asiatic), Gajarati (Indo-European), Spanish (Indo-European) Basque (Basque), Lama (Niger-Congo), and Hausa (Afro-Asiatic) (Lewis, 2009, noting language families) as reported in Kirchner (1998).

(1) L1 Spirantization Examples

Badimaya	d, d^j → ð, ʒ / V__V	(p.7)
Dahalo	b, d → ß, ð / V__V	(p.7)
Gujarati	b^h, d^h, g^h → ß, ð, ɣ / V__V	(p.7)
Spanish	b, d, g → ß, ð, ɣ / non-initially, except after an [n] or [l]	(p.7)
Basque	k → ɣ / word-finally	(p. 8)
Hausa	b, d, g → w, r, w / coda position	(p. 9)

As seen in (1), spirantization can be applied to various place features (e.g., labial, coronal, velar) and in various syllable positions (e.g., intervocalic-onset, coda). Kirchner (1998) reviewed 272 lenition patterns and found that intervocalic onset position is the most preferred position for spirantization in L1 grammars. Based on this data, it can be assumed

that, typologically, intervocalic onset position is the most common position for the process of spirantization. Thus, intervocalic onset position is an unmarked position for the feature +Continuant.

These typological facts about spirantization raise the question of whether L2ers' production rates of interdental fricatives in intervocalic position follow the universal pattern in L1 grammars. In order for spirantization to be illustrated in L2 English, [ð] would need to be produced less in word-initial onset than in intervocalic onset position. However, there is nothing in the target English input that would suggest that [ð] should be produced in intervocalic onset position and *not* in word-initial onset position.[1] Thus, if spirantization were illustrated in L2 English, its origin would be universal grammar or L1 transfer.

Maddieson (1984) reports that [ð] is present in only 7% of the languages in the UCLA Phonological Segment Inventory Database. On top of being a rare sound typologically, due to the marked place (+interdental) and manner (+fricative) features of [ð] (Ladafoged, 1993), the segment [ð] is difficult for L2 English learners to acquire. Since [ð] is marked segment with regards to typology and articulation, L2ers often substitute another segment for [ð]. Most researchers have found that L2ers substitute either [d] or [z] for [ð] (Kohmoto, 1965 (L1 Japanese L2ers)); (Weinreich, 1968 (L1 Russian L2ers)); (Michaels, 1973 (L1 Sinhalese L2ers)); (Altenberg &Vago, 1983 (L1 Hungarian L2ers)); (James, 1986 (L1 German L2ers)). Additionally, most L2 studies on [ð] (and [θ]) primarily analyze productions in onset and coda position (Weinberger, 1990); (Hancin-Bhatt, 1994); (Flege et al., 1995); (Lombardi, 2003); (Wester et al., 2007); (Rau et al., 2009), leaving the L2 production of [ð] in intervocalic position a relatively open area of research. In the domain of English L2 acquisition, the typological and articulatory markedness of [ð] allow L2 researchers to investigate the role of L1 transfer and language universals in an L2 grammar.

To determine if the universal process of spirantization is operable in an L2 English grammar, I investigate the production of [ð] in word-initial onset position and intervocalic onset position by Russian, Mongolian, Thai, and Amharic L2ers. Learners with these L1 backgrounds were chosen for two reasons: 1) because they lack [ð]; 2) they lack spirantization of the stop /d/.[2]

The data collected in this empirical study reveal that in word-initial onset position,

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[1] In African-American Vernacular (AAVE), there is fortition of [ð] in word-initial onset position and [v] can be a substitute for [ð] in intervocalic onset position: they [ðej] → [dej]; mother [mʌðɚ] → [mʌvɚ] (Yavas, 2011, p. 65). Although exposure to AAVE might explain why L2ers substitute [d] for [ð] in word-initial onset position, it does not explain why [ð] is produced regularly in intervocalic onset position. With this said, however, since the participants of this study are exposed to a standard variety English in college ESL classes, it is doubtful that AAVE plays a role in their production of [ð].

[2] Stops in Amharic do undergo spirantization. However, spirantization in Amharic excludes the stop [d], so there is no /d/→ [ð] spirantization. It is argued here that lenition processes that affect other segments in these L1s will not be applied to stops (e.g. /d/) in the English L2. It might be expected that the Amharic learners would illustrate positive transfer of spirantization; however, the data from the Amharic speakers is similar to the data of the other participants.

[d] is substituted for [ð] more often than not. The data also show that [ð] is produced more, by a considerable margin, in intervocalic onset position than in word-initial onset position. I argue here that the data illustrate the universal process of spirantization.

I analyze the process of spirantization within the framework of Optimality Theory (OT) (Prince & Smolensky, 1993/2004). OT is a linguistic model that implements universal language constraints. The constraints hinge on linguistic typological universals and these linguistic universals' direct relationship to markedness. That is, the main force behind OT is the antagonistic relationship between markedness and faithfulness. Markedness constraints "compete" against faithfulness constraints, which seek faithfulness to the input, even if the input includes marked forms. The interaction between these two sets of constraints determines the surface forms of the phonological grammar. One aspect of phonological grammars that has been incorporated into OT is the so called *Emergence of the Unmarked* (McCarthy & Prince, 1994). This is a process in which an unmarked aspect of universal grammar, underdetermined by the L1 or the L2, "emerges" in the L2 grammar. In the case of the data here, spirantization, in which stops become fricatives in intervocalic onset position, is the emergent/unmarked process. I argue that this process is dictated by the positive markedness constraint SPIR (spirantization of stops in intervocalic position), and that this constraint competes against negative markedness constraints banning the highly marked segment [ð] (i.e., *ð) and segmental faithfulness constraints mandating that the input and output match.

2. Literature Review

2.1 Implicational Markedness and the Emergence of the Unmarked

Studies such as Colantoni and Steele (2007) focus on positional (or implicational) markedness. Colantoni and Steele (2007) also couch their study of the acquisition of the French [ʁ] in terms of positional markedness by supporting the claim that intervocalic position is the least marked position for fricatives. They analyze the acquisition of [ʁ], a voiced "dorsal" fricative (their description rather than "uvular"), in intermediate and advanced English learners of French with a word-reading and a passage-reading task. Calantoni and Steele evaluate several factors regarding the acquisition of [ʁ] such as voicing and manner, phonetic environment, and voicing by position. It is the last factor, voicing by position, which concerns us here. They argue that there is a developmental hierarchy with the acquisition of voiced fricatives. Generally speaking, [ʁ] in onset position is acquired before [ʁ] in coda position. However, the major claim made by Calantoni and Steele is that [ʁ] in intervocalic position (V.CV), which is an onset, is the position that will facilitate the highest production rate of [ʁ]. The results of their study partially support this hierarchy. Their advanced group produced [ʁ] in intervocalic position correctly 89% of the time versus word-onset position at 85% and coda position at 75%. However, their intermediate

group's results do not fully support the hierarchy. This group had a 73% accuracy rate in coda position, specifically word-medial pre-consonantal position. However, their accuracy rate in word onset and intervocalic position was 52% and 69%, respectively.

In this paper, I argue that the L2 data reflect spirantization and that spirantization has emerged in the L2 grammar without positive evidence from the L2 or the L1, making this an example of the emergence of the unmarked (McCarthy & Prince, 1994). One example of the emergence of the unmarked is presented in Broselow et al. (1998), which investigated the simplification of English codas by Mandarin L2ers. Their argument is that universal markedness constraints prompt English coda simplification. Codas in Mandarin are only permitted to have glides and alveolar and velar nasals. Because of this L1 fact, Mandarin speakers have difficulty producing English obstruent codas which permit a wide variety of obstruents and consequently "repair" codas, for instance, with epenthesis, devoicing, or deletion in order to maintain their L1 licensed syllable structure. Broselow et al. (1998) argue that the OT constraints WD BIN (words must have two syllables) and NO OBS CODA (obstruents are disallowed in codas) conflict in the L1 grammar. The constraint WD BIN, a low ranked/violated constraint in L1 English and L1 Mandarin, *emerges* in the IL when the target L2 English violates the constraint NO OBS CODA, a constraint that is ranked high in L1 Mandarin. In this syllable context, the constraint WD BIN outranks NO OBS CODA and the faithfulness constraints relating to epenthesis (DEP – do not insert a segment not present in the input), deletion (MAX – do not delete a segment present in the input.), and devoicing (IDENT(VOI) — input and output must match). Like Broselow (1998), this study argues that L2 learners utilize a process (e.g spirantization) not found in the L1 or the L2, suggesting that a low ranked constraint has emerged.

2.2 Role of L1 Transfer[3]

Previous studies have claimed that L1 transfer explains why certain L2ers use the substitutes they do for [θ] and [ð]. Weinberger (1990), Hancin-Bhatt (1994), and Lombardi (2003) argue that features in the L1 determine whether [θ] and [ð] are substituted with [t] and [s] or [d] and [z]. Weinberger claims that a solution for differential substitution, at least between Japanese and Russian English language learners, is found by determining the most underspecified obstruent in each L1. Weinberger argues the segment

[3] Rau et al (2009) suggest that studies only focusing on L1 transfer have limited value in that they only account for the data in a general manner: e.g., Thai speakers substitute [θ] with [t], but Japanese speakers substitute [θ] with [s]. Rather, Rau et al. propose that the variable factors of frequency, markedness, speech style, and others are necessary to categorize and explain the variable L2er production data of interdental fricatives. According to the authors, participants had a higher accuracy rate with the formal tasks (word list, passage reading) and had a lower accuracy rate with the informal tasks (interview, story retelling). Participants' accuracy was also higher with high frequency words and lower with low frequency words. I refer the reader to the article for specifics as frequency and speech style are beyond the scope of this paper.

/s/ is underspecified in Japanese whereas /t/ is underspecified in Russian. Thus, Japanese speaking learners of English substitute [θ] with [s], and Russian speaking learners substitute [θ] with [t]. Lombardi (2003) departs from underspecification theory and posits that differential substitution can be explained by the transfer of L1 phonological rules. For instance, in L1 Japanese, an underlying /t/ becomes [ts] before [u]. This shows that manner features such as [stop] and [continuant] can be teased apart in the L1, prompting Japanese L2ers to be faithful to the [continuant] feature of [θ] with the substitute of [s]. Lombardi (2003) claims the opposite is true for L2ers with a Thai L1 background. In Thai, an underlying fricative in coda position is always realized as a stop. Thus, these L2ers substitute [t] for [θ] in L2 English.

Hancin-Bhatt (1994) also claims that L1 transfer is a determining factor in the L2 acquisition of English interdentals; however, unlike Weinberger and Lombardi, her study centers on the perception of interdentals rather than their production. Specifically, Hancin-Bhatt (1994) studies the L2 perception of the English interdentals by L2ers with Japanese, German, and Turkish L1 backgrounds with varying degrees of English proficiency. In this study, Hancin-Bhatt proposes the Feature Competition Model (FCM), which claims that prominent L1 features are transferred in L2 perception and learning. For instance, if the feature [continuant] is found to be a prominent distinctive feature in the L1 inventory, the feature will obscure other relevant L2 features in L2 perception. To test the FCM, participants listened to a total of 168 pseudowords with /θ, ð/. Six other segments, /f,v/, /t,d/, and /s,z/ were also tested since they can be mistaken for /θ, ð/ in perception. These segments were incorporated into three contexts: 1) word-initial 2) intervocalic and 3) word-final position.

Hancin-Bhatt (1994) predicts that the features that are prominent in the L1 will determine what segment will act as the substitutes for the English interdentals. For example, those from German and Turkish L1 backgrounds were predicted to use [s,z]. Following the predictions, the German group preferred /s,z/ as substitutes for the English interdentals; however, the Turkish group preferred to substitute English interdentals with stops in all three contexts. Hancin-Bhatt argues this discrepancy suggests that the FCM cannot predict prominence feature patterns of all L1s correctly.

Looking specifically at the production of the spirant/fricative [ð] and the spirantization process of /d/ → [ð] in monolingual native Spanish and German/Spanish bilinguals, Lleo and Rakow (2005) give evidence that L1 transfer plays a role in the production of [ð]. They showed that monolingual Spanish-speaking children had a high rate of spirantization from 1;3 years of age to 3;0 in words such as [deðo] "finger" (/dedo/ → [deðo]). In fact, the production rate of spirants never goes below 60% and reaches above 80% by 3;0 years of age. Lleo and Rakow found that the production of spirantization in German/Spanish bilingual children when speaking Spanish was lower than the monolingual Spanish speaking children. They conclude that L1 transfer of German is a factor here since German does not have the spirantization process of /d/ → [ð].

3. The Empirical Study

I investigate the interaction between the L2 English production of the segment [ð] and the syllable position [ð] is in by Russian, Mongolian, Thai, and Amharic L2ers. The syllable positions analyzed in this paper are word-initial onset position and intervocalic onset position. If L2ers make no distinction regarding the permissibility of the segment [ð] in various syllable positions, we might predict that the production rates of [ð] in word-initial onset, intervocalic onset, and coda syllable positions would be equally high or equally low for L2ers. In this case, it could be argued that L2ers are "blind" to syllable position when acquiring a new segment not in the L1 and do not illustrate spirantization. On the other hand, if production rates were inconsistent—say some high and some low—across various syllable positions, the implication in this case would be that certain syllable positions may facilitate the production of [ð] and that other positions may impede the production of [ð], suggesting that L2ers are *not* "blind" to syllable position. If the segment [ð] is produced more in intervocalic position than in word-initial onset position, spirantization would be illustrated.

Research Question

The empirical study presented here poses the following question: Do L2ers have access to the universal process of spirantization when acquiring the segment [ð]?

3.1 Linguistic Background for the Empirical Study

The following subsections present an overview of the pertinent linguistic facts regarding English, Mongolian, Russian, Thai, and Amharic. Since this study centers on the English segment [ð], the articulatory features of this segment are discussed as well. Additionally, since it is argued here that the universal process of spirantization is illustrated in the data, the following subsections take care to show that the segment [ð] and the process of spirantization is not present in the L1s of Mongolian, Thai, Russian, and Amharic.

a. English Interdental Fricatives

The interdental fricatives [θ] and [ð] (along with the palatal fricative [ʒ]) are some of the last segments to be acquired by native English speakers (Sander, 1961 qtd. in Ingram, 1989). In general, stops, nasals, laterals, and glides are mastered before fricatives by normal monolingual, English-speaking children and children with common phonological disorders. For example, children undergoing standard phonological development master stops such as [p], [b], [k], [g], and [d] by age 3;0 to 4;0; and children master fricatives such

as [θ], [ʃ], [v], [ð], [s], and [z] by age 7;0 to 8;0 (Stoel-Gammon & Dunn, 1985, p. 31).

One major difference between fricatives and other classes of sounds such as stops is that fricatives have the [+continuant] feature. Based on a study with 90 children ranging in age from 40 months to 120 months, Singh and Frank (1979, p. 263) found that stops replace fricatives more than any other sound. Such a process is called "stopping" and is employed because stops are less complex than fricatives. Ladefoged (1993) describes the manner of articulation of a stop as a "complete closure of the articulator involved so that the airstream cannot escape through the mouth" (p. 8); he describes the manner of articulation of a fricative as a "close approximation of two articulators so that the airstream is partially obstructed and turbulent airflow is produced" (p. 10). Simply put, the "narrowed approximation" of fricatives demands great muscle control, whereas stops "involve very straight forward contact of the articulators" (Yavas, 1998, p. 138).

As noted, English has interdental fricatives and the stop [d]. However [d] and [ð] are separate phonemes in English, and there is no spirantization process of /d/ → [ð] with these segments in English. However, English does have other weakening processes. For instance, /t/ becomes the tap [ɾ] in intervocalic position when the proceeding syllable is stressed and the following syllable is unstressed as in /bɛtɚ/ → [bɛɾɚ] (Ladefoged, 1993, p. 92).[4]

b. Mongolian background

x, χ, x□, s,

Svantesson et al. (2005) states that Mongolian has five fricatives: [ʃ]; Campbell (1995) notes that Mongolian has the aforementioned fricatives as well as [v]. There are differing accounts for stops as well. Svantesson et al. (2005) reports that Mongolian has [p, t, g, G] but no [d]; however, Campbell (1995) notes Mongolian has [d]. In the examples with [d] in Campbell (1995), [d] is only in word initial onset or coda position. Neither of these sources report that Modern Mongolian has spirantization. The sample words below confirm that stops do not become fricatives intervocalically.

(2) No intervocalic spirantization of stops in Mongolian

a.	[vagon]	'coach' (Russian Loan word)	(Svantesson et al 2005 p. 31)
b.	[juutəŋ]	'hood'	(Svantesson et al 2005 p. 60)
c.	[igəm]	'collar bone'	(Svantesson et al 2005 p. 82)
d.	[saɢəm]	'buckwheat'	(Svantesson et al 2005 p. 81)

However, Svantesson et al. (2005) does report that Old Mongolian spirantized velar and

[4] Additionally, English has a spirantization process that morphs stops into fricatives when derivational suffixes are added as in /ɪkspænd/ → [ɪkspænsɪv]; /dəsajd/ → [dəsajsɪv]; /pɻmɪt/ → [pɻmɪsɪv]. Although English does have spirantization, it is doubtful that L2 English learners would apply this particular spirantization process to the production of [ð] for two reasons: 1) the English spirantization process mentioned here is prompted by morphology; 2) there is sufficient evidence in the target language of English that [ð] is its own separate phone and not a result of allophonic variation. Thus, spirantization process of /d/ → [ð] / V ___ V by L1 learners from L1 backgrounds lacking [ð] altogether suggests that this process is still underdetermined in the target L2 of English.

uvular stops in onset and intervocalic position, but there is no report that alveolar stops were weakened intervocalically. Additionally, as best I can determine, velar and uvular spirantization is not retained in Modern Mongolian.

Unfortunately, to my knowledge, there are no previous studies on Mongolian L2ers' production of interdental fricatives; thus, there is no precedent on what segments these L2ers will use as substitutes for [ð].

c. Thai Background

Thai has very few fricatives: [f, s, h] (Campbell, 1995; Tingsabadh & Abramson, 1999). Additionally, there is no report by Campbell (1995), Tingsabadh and Abramson (1999), or Kirchner (1999) of Thai having a spirantization process.

Smyth (2001) claims that L2 English learners from a Thai L1 background often substitute the stops /t, d/ or the fricative /s/ for English interdental fricatives in onset position and generally substitute /t/ for interdental fricatives in coda position.

(3) a. Thai L2er Onset Position Substitutes for Interdental Fricatives

/θ/ → [t, s]
/ð/ → [d, t, s]

b. Thai L2er coda position substitutes for interdental fricatives

/θ, ð/ → [t]

Additionally, in English loan words, Thai keeps intervocalic stops, as the examples in (4) show.

(4) No intervocalic spirantization of stops in English loan words in L1 Thai

a. /lejdi/ → [leedii] "lady"
b. /sajdɚ/ → [sajdəə] "cider"
c. /bejrə/ → [beetaa] "beta" (From Kenstowicz & Suchato, 2006)

With these L2 pronunciation and loanword facts in mind, it appears that Thai speakers have no spirantization of stops in their L1.

d. Russian Background

The fricatives in Russian are [f, v, s, z, ʃ, ʒ, x] (Monk and Burak, 2001; Campbell, 1995). Timberlake (2004) notes that Russian also has [ɣ], in addition to the previously mentioned fricatives. Russian stops do not undergo spirantization, but they do undergo palatalization, as examples from loanwords show below.

(5) Russian palatalization of intervocalic stops in loan words

a. German *Flugel* 'wing' /fly:gəl/ → [fiʲu:gʲɛr]
b. Turkish *bituk* 'hooligan' /bityk/ → [bitʲuk]
c. French *bordure* 'edge' /bɔrdyr/ → [bɔrdʲyr]

Monk and Burak (2001) report that Russians learning English will substitute /s/ and /z/ rather than /t/ or /d/ for /θ/ and /ð/, respectively. With this in mind, we expect that Russian speakers will be faithful to the feature of +continuant when producing interdental fricatives, but still err with regards to place of articulation. Thus, English L2 learners with a Russian L1 background are expected to perform equally to other L2 English learners who lack interdental fricatives in their L1.

e. Amharic Background

The fricatives in Amharic are [f, s, s', z, ʃ, ʒ, h] (Hayward & Hayward, 1999). Campbell (1995) notes that Amharic also has [v]. The stops /b/ and /k/ do undergo spirantization in intervocalic position. The stop /b/ becomes [ß] in intervocalic position within words void of morphology and at word boundaries where affixes are added to the root.

(6) a. /ababa/ → [aßaßa] 'a flower' ("Archive Phonetics," 1996)

b. /bet/ 'house' → [kəßet] 'from the house' (van Oostendorp, 2011, p. 2227)

The stop /k/ becomes [h] intervocalically when affixes are added to the root.

a. /nəka/ 'touch' → [yə.nahal] 'he touches' (Leslau, 1995, p. 17).

However, /k/ → [h] intervocalically does not appear to be an across-the-board process, as the examples below illustrate.

(7) a. /hakim/ → [hakim] 'a doctor' ("Archive Phonetics," 1996)
b. /täkus/ → [täkʊ̥s] 'shooting' ("Archive Phonetics," 1996)

Geminate /kk/ or geminate /k'k'/ do undergo weakening to one segment.

(8) a. /täkkälä/ → [täkːʰälä] 'he planted' ("Archive Phonetics," 1996)
b. /bäk'k'älä/ → [bäk'ːälä] 'it grew' ("Archive Phonetics," 1996)

However, the segment /d/ does not undergo any spirantization (or weakening) in intervocalic position (Clavavin, 2010), which is an important distinction since the L2 data suggest that L2ers with an L1 Amharic background weaken /d/ in intervocalic position.

(9) No intervocalic spirantization of [d] in L1 Amharic

a. [awwədə] "perfume" (Colavin et al., 2010)

b. [bədəbbədə] "beat" (Colavin et al., 2010)

Although Amharic segments, such as /b/ and /k/, as shown in example (7) above, can undergo spirantization in intervocalic position, it is not certain that this L1 spirantization process would be generalized to the English segments /d/ and /ð/.

On the other hand, at minimum, it could be argued that these Amharic speakers would have slightly higher production rates of [ð] in intervocalic position since they have L1 spirantization. In fact, one Amharic speaker has 100% accuracy rate of [ð] in intervocalic position. However, this is not all that different from the Russian speakers who have 91-96% accuracy rate of [ð] in intervocalic position. Since the production rates are high for the Russian and Amharic speakers, I assume that the data of the participants of this study with an Amharic L1 background do not illustrate L1 transfer of spirantization. (Figure 3 in the results sections illustrates the results mentioned here.)

3.2 Methods for the Empirical Study

A. Participants

*a. **Non-native Speakers of English***: A total of eight nonnative speakers participated in the study. Three participants were native speakers of Russian, two were native speakers of Mongolian, two were native speakers of Amharic, and one was a native speaker of Thai. All were current or former ESL students at Northern Virginia Community College (NVCC). The current ESL students were high intermediate to advanced learners of English based on their current ESL courses.

Since all participants of the study were ESL students at NVCC, the following gives background on the ESL program for a better understanding of the participants' English proficiency. The credit-ESL program emphasizes academic writing and reading skills at all levels. Most credit ESL students in this study were in class 10-15 hours a week. There are four levels in this program: level 2, 3, 4, and 5. Level 5 is the exit level for ESL at NVCC that permits students to register for freshman English composition at the college.

The primary placement test NVCC uses is the English Accuplacer Test. This placement test has a reading skills, sentence meaning, and language use section, each with 20 questions ("Accuplacer"). The highest possible score on the test is 360. The following are Accuplacer test score ranges and proficiency rates: 225-274 = Beginning; 275-299 = intermediate; 300-324 = high intermediate; 325-349 = Advanced; 350 = placement into Comp 101. NVCC also asks students to write an essay after completing the Accuplacer. Their Accuplacer score, in combination with their essay test results, determine their ESL level.

The figure below summarizes pertinent background information for all participants. Each participant is given a code, and specific participants will be referred to by the code in

the remainder of the paper. The first letter of the code matches the first letter of the speakers' L1: R = Russian; M = Mongolian; T = Thai; A = Amharic. In the figure below, the following abbreviations are used: AOE: Age of onset English; LOR = length of residence in the US; Acc = Accuplacer. All participants were female, so gender is not noted.

Figure (1): Participant background information

Code	Origin	L1	Age	AOE	LOR	Acc. Placement	Acc. date	Current English level	Daily % of English use
R1	Ukraine	Russian	39	30	8	Intermediate	2003	Completed ESL & English freshman comp	90
R2	Ukraine	Russian	24	21	3	Advanced	2011	ESL Lvl 5	50
R3	Ukraine	Russian	24	20	1	Advanced	2011	ESL Lvl 5	50
M1	Mongolia	Mongolian	38	36	1.6	Beginner	2010	ESL Lvl 4	70
M2	Mongolia	Mongolian	22	18	3	Beginner	2010	ESL Lvl 4	70
T1	Thailand	Thai	46	7	8	High Intermediate	2010	Completed ESL & English freshman comp	60
A1	Ethiopia	Amharic	36	9	8	Beginner	2008	ESL Lvl 4	50
A2	Ethiopia	Amharic	27	12	5	Beginner	2008	ESL Lvl 4	50
Median			**31.5**	**21**	**4**	**--**	**--**	**--**	**55**

Although all of participants have differing initial placement test scores, at the time of the study, they were all are intermediate or advanced learners of English. The overall median age of English onset for all participants is 31.5.

As figure (1) shows, the participants' daily use of English varies from 50% to 90%. The high usage of English in participant R1 can be explained by the fact the participant has a job requiring her to speak English. Participants who use English 50-60% of the day have friends and family members with their same L1 with whom they speak regularly. The median percentage that the participants use English daily is 55%.

b. ***Native English Speaking Control Group***: Two native English speakers participated in the study. Both native speakers were female and from Virginia. One speaker was 21 years old and the other was 65. Both speakers had studied French and Spanish in college but reported they were not proficient in either language.

B. Materials

All participants read a word list and a story. (See the appendix for the word list and story.) The word reading task had 100 words. Twelve words had [ð] as an onset (e.g., *there*) and thirteen words had [ð] intervocalically (e.g., *neither*), for a total of 25 instances of [ð]. Three words had [ð] as a coda (*bathe*, *breathe*, *teethe*), but due to apparent

unfamiliarity with these words, these were excluded from the study. The other 72 words were distractors.

The story reading task had multiple paragraphs and [ð] was in the onset position thirty-three times and [ð] was in intervocalic position thirty-two times for a total of 65 instances of [ð]. There are a total of 340 words in the reading task. There is relative repetition of words such as *the*, *this*, *that* and *brother*, *mother*, *father*.

Altogether, there were a total of 90 instances of [ð]: 45 in word-initial onset position and 45 in intervocalic position.

C. Recording Procedures

Participants were told that they would have two reading tasks to complete and that they would be recorded. Participants were instructed to read the word list first and then read the story directly after in the same recording session. Before recording began, the investigator stated that the words in the word list reading task needed to be said in the carrier phrase: "Now say _____ again." The first two words of the reading list were modeled by the investigator and the investor said, "*Now say big again*; *Now say four again*." After the investigator explained the tasks, he asked participants if they had any questions. The only questions related to the carrier phrases. Most participants double-checked that they were to put each word in a phrase. The investigator did not model any part of the story reading task.

Participants were recorded with a SONY ICD-SX712 digital voice recorder. The recorder was set to interview mode and noise reduction mode. All recordings took place in a quiet room. The participants were alone in the room while completing the tasks.

D. Coding

The investigator reviewed each data sample three times. Most coding errors were due to an oversight on a particular word not being counted rather than a mistake with transcription.

All determiners such as *the*, *these*, and *that* were considered to be a word-initial onset environment for [ð] regardless of the preceding word. There were only three instances where a determiner occurred directly after a vowel sound: *by the, be the*, and *to their*. This coding choice was determined because there was no clear pattern with the production of [ð] in these environments. Most participants substituted [d] in each of these positions, matching their production in standard onset [ð] environments. This suggests most learners treat the [ð] in determiners as onsets.

A deletion of a determiner[5], schwa insertion before [ð] in an onset position, or an unnaturally long pause before [ð] in onset position were all considered a non-production of [ð] in onset position.

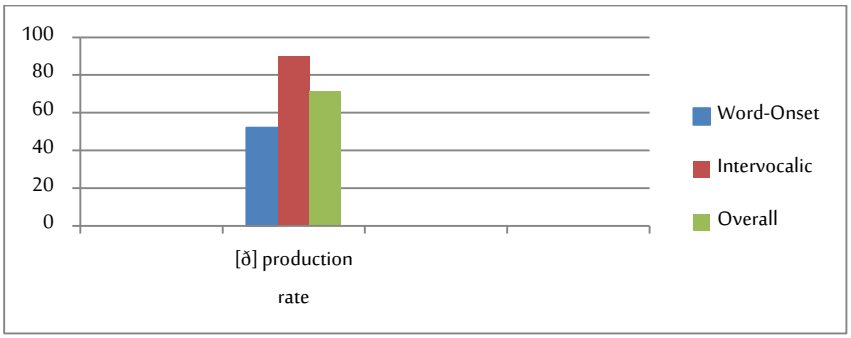
[5] The deletion of a determiner only occurred four times and it occurred in all L1 language groups. It appears this deletion was a reading error.

4. Results

The two native speaker controls performed at 100% accuracy in the production of [ð] on the word and story reading task. No other errors regarding other segments were made.

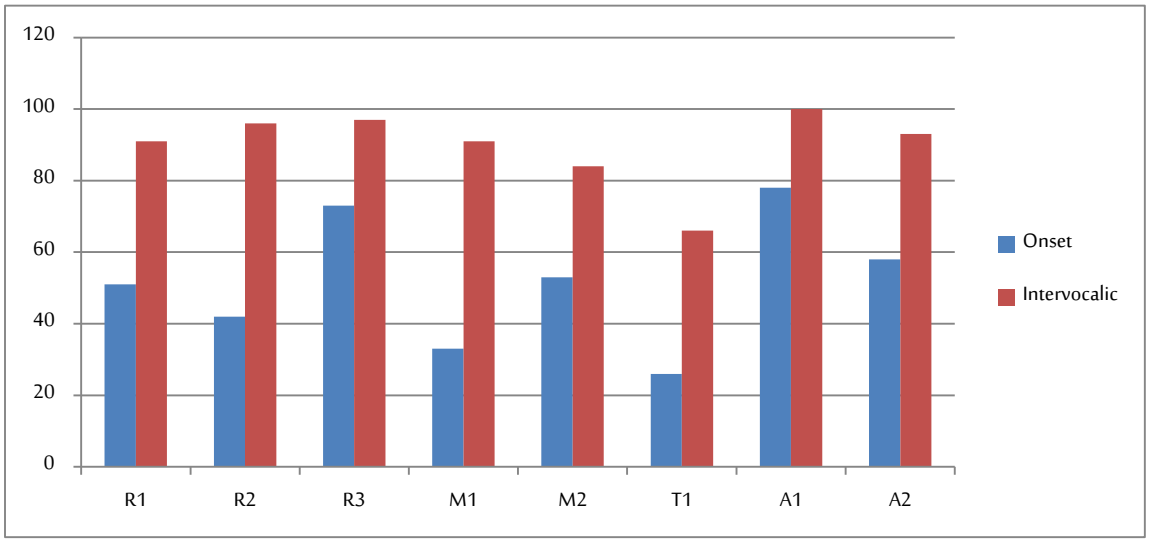
The overall accuracy rate of fricatives in onset and intervocalic position in both the word and story reading task by the L2ers was 71% (512/720). The production rate of [ð] in onset position was 52% (187/360), and the production rate of [ð] in intervocalic position was 90% (325/360). Figure (1) below gives an overview of the accuracy rate of [ð] in word-onset, intervocalic position, and the combined overall accuracy rate in both word-onset and intervocalic position.

Figure (2): Accuracy rates of [ð] in word onset and intervocalic position



These overall results show that [ð] is a relatively marked segment that is somewhat troublesome for L2 English learners, but that it is still produced more in intervocalic position than onset position. This is also true with each participant. In every case, the accuracy rate of [ð] in intervocalic position is higher than in word-initial onset position.

Figure (3): Participant Accuracy rates of [ð] in word onset and intervocalic position



If an accuracy rate criterion for the segment [ð] was set at 79%, as in other L2 studies (see (Anderson, 1978); (Cancino et al., 1975); (Eckman & Iverson, 1993); (Carlisle, 1998), only intervocalic position illustrates stable accuracy rate.

Figure (4), below, presents the median, average, and standard deviation for the accuracy rate of [ð] in onset and intervocalic position.

Figure (4): [ð] accuracy rate in onset and intervocalic position

	Onset	Intervocalic
Median	23.5	42
Average	20.7	38.4
Standard deviation	7.53	11.9

In addition, a two-tailed t-test was used to determine if the L2 learners' accuracy rate differs significantly in onset and intervocalic position.

Figure (5): Significant differences of accuracy rate of [ð] in onset and intervocalic position

Condition	t-statistic	df	two-tailed p-value	Significant?
Onset vs. Intervocalic	5.40	7	<0.0001	Yes

The results from this t-test reveal a probability of 0.0001, which is well below the threshold for significance of $p < .05$. In fact, the probability of this result being due to chance is less than .1 percent ($p < .001$), and the results are significant to the level of 99.9 percent. Moreover, the effect size (Cohen's d) is 2.35. Generally, effect size values of .2, .5, and .8 are thought to be small, medium, and large effect sizes, respectively (Mackey & Gass, 2005). The effect size of 2.35 calculated here is, therefore, well over the range for a large effect. Taking all of this into consideration, the results from this experiment support the hypothesis that L2ers utilize the universal process of spirantization.

Theoretical Implications

5. OT Analysis

The data presented in the previous section leads to several theoretical implications regarding the interplay between SLA and Optimality Theory (OT). OT is a framework that seeks to offer analyses of natural grammars with universal language constraints. By incorporating empirical SLA data in an OT analysis, the claim that L2 grammars are, in fact, constrained by UG, will be strengthened. Additionally, as mentioned earlier, the data reported here cannot be attributed to positive evidence from the L1 or L2. Hence, OT is an appropriate framework in which to analyze the data, presenting insights that may not be best illustrated with derivational rewrite rules.

5.1 Input—Output Representations

In phonology, one of the main goals is to analyze the difference between competence and performance. In the case of L2 phonologies, the gap between competency and performance can be wide. One way to explain this gap is in terms of mental representations and surface representations. Speakers have mental representations for segments that differ from the surface representations. Derivational phonology (Chomsky & Halle, 1968; Goldsmith, 1990; Kiparsky, 1982) assumes that derivational rewrite rules "chart" the mental representations to the surface representations, and these rewrite rules are argued to explain the difference between competence and performance.

OT argues, however, that grammars are organized differently from derivational phonology. The concept of mental and surface forms still remains, but in OT these are referred to as *input* and *output representations* (I use the terms input and output representation from here on out). The primary difference between derivational phonology and OT is that in OT, constraints, not rewrite rules, "chart" the input representations to the mental representation. Specifically, the ordering or ranking of constraints determine the output representation. When an output representation best abides by the ranking of the constraints, the output is considered to be optimal.

OT diverges from derivational in theory in other ways as well. Two of OT's abstract components are the Generator (GEN) and Evaluator (EVAL). Before the optimal output representation can surface, candidates (possible outputs) must be generated by the generator (GEN), and those candidates must be evaluated by the evaluator (EVAL) with the proper constraint ranking of the language. Derivational phonology, in contrast, only

considers the actual output and does not consider other "candidates" (hypothetical outputs) as OT does. Also, GEN can give more than one hypothetical candidate and "is free to generate any conceivable output candidate for some input" (Kager, 1999, p. 20).

Depending *how* the input and output representations are categorized for the data collected for this paper, different explanations of the data can be presented. In the IL, if the underlying form for [ð] is /ð/ then a fortition argument can be presented, but if the underlying form of [ð] is /d/, then a lenition (or spirantization) argument can be presented (Shea & Curtin, 2006). (See Bauer (1988) for a discussion on the difficulty determining the difference between fortition and lenition.)

(10) Input / Output Representations of Fortition and Lenition

Lenition: Input representation of /d/ in intervocalic position = output representation of [ð]

Fortition: Input representation of /ð/ in intervocalic position = output representation of [d]

I adopt a lenition argument for the OT analysis that follows. Specifically, I argue that even at the intermediate stage of acquisition, the L2ers in this study have the input representation of /d/ for [ð]. This, of course, is crucial to the argument here as I claim the L2er data illustrate the universal process of spirantization.

However, I recognize the alternative view that if these L2ers do produce the segment [ð] that this segment is available as an input representation. In this case, a fortition argument, rather than a lenition argument, can be made. This would call for a constraint that bans continuants in intervocalic position instead of a constraint banning stops in intervocalic position, contrasting the argument posed here. Although the argument that /ð/ is available to the L2ers as an input representation is reasonable, I argue that /ð/ is not available as an input representation for the following reasons.

The first reason relates to segment [ð] itself and its relation to L1 transfer. As noted earlier, this segment is highly marked with regards to typology and articulation, strongly suggesting it will be a difficult segment to acquire. Consequently, it is assumed here that the L2ers retain L1 input representation even at an intermediate stage of acquisition. This is in line with Shea and Curtin's (2006) analysis of L2 Spanish. They report data from L1 English/L2 Spanish learners that show that the L2ers' input representation of the target L2 [ß] is, in fact, /b/. Shea and Curtin (Ibid) argue that the input representation of /b/ for [ß] remains even at the intermediate stage of acquisition at which L2ers begin to produce [ß]. The L2ers with Mongolian, Russian, Thai, and Amharic L1 backgrounds in this study are still at an intermediate level as well, and so I claim /ð/ is not yet available as an input representation.

Second, I argue that these L2ers illustrate spirantization because the results of the data mirror typological facts related to spirantization. The data here show that /d/ weakens to [ð] intervocalically rather than weakening to other phonetically similar segments such as [z], [f], and [v], which are other possibilities noted in the literature. For instance, a /d/ to [z] spirantization process is noted in the Tahltan language (Reported in Kirchner, 1998). And although I still assume that /d/ is the input representation of [ð], previously noted substitutions of the input representation /ð/ should be considered as well

in order to be thorough. In L2 grammars, researchers have noted that [z] is often a substitute for /ð/ (Weinberger, 1990; Hancin-Bhatt, 1994; Lombardi, 2003), and the output of [z] is believed to be a result of L1 transfer. Finally, [f] and [v] are substitutes for /ð/ in AAVE due to the shared phonetic features of [ð], and [f] and [v] (Bailey & Thomas, 1998; Rickford, 1999).

A review of the spirantization data in Kirchner (1998) shows that when /d/ is weakened to a fricative in intervocalic position, the fricative is [ð] more often than not. This is true in the following languages: Badimaya, Dahalo, Danish, Guayabero, Gujarati, Ladakhi, Mexico City Spanish, Pennsylvania German, Purki, and Proto-Germanic. Additionally, [t] becomes [ð] intervocalically in Yindjibardndi, Uradhi, and Taiwanese. Furthermore, the typological data of spirantization show that a voiced segment never becomes voiceless in intervocalic position. However, voiceless segments can remain voiceless or become voiced in intervocalic position (e.g. British English: /t/ → [ʔ]; Gondi /k/ → [h]; Maori /k/ → [x]; Basque /k/ → [ɣ]) (as reported Kirchner, 1998), implying that the feature specification of [–voice] is the marked specification in intervocalic spirantization. Altogether, these typological facts suggest that when /d/ becomes a fricative in intervocalic position, the tendency is for the fricative to be a voiced non-alveolar coronal (i.e., [ð]), ruling out other possible segments in intervocalic position.

(11) Dispreferred Segments for Spirantization in Intervocalic Position

a) *[f]: not possible because it is a labial and voiceless
b) *[v]: not possible because it is labial
c) *[z]: not possible because it is alveolar

These facts strengthen the argument that constraint SPIR emerges and that the L2er production reported in this paper replicates the typological tendencies of spirantization.

Finally, /d/→ [ð] spirantization essentially illustrates that the segments [d] and [ð] are in complementary distribution, making [ð] an allophone of /d/, suggesting that /ð/ is unavailable at the phonemic level to the L2ers in this study. The same is true, for instance, in L1 Spanish. Although there is dialectal variation with regards to spirantization in Spanish, Lleo and Rakow (2005) conclude that *intervocalic* spirantization of stops is mandatory in all dialects. I have informally tested L1 Spanish speakers to see if they do, in fact, treat [ð] as an allophone of /d/, disallowing /ð/ phonemically. When I have asked linguistically naïve L1 Spanish speakers whether the consonants in the word [deðo] ("finger") are similar or different, they all say that the segments are pronounced the same and that each segment is a [d].[6] This is analogous to the fact that native English speakers do not perceive the difference between aspirated and unreleased voiceless stops in onset and coda position (e.g., [p^{h}ip̚] vs. [pip] "peep"). For native English speakers, the underlying representation for an [p^{h}] and [p̚] is /p/. Therefore, if L1s have allophones in complementary distribution, it is presumed that L2 grammars can as well.

Since I adopt an input representation of /d/, I use the hypothetical input of /dada/ for illustrative purposes because this input has word-initial and intervocalic position for

[6] It is possible that the Spanish speakers make this determination based on spelling as the orthographic representation is *dedo*.

the data from the intermediate stage reported in the data section of the paper. I also argue this same representation for the L2 initial state. The input of /dada/ is also used for the L2 initial state analysis as well.

5.2 OT Constraints

Rather than describing phonological grammars with derivational rules, OT's descriptive force is driven by violable constraints (constraints that can be violated). Constraint rankings determine the optimal output of a phonological form, and this fundamental characteristic of OT is applicable to the data presented here. Again, although it is possible to describe an L2er's process of spirantization with a classical derivation rule, derivational rules are assumed to be acquired through positive evidence. In the case of the L2ers with a Russian, Mongolian, Thai, and Amharic L1 background, no spirantization rule of /d/ → [ð] has been demonstrated in the L1. Moreover, these learners have not received positive evidence of spirantization from the English target language since English does not spirantize voiced stops. Without positive evidence, it would be theoretically unsound to argue that these learners have acquired a spirantization rewrite rule. Thus, the claim here is that the L2ers have reranked constraints. The constraints needed for an OT analysis of the data reported in this paper are as follows:

- **SPIRANTIZATION (SPIR):** This is a *positional markedness* constraint mandating that stops be weakened in intervocalic position (Kirchner, 1998; Shea & Curtin, 2006). This constraint is noted formally as LAZY(STOP)V_V in Kirchner (1998) and as LENITION in Kennedy (2008). I use SPIR to reflect the specific process the data in this paper illustrate. Although the descriptor/constraint LENITION (Kennedy, 2008) would not be incorrect, it is a more general description as lenition could refer to a number of processes (e.g. flapping, degemination). In this paper, the constraint SPIR reflects that the stop /d/ becomes the fricative [ð] in intervocalic position. Kirchner (1998) emphasizes that the constraint LAZY(STOP)V_V (or SPIR as I have labeled it) is particularly focused on the "minimization of articulatory effort" and is therefore a constraint that promotes lenition. As McCarthy (2002) points out, the LAZY constraint is "functionally motivated" as the constraint embodies a measurable physical event of weakening a segment (p. 222). This constraint (SPIR) is argued to be the markedness constraint that becomes highly ranked due to the trigger of the L2 input, illustrating the emergence of the unmarked.

- **MAX-IO**: This is a *faithfulness* constraint disallowing the deletion of segments: "every segment in the input has a correspondent in the output" (McCarthy & Prince, 1997, p. 6). This constraint is labeled "MAX" to emphasize the requirement that "input segments be MAXIMALLY expressed in the output" (McCarthy, 2008, p. 24). This constraint is used here to show that an IL grammar is more faithful to the input than a child L1 grammar: child L1 grammars delete more than IL grammars. I use

"MAX" in the OT analysis as this is commonly done in the OT literature.

- **IDENT (Manner)**: This is a *faithfulness* constraint that mandates that the feature(s) of the output match the feature(s) of the input regarding manner of articulation (McCarthy and Prince 1997). The term "IDENT" is short for "Identity." In the OT literature, this constraint has been "exploded" to indicate specific features: IDENT(Place), IDENT(syllabic); IDENT(round), and so on. See McCarthy (2008) for an expanded list. (See Lombardi, 2003 for an illustration of the necessity of constraint "explosion." Generally, the data in this paper violate the "identity" of place and manner features. However, I only highlight the manner feature here because it is the most prominent feature this paper discusses.

- ***ð**: This is a *segmental markedness* constraint prohibiting the segment [ð] in any syllable position (adapted from Lombardi, 2003). Note the constraint *ð is an extrapolation of Lombardi's (2003) constraint *θ. I assume here that if there can be a markedness constraint for [θ], there can also be a markedness constraint for [ð]. Like the constraint SPIR, the constraint *ð can be motivated typologically and articulatorily. Recall that interdental fricatives are rare among the world's languages (Maddieson, 1984) and that the articulation of a fricative is more difficult than the articulation of a stop (Yavas, 1998, p. 138).

  When discussing the initial state of the L2ers' grammar, I use the constraint *ð because it is assumed that L2ers begin L2 acquisition with their L1 constraint ranking. Since interdental fricatives are not part of L1 Russian, Mongolian, Thai, or Amharic, the constraint *ð must be highly ranked.

- ***ð(Onset)**: This is a *segmental markedness* constraint prohibiting the segment [ð] in a word-initial onset position. This constraint is a proposed subset constraint of the more general constraint *ð presented above. This subset constraint is used in this paper because it accounts for the data that show the segment [ð] is not consistently produced in word-initial onset position. The constraint *ð(Onset) also directly relates to the sonority of the onset segment. If we adopt Selkirk's (1984) sonority scale, for instance, which states that fricatives are more sonorous than stops:

  (12) Selkirk's (1984) Consonant Sonority Scale – least to most sonorous:

  p,t,k < b,d,g < f,θ < v,z,ð < s < m,n < l < r

  and we assume that onsets prefer the least sonorous segment in order to have the highest possible peak between the onset and vowel, the segment [ð] is dispreferred in onset position because it is more sonorous than stops such as [d]. Of course, a more general constraint pertaining to sonority

such as, *ONSET/FRICATIVE (i.e., onsets do not have the sonority level fricative), could account for why more sonorous onsets are dispreferred over less sonorous onsets (Prince & Smolensky, 1993: §8.1; Zec, 1988; Clements, 1990). However, I retain the constraint *ð(Onset) here as this paper's focus is the segment [ð].

Additionally, the constraint *ð(Onset) is also necessary to avoid stringency violations with the more general (or less stringent) constraint *ð. I discuss stringency violations in section 5.4.

In the analysis that follows, the constraints above will have different rankings depending on the L2ers's particular stage of acquisition. At the initial state it is presumed that the markedness constraint *ð is highly ranked, prohibiting production of [ð] altogether. Once the L2ers begin to acquire the L2, the target L2 triggers constraint re-rankings. The data in this paper reflect an intermediate stage of L2 English acquisition. In this stage, the markedness constraint SPIR "emerges" and permits [ð] in intervocalic position. However, in word-initial onset position, the markedness constraint *ð (Onset) is ranked higher than the faithfulness constraint IDENT(Manner), disallowing [ð]. Consequently, this intermediate stage of acquisition reflects an IL grammar that is partially producing the segment [ð]. In this sense, the data reflect partial faithfulness to the L1 grammar. As the L2ers progress, we expect that they will be more accurate in their production of [ð] in all contexts, coming close to the accuracy rates of native English speakers. This shift would illustrate total faithfulness to the L2 grammar.

5.3 L2 Initial State Constraint Ranking

It is generally assumed that the initial state of the L2 incorporates most, if not all, the features/representations of the L1, and presumably, the L2 initial state prohibits [ð] in all contexts. With the Russian, Mongolian, Thai, and Amharic L1s, a constraint ranking regarding the fricative [ð] is straightforward in that [ð] is prohibited in the L1 altogether. Recall that, as far as fricatives are concerned, Russian permits [f, v, s, z, ʃ, ʒ, x] (Monk & Burak, 2001); Mongolian permits [x, χ, xʷ, s, ʃ] (Svantesson et al., 2005); Thai only permits [f, s, h] (Campbell, 1995; Tingsabadh & Abramson, 1999); the fricatives in Amharic are [f, s, s', z, ʃ, ʒ, h] (Hayward & Hayward, 1999). None of the permissible fricatives are interdentals and so the constraint *ð is *highly* ranked in these L1s. At the same time, these L1s do not demonstrate the spirantization process of /d/ → [ð], so a constraint mandating the spirantization of stops (e.g. SPIR) is ranked *low* in these grammars. Tableau (1) below represents the L2 initial state constraint ranking regarding the absence of [ð] and spirantization in L1 Russian, Mongolian, Thai, and Amharic.

In tableau (1), below, it is assumed that at the initial state, these L2ers'output representation will not have [ð]. I use the input representation of /d/ for [ð] because the L2ers presumably transfer their L1 input representations to the L2 initial state. With this in mind, I use the hypothetical input of /dada/ rather than actual English words for illustrative purposes as the input /dada/ has all the necessary syllable positions needed for

the analysis.

Tableau (1): L2 Initial State Constraint Ranking

/dada/	*ð	IDENT(Manner)	SPIR
→ a. dada		*	
b. daða	*!	*!	
c. ðada	*!	*! *	

Candidate-a is the preferred surface form as there is no violation of the markedness constraint *ð, nor is there a violation of the constraint IDENT(Manner). The non-violation of INDENT(Manner) illustrates L1 transfer: the L2ers are faithful to their transferred L1 input representations. Since [ð] is not permitted in the output in intervocalic position, the constraint SPIR is the only constraint violated in the optimal candidate; thus, it is ranked lowest here. The constraints *ð and IDENT(Manner) are separated by a broken line to signify they are equally ranked as candidate-a does not violate either constraint. Although neither constraint can be officially noted as dominating the other, intuition suggests that *ð is the highest ranking constraint since the segment [ð] is prohibited in all the L1s noted in this study. Since the constraint the *ð is violated, this assumes that its subset constraint *ð(Onset) is also violated.

Regarding the losing candidates -- b and c -- they each have a "fatal" violation of the equally ranked constraints *ð and IDENT(Manner), producing dispreferred outputs. Candidate-b does not violate SPIR because [ð] is present in intervocalic position. Candidate-b violates the markedness constraint SPIR by permitting [ð] intervocalically. These losing candidates show that [ð] is dispreferred altogether.

5.4 IL Intermediate Stage Constraint Ranking

The overall results of the data from the IL grammars gathered for this paper report [ð] is produced more in intervocalic-initial position (90%: 325/360) than in word-onset position (52%: 187/360).[7] Production of [ð] suggests there has been a shift in constraints from the initial state constraint ranking proposed above in tableau (1). One constraint ranking shift is that SPIR has become promoted, permitting [ð] in intervocalic position. Thus, the constraint *ð can now be violated, but this constraint is violated by the separate subset constraint of *ð(onset). Tableau (2) below shows the constraint ranking for this IL intermediate stage. Again, I use the hypothetical input of /dada/ for illustrative purposes.

[7] These data illustrate variable output by L2ers. Sometimes the L2ers produce [ð] correctly in all contexts and sometimes one context has a higher production rate than another. Thus, the constraint rankings are not necessarily fixed. Stochastic OT (Boersma, 1998; Boersma & Hayes, 2001) is an amendment to "classic" OT theory in that it argues that constraints can be variable and do not have to have a fixed ranking. So, for instance, Constraint A could dominate Constraint B at times and vice versa at other times. Although the data here could be incorporated into a Stochastic OT model, I have chosen to explain constraint rankings in terms of what most often happens in the production data.

Tableau (2): IL Intermediate ranking

/dada/	*ð(Onset)	SPIR	IDENT(Manner)
→ a. daða		*	
b. ðada	*!	*! *	
c. ðaða	*!	**	
d. dada		*!	

As tableau (2) reflects, the constraints *ð(Onset) and SPIR are equally ranked as these constraints are not violated in optimal candidate-a; the constraint IDENT(Manner) is violated in the optimal candidate, so it is ranked the lowest. The non-optimal candidates b through c either have a fatal violation of *ð(Onset) and/or SPIR.[8] The segment [ð] is still dispreferred in word-initial onset position and the segment [d] is dispreferred in intervocalic position. Again, I use the constraint *ð(Onset) instead of the constraint *ONSET/FRICATIVE as the specific segment [ð] is the dispreferred segment in onsets. Other fricatives, such as [s], [f], [v], and [z] are available to these L2ers.

The constraint *ð is not in tableau (2) because of the so called "stringency relationship" (McCarthy, 2008). I illustrate this below in tableau (3). Tableau (3) is the same as tableau (2) with the constraint *ð added on the far right.

Tableau (3): Stringency Violation(SV)

	(SV)			**(SV)**
/dada/	*ð(Onset)	SPIR	IDENT(Manner)	*ð
→ a. daða			*	*
b. ðada	*!	*!	*	*
c. ðaða	*!		**	**
d. dada		*!		

A stringency relationship is a relationship between a general and specific constraint in which a violation of the specific constraint is *also* a violation of the general constraint. Thus, such constraints cannot conflict and, as a consequence, cannot be ranked (McCarthy, 2008, p. 67). In this case, the specific constraint (more stringent) is *ð(Onset) and the general constraint (less stringent) is *ð. The constraint *ð cannot be ranked below *ð(Onset) due to a stringency violation. Because of this stringency violation, the constraint *ð is not included in intermediate ranking in tableau (2).

The most important shift noted in tableau (2) is the re-ranking of SPIR. The constraint SPIR permits a violation of *ð, illustrating the process of the emergence of the unmarked in which fricatives are preferred in intervocalic position. This positional markedness constraint has "emerged" (been promoted) in the IL grammar. As the section above pointed out, the constraint SPIR is ranked the lowest in the initial state ranking as [ð] is not predicted to be produced in any context at that stage. However, due to the trigger of the L2 input at the intermediate stage, SPIR is ranked the highest, facilitating the production of [ð] in intervocalic position. This constraint shift, in which SPIR has emerged,

[8] It is assumed that other markedness constraints such as *θ and *ɣ are also active, but I have omitted them since the focus here is on [ð].

facilitates the positionally conditioned production of [ð] (or "positional asymmetry" in which [ð] is more marked in word-initial onset position than in intervocalic position). The positional asymmetry that the constraint SPIR prompts in an L2 grammar is certainly curious. It could not have come from L1 or L2 input, as there is no evidence of such a process in either of these grammars. At the same time, the data that show [ð] is not produced in word-initial onset is unsurprising since this illustrates L1 transfer.

Keeping the facts of these data in mind, we are given clues as to what roles L1 transfer and UG play in the acquisition of an L2. There are a variety of proposals concerning the relationship between UG and L1 transfer in an L2 grammar. The data here support, for example, the Full Transfer-Full Access proposal (FTFA), which states that the L1 is the initial state of the L2 and that the L2 grammar conforms to the properties of UG (Schwartz & Sprouse, 1994, 1996). In short, at least with this phonological data, L1 transfer affects acquisition and UG is accessible. Moreover, not only does the constraint SPIR illustrate access to UG, but it also helps codify the characteristics of an IL phonological grammar and how it differs from an emerging L1 and adult L1 grammar. One such difference is the positionally conditioned production of [ð] (or "positional asymmetry"). The role markedness and faithfulness play is another difference between an IL grammar, an emerging L1 grammar, and an adult L1. I expand on these differences in the next section.

5.5 Emerging L1 grammars and adult L1 grammars

In an emerging L1 grammar and an adult L1 grammar, this positional asymmetry illustrated in the L2 grammar is absent. In an emerging L1 child grammar, the constraint *ð will be ranked above MAX or IDENT. For instance, Moskowitz (1970) presents data from a two-year-old child, Erica, that show the accuracy rate of [ð] to be at zero. In word-initial and intervocalic position, Erica deletes [ð] altogether or uses [d] as a substitute. It is the substitution that I wish to focus on here. In tableau (4), below, we see that the preferred surface output, candidate-a, has substituted [d] for [ð]. It is assumed here that the input representation for an emerging L1 grammar would be /ð/ (I assume L1ers interpret L1 segments at "face value," which is, of course, divergent from the input representations of an L2er). I use the hypothetical input of /ðaða/ for illustrative purposes.

Tableau (4): Child L1 Grammar: Constraint Ranking for [ð]

	/ðaða/	*ð	IDENT(Manner)
→ a.	dada		**
b.	ðaða	**!	

The constraint *ð(Onset) is not present in tableau (4) because the segment [ð] is deleted in all syllable positions, and so this constraint does not apply here (Also, having both *ð(Onset) and *ð would be a stringency violation). The indication here is that the child L1er treats all syllable positions equally. Moreover, the emerging L1 grammar ranking in

tableau (4) is similar to the L2 initial state ranking (see tableau (1), above) in that interdental fricatives are prohibited in the grammar. The ranking in tableau (4) illustrates the preference of markedness over faithfulness (or unmarked structures over marked structures) in a child L1 grammar. That is, the markedness constraint *ð dominates the faithfulness constraint IDENT(Manner). Thus, Erica's data show unmarked surface forms trumping marked surface forms. (See Gnanadesikan (1995) for an in-depth OT account of a child L1 grammar.)

In an L1 adult grammar, the ranking presented in tableau (4) would be reversed, illustrating that faithfulness dominates markedness.

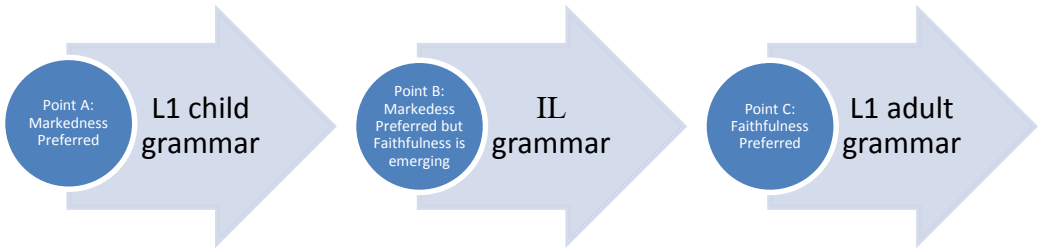
Tableau (5): Adult L1 grammar: Constraint Ranking for [ð]

	/ðaða/	IDENT(Manner)	*ð
→ a.	ðaða		**
b.	dada	**!	

Also, in the adult L1 grammar, as in the emerging L1 grammar, there is no positional asymmetry regarding the segment [ð]. Presumably, this would be the same constraint ranking of a final state L2 grammar that reflected accurate production of [ð] in word-initial onset and intervocalic position. Also, the input representation for an L1 adult grammar and a final state L2 grammar production accuracy of [ð] across the board would each have the input representation of /ð/.

In sum, a comparison of the L1 emerging grammars, the L2 intermediate grammar, and the L1 adult grammar reveal that the IL intermediate grammar could be metaphorically described "as one step ahead" of child L1 grammar and "one step behind" an L1 adult grammar.

Figure (6): Markedness to Faithfulness Continuum



The IL intermediate grammar is one step ahead in the sense that the syllable position of [ð] matters in the IL grammar whereas in L1 child grammars [ð] can be deleted in all positions as illustrated in the L1 data presented in Moskowitz (1970). The IL grammar is one step behind an L1 adult grammar in the sense that there is still a preference for unmarked forms; however, marked forms such as [ð] are emerging in the IL grammar.

With this continuum in mind, it is assumed that an end state L2 grammar that produces [ð] in all contexts has the same constraint ranking as an adult L1 grammar.

5.6 Summary of OT Rankings

In sum, the following stages of [ð] production were presented:

(1): At the initial state, L2ers transfer their L1 ranking and L1 input representations which prohibit interdental fricatives.
(2): At the intermediate stage of acquisition the input representation of [ð] is still /d/, and L2ers promote the constraint SPIR to permit [ð] in intervocalic position, illustrating the emergence of the unmarked. The constraint *ð(Onset) prohibits [ð] in onset position.
(3): At the final state of acquisition, L2ers have a context-free input representation of /ð/ and demote *ð(Onset) and SPIR, prompting production of [ð] across the board.

These stages move from disallowing marked segments to permitting marked segments in the output. So, over time, an L2er's grammar shifts from being dominated by markedness constraints to be being dominated by faithfulness constraints.

The re-ranking in stage (3) noted directly above, of course, is hypothetical. L2ers show variability, and it is plausible that some learners would become more inconsistent than stated in stage (2), illustrating a U-shaped acquisition curve. It is also plausible that certain learners would *never* shift the input representation from /d/ to /ð/ and/or produce [ð] correctly, illustrating fossilization.

6. Conclusion

This empirical study has shown that [ð] is a troublesome segment for L2 English learners. More interestingly, however, this study shows that the universal process of spirantization is accessible in L2 acquisition. The high accuracy rate of [ð] in intervocalic position is the primary support for L2 spirantization.

Although this study makes claims related to markedness and UG in an L2 context, there are limitations to the study. First, it could be argued that the word list and story reading tasks only prompt a formal speech style, possibly inflating the results presented here. Second, frequency was not evaluated here. An analysis of frequency may reveal that more frequent words with [ð] intervocalically may have a higher accuracy rate than less frequent words with [ð] intervocalically. However, the lower accuracy rates with [ð] in word-onset position suggest that frequency is most likely not a factor for this position. Moreover, this study did not incorporate a contrastive analysis between function and content words (See Bybee (2001) for a discussion on function vs. content words).

Since the data reflect a pattern that is underdetermined by the L1s or the target L2 English, a derivational rewrite rule accounting for the data cannot be presented. Thus, I have shown that an OT analysis is an appropriate framework to invoke here. The data reported here suggest that the ranking of the constraint SPIR illustrates the emergence of the unmarked. The emergence of SPIR creates a positional asymmetry between word-initial onset and intervocalic position in which [ð] is inconsistently produced in word-

initial onset, but consistently produced in intervocalic position.

Overall, the investigation of the L2 production of [ð] permits researchers to evaluate the role markedness and UG play in L2 acquisition. Consequently, L2 studies focusing on interdental fricatives remain a fruitful area of research.

References

Altenberg, E. and Vago, R.M. (1987). Theoretical implications of an error analysis of second language phonology production. In G Ioup, and S. Weinberger (Eds.), *Interlanguage phonology* (pp. 148–164). Cambridge, MA: Newbury House.

Archive Phonetics. (2012). UCLA Phonetics Lab: http://archive.phonetics.ucla.edu/. Retrieved from Oct. 1, 2012, from http://archive.phonetics.ucla.edu/Language/AMH/amh_word-list_1966_01.html

Asher, J & Garcia, R. (1969). The optimal age to learn a foreign language. *Modern Language Journal*, *53*, 334-341.

Bailey, G. & Thomas, E. (1998). Some aspects or African-American Vernacular English phonology. In S. Mufwene, J. Rickford, G. Bailey, and J. Baugh (Eds.), *African-American English* (pp. 85-109). New York: Routledge.

Barlow, J. A. & Gierut, J. A. (1999). Optimality theory in phonological acquisition. *Journal of Speech Language & Hearing Research, 42,* 1482-1498.

Bauer, L. (1988). What is lenition? *Journal of Linguistics* , *24*, 381-92.

Best, C. T. (1995). A direct realist view of cross-language speech perception. In W. Strange (Ed.), *Speech, Perception and Linguistic Experience: Issues in Crosslanguage Research (pp.* 171–203). Baltimore: York.

Boersma, P. (1998). *Functional Phonology: Formalizing the interactions between articulatory and perceptual drives*. The Hague: Holland Academic Graphics.

Boersma, Paul, & Hayes, B. (2001). Empirical tests of the Gradual Learning Algorithm. *Linguistic Inquiry ,32*, 45-86.

Broselow, E., Chen, S.-I., & Wang, C. (1998). The Emergence of the Unmarked in Second Language Phonology. *Studies in Second Language Acquisition, 20*, 261-280.

Bybee, J. (2001). *Phonology and language use*. Cambridge Studies in Linguistics 94. Cambridge: Cambridge University Press.

Campbell, G.L. (1995). *Concise Compendium of the World's Languages.* New York: Londres.

Carlisle, Robert. (1998). The acquisition of onsets in a markedness relationship: A longitudinal study. *Studies in Second Language Acquisition, 20*, 245-260.

Chomsky, N., & Halle, M. 1968. *The sound pattern of English*. New York: Harper & Row.

Clements, G. N. 1990. The role of the sonority cycle in core syllabification. In J. Kingston and M. Beckman (Eds), *Papers in Laboratory Phonology I: Between the*

*Grammar and Physics of Speech (*pp. 283-333). Cambridge: Cambridge University Press.

Colavin, R., Levy, R. & Rose, S. (2010). Modeling OCP-Place in Amharic with the Maximum Entropy phonotactic learner. Chicago Linguistic Society 46.

Eckman, F.R. & Iverson, G.K. (1993). Sonority and markedness among onset clusters in the interlanguage of ESL learners. *Second Language Research 9*, 234–52.

Elliott, R. E. (1995) Field independence/dependence, hemispheric specialization, and attitude in relation to pronunciation accuracy in Spanish as a foreign language. *The Modern Language Journal*, *79*, 356-371.

Flege, J. E. & Fletcher, K. L. (1992). Talker and listener effects on degree of perceived foreign accent. *Journal of the Acoustical Society of America*, *91*, 370-389.

Flege, J., Munro, M. & MacKay, I. (1995). The effect of age of second language learning on the production of English consonants*. Speech Communication*, *16*, 1-26.

Flege, J. E., Yeni-Komshian, G. & Liu, H. 1999. Age constraints on second language acquisition, *Journal of Memory & Language*, *41*, 78-104.

Gnanadesikan, A. (1995). Markedness and faithfulness constraints in child phonology. Ms., University of Massachusetts, Amherst.

Goldsmith, J. A. (1990). *Autosegmental and metrical phonology*. Cambridge, MA: Blackwell.

Hancin-Bhatt, B. 2008. Second language phonology in Optimality Theory. Phonology and Second Language Acquisition. Ed. M Zampini and J Hansen.
Amsterdam/Philadelphia:
John Benjamins, 2008. 117-146.

Hayward, K. & Hayward, R. (1999). Amharic. In International Phonetic Association (Ed.), *Handbook of the International Phonetic Association: A guide to the use of the International Phonetic Alphabet* (pp. 45-49). Cambridge, UK: Cambridge University Press.

James, A. (1986). *Suprasegmental Phonology and Segmental Form.* Niemeyer: Tübingen.

Kahn, D. (1976). Syllable-based Generalizations in English Phonology, Doctoral dissertation, MIT.

Kiparsky, P. (1982). Lexical morphology and phonology. In The Linguistic Society of Korea (Ed.), *Linguistics in the morning calm* (pp. 1–91). Seoul, Korea: Hanshin.

Kirchner, R. (1998). An effort-based approach to consonant lenition. Doctoral Dissertation. UCLA. [Available on Rutgers Optimality Archive, ROA-276.]

Kirk, C, & Katherine D. (2003). Onset/coda asymmetries in the acquisition of clusters. In B. Beachley, A. Brown, & F. Conlin (Eds.), *Proceedings of the 27th Annual Boston University Conference on Language Development* (pp. 437-448). Somerville, MA: Cascadilla Press.

Kohmoto, S. (1965). *Applied English Phonology: Teaching of English Pronunciation to the Native Japanese Speaker*. Tanaka Press.

Kuhl, P. K. (1995). 'Linguistic experience and the perceptual magnet effect in W. Strange (Ed.), *Speech Perception and Linguistic Experience: Issues in Crosslanguage Research* (pp. 121–154). Timonium: MD.

Ladefoged, P. (1993). *A Course in Phonetics*, 3rd ed. Fort Worth TX: Harcourt Brace & Company.

Leslau, W. (1995). *Reference Grammar of Amharic.* Wiesbaden: Harrassowitz.

Lewis, M. P. (Ed.). (2011). Ethnologue: Languages of the World, Sixteenth edition. Dallas, Tex.: SIL International. Online version: http://www.ethnologue.com/.

Lleó, C. & Rakow, M. (2005). Markedness Effects in the Acquisition of Voiced Stop Spirantization by Spanish-German Bilinguals. In Cohen, J., McAlister, K. T., Rolstad, K. & MacSwan, J. (Eds.), *Proceedings of the International Symposium on Bilingualism 4* (pp. 1353–1371.). Cascadilla Press, Somerville, Massachusetts.

Lombardi, L. (2003). Second language data and constraints on Manner: explaining substitutions for the English interdentals. *Second Language Research*, *19*(3), 225-250.

Maddieson, I. (1984). *Patterns of Sounds*. Cambridge: UP Press.

Mackey, A., & Gass, S. M. (2005). *Second language research: Methodology and design*. Mahwah, NJ: Lawrence Erlbaum.

McCarthy, J. (2002). *A Thematic Guide to Optimality Theory*. Cambridge: Cambridge University Press.

McCarthy, J. (2008). *Doing Optimality Theory*. Malden, MA and Oxford: Blackwell.

McCarthy, J., & Prince, A. (1994). The emergence of the unmarked: Optimality in prosodic morphology. *Proceedings of the North East Linguistics Society 24*, 333–379.

McCarthy, J. & A. Prince. (1997). Faithfulness and Reduplicative Identity. [Available on Rutgers Optimality Archive, ROA-216.]

Michaels, D. (1974). Sound replacements and phonological systems. *Linguistics* , *126*, 69–81.

Missaglia, F. (1999). Contrastive prosody in SLA: an empirical study with adult Italian learners of German. *Proceedings of the 14th International Congress of Phonetic Sciences*, *1*, 551-554.

Monk, B. & Burak, A. (2001). Russian speakers. In M. Swan, & B. Smith (Eds.), *Learner English: A teacher's guide to interference and other problems* (pp. 145– 161).

Moskowitz, A. I. (1970). The two-year-old stage in the acquisition of English phonology. *Language, 46*, 426–41.

Moyer, A. (1999). Ultimate attainment in L2 phonology. *Studies in Second Language Acquisition, 21*, 81-108.

Oyama, S. (1982). The sensitive period for the acquisition of a nonnative phonological system. In R. Scarcella & M. Long (Eds.), *Child-Adult Differences in Second Language Acquisition* (pp. 20-38). Newbury House, Rowley, MA

Piper, T. & Cansin, D. (1988). Factors influencing the foreign accent. *The Canadian Modern Language Review, 44*, 334-342.

Purcell, E & Suter, R. (1980). Predictors of pronunciation accuracy: A reexamination. *Language Learning, 30*, 271-287.

Prince, A. & Smolensky, P. (1993/2004). *Optimality Theory: Constraint Interaction in Generative Grammar.* Malden, MA, & Oxford: Blackwell. [Revision of 1993 technical report, Rutgers University Center for Cognitive Science. Available on Rutgers Optimality Archive, ROA-537.]

Rickford, J. R. (1999). *African American Vernacular English: Features and Use, Evolution, and Educational Implications*. Oxford: Blackwell.

Selkirk, E. (1984). On the major class features and syllable theory. In Aronoff & Oehrle (Eds.) *Language Sound Structure: Studies in Phonology* (pp. 107-136). Cambridge: MIT Press.

Shea, C and Curtin S. (2006). Learning Allophonic Alternations in a Second Language: Phonetics, Phonology, and Grammatical Chang. In M. O'Brien, C. Shea, & J. Archibald, (Eds.), *Proceedings of the 8th Generative Approaches to Second Language Acquisition Conference (GASLA 2006)* (pp. 124-131). Somerville, MA: Cascadilla Proceedings

Svantesson, J., Tsendina, A., Karlsson, A., & Franzén, V. (2005). *The phonology of Mongolian.* Oxford: Oxford University Press.

Tahta, S.,Wood, M ., & Lowenthal, K. (1981). Foreign accents: Factors Relating to transfer of accent from the first language to the second language. *Language Speech, 24*, 265-272.

Tingsabadh, M.R., & Abramson, A. (1999). Thai. In International Phonetic Association (Ed.), *Handbook of the International Phonetic Association: A guide to the use of the International Phonetic Alphabet* (pp. 147-150). Cambridge, UK: Cambridge University Press.

Yavas, M. (2011). *Applied English phonology.* Malden, MA: Blackwell Publishing.

Yavas, M. (1998). *Phonology development and disorders.* San Diego: Singular Publishing.

Weinberger, S. (1990). Minimal segments in second language phonology. In J. Leather & A. James (Eds.), *New Sounds 90: Proceedings of the 1990 Amsterdam Symposium on the acquisition of second language speech*. University of Amsterdam.

Weinreich, U. (1953/1968). *Language in contact.* The Hague: Mouton.

Wireback, K. (1997). *The role of phonological structure in sound change from Latin to Spanish and Portuguese*. New York: Peter Lang.

Zec, D. (1988). *Sonority Constraints on Prosodic Structure*. PhD dissertation, Stanford University.

APPENDIX: READING TASKS

For each word, insert the word into the following phrase: “Now say _____ again”: “Now say ‘big’ again.”

1)	big	four	etch	maze	legal
2)	earth	when	this	hurts	another
3)	hope	brother	vision	then	jolly
4)	thinks	your	stripe	mother	bath
5)	van	personal	principle	neither	cannot
6)	green	these	bathe	fresh	apples
7)	speak	sunny	rather	author	than
8)	those	sprint	phrase	joke	weather
9)	math	bread	pants	father	hopes
10)	dials	them	played	games	hotel
11)	other	birth	though	locks	doors
12)	changes	other	admit	curse	there
13)	even	they’ll	eggs	leather	fox
14)	burst	breathe	now	therefore	joy
15)	strange	weather	thumb	fingers	Athens
16)	the	offer	ouch	angry	either
17)	healthy	school	stereo	spend	pencils
18)	essay	notes	bother	teacher	they
19)	orange	teethe	commuting	drives	passion

20) choices whether maybe oceans first

Story reading task

This story is about two brothers, Othello and Keith, from Athens, Georgia. Othello was always thought of by the family to be the one who did everything right while Keith was always thought to do things wrong.

Thanks to a winning lottery ticket, Keith was able to buy a house with his own money, and decided to move southwest of Athens to Oglethorpe County.

Othello's mother thought that Othello would go see Keith often after he moved to Oglethorpe County, but Othello never went to see his brother there.

One winter the weather was really bad and Keith had no heat or running water, but Othello still did not visit or help Keith either. Keith called his mother, who at that time, lived in another state to tell her about this situation between him and his brother. She was really confused about everything that Keith told her and she said that she planned to talk to their father about the situation.

A week went by, and then another, and finally the mother spoke to the father about the situation with the brothers. Later in the evening after Keith called, his mother was a little nervous about telling her husband about the situation. She thought about this and she knew that this would either bother him a little or really make him angry. After the mother told the father about the brothers, she was surprised because he laughed. He laughed and laughed and he did not bother to tell her why. The mother just threw her hands up in the air during this strange display from the father. Therefore, the mother did not know whether the father had understood her or whether he was keeping something from her.

The mother had to find out what was going on between the father and the brothers, Othello and Keith. She had some questions: Why was neither brother speaking to each other? What did her husband think was so funny? Why on earth did Keith think it was a good idea to live in Oglethorpe County?