The Acquisition of Allophonic Variation in Spanish as a Second Language

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1. Introduction

This study will examine the acquisition of the Spanish trill by adult Farsi-speaking learners. It is generally agreed that trills are difficult segments to produce. They are difficult for L2 learners (Face, 2004; Major, 1985; Waltmunson, 2005) and are mastered late in acquisition (Carballo & Mendoza, 2000; Jiménez, 1987). Despite the fact that they are not uncommon sounds in phonological systems (Maddieson, 1984) their production requires precise aerodynamic and postural constraints (Solé, 2002). Conditions for tongue tip trilling involve muscle contraction of the tongue to assume the position, shape and elasticity requirements, and a sufficient air pressure difference across lingual constriction (Solé, 1998; Solé 2002). Furthermore, the strict aerodynamic and postural constraints required for trilling are not equally attainable in different positions in word. Solé (2002) reports that intervocalic position is more favourable to trill production than post-consonantal position. She explains that in the latter position, coproduction with adjacent consonants could disrupt the narrowly constrained postural and aerodynamic conditions for trilling. Lewis (2004) also reports that there is a positive degree of correlation between the degree of stricture associated with the pre-rhotic segment and the frequency with which voiced trills occur in the post-consonantal context. That is, as the degree of the pre-rhotic stricture decreases from /n/ to /l/ to /s/, so decreases the likelihood of trilling and increases the likelihood of approximantization. In addition, he states that chances of trill production is higher in word initial and post-vocalic positions in comparison with their post-consonantal counterparts. Lewis (2004) explains that in word initial and post-vocalic positions there are no demands placed on position of the tongue prior to articulation of the rhotic. Hence, speakers are better able to control tongue position along with aperture and size of the channel, thus increasing the likelihood of producing a trilled allophone.

Previous studies (Face, 2004: Major, 1985; Waltmunson, 2005) that have investigated the acquisition of the trill in Spanish have mainly dealt with the issue of transfer of L1 categories. This study also deals with the issue of transfer of L1 categories and tests Flege' s (1995) prediction that states that sounds in the L1 and L2 are related perceptually to one another at a position-sensitive allophonic level. However, it differs from previous studies in several aspects. First, in addition to the issue of transfer, inspired by Colantoni & Steele (2007 a & b) on the acquisition of rhotics by English speakers, it investigates the role of articulatory constraints in the acquisition of trills. Second, whereas previous studies have analyzed the acquisition of the Spanish trill by English learners,

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this study focuses on Farsi-speaking learners of Spanish. The choice of the structure, namely trills, and language pairing here is motivated by the fact that while trills exist in Farsi, their distributional pattern differs from Spanish. In Spanish, word initially and post-consonantally, the trill has been reported as the main variant in comparison with the other rhotic allophones (Lewis, 2004; Navarro; Quilis, 1993; Tomás 1971). In Farsi, fricatives have been reported as the main variant in the latter positions (Rafat, 2008). Intervocalically, trills have been reported to contrast with taps in Spanish (Blecua, 2001; Navarro Tomás, 1971; Quilis, 1993). In Farsi, trill and tap contrast in minimal pairs in this position (Rafat, 2008). Finally, whereas previous studies on trill acquisition in Spanish have relied on global measurements (Colantoni & Steele, 2007 a), this study analyzes three of the phonetic parameters of trills.

2. Trills in Spanish and Farsi

The alveolar trill occurs intervocalically as in /perro/ 'dog', word initially as in /rama/ 'branch' and preceded by /n,l,s/ word internally as in honra 'honour', Israel 'Israel' and alrededor 'around' (Lewis 2004; Lipski, 1994;Navarro Tomás, 1971). It contrasts with the tap in intervocalic position (Lewis, 2004; Navarro Tomás, 1971). Furthermore, word initial and post-consonantal trills correspond to a single rhotic in the orthographic system and word medial trills correspond to two rhotics and taps to a single rhotic.

Acoustically, the trill consists of silences and vocalic elements (Quilis, 1993) and openings and closures (Blecua, 1996). Whereas the openings are on average 18 ms long, the closures are 15 ms long (Quilis, 1983). The number of vibrations in trills have been reported to range between two to five (Recasens Pllarés, 1999), and two to three closures (Lindau, 1985). Quilis (1993) reports a mean average of three closures in spontaneous speech and Lindau (1985) an average of two to three closures. Navarro Tomás (1916) reports the highest number of vibrations in intervocalic position. Navarro Tomás (1971) reports three vibrations in stressed syllables as in /roca/ 'stone' and /barrena/ 'drill', two vibrations when it is preceded by 'n,l,s' as in /honrado/ ' honoured', four vibrations when it is preceded by a stressed vowel in intervocalic position as in /carro/ ' car', five to six when the preceding /s/ is deleted as in 'Israel', two when in unstressed syllables. Lewis (2004) reports two to three closures word initially and post /n,l,s/ where voiceless trills are characterised by a higher mean number of contacts (Lewis 2004).

Regarding variation in voicing, trills have been described as voiced (Navarro Tomás, 1971) and reported as having both voiced and voiceless variants in word initial, post-alveolar consonants (Lewis, 2004).

Regarding duration, trill mean duration has been reported as 85 ms (Quilis, 1993). Its mean duration values are 69-112 ms word initially, 61-65 ms post-vocalically, 61-97 ms when preceded by /s/, 77 ms to 81 ms when preceded by /l/, 45- 60 ms when preceded by /n/ (Lewis, 2004).

Variation in manner has been attested in different dialects of Spanish (Colantoni 2001& 2006; Navarro Tomás 1971; Quilis, 1993). Fricative realization of trills has been observed in a number of Spanish varieties

(Colantoni, 2001; Lipski, 1994; Navarro Tomás, 1971; Quilis and Carril, 1971; Quilis, 1993). Navarro Tomás (1971) has observed fricative realizations in Peninsular Spanish. Lipski (1994) has found the same in Bolivian, Guatemalan, Honduran, Paraguayan, some Chilean, Costa Rican, Ecuadorean, Nicaraguan, and Peruvian varieties. Lipski (1994) and Rissel (1989) have observed the same in some Mexican varieties while Lipski (1994) and Colantoni (2001) have done so in some Argentine varieties of Spanish. Quilis (1993) reports its existence in Cuba, Costa Rica and Panama in addition to those mentioned by Lipski (1994) and does not include Honduras. Furthermore, different degrees of assibilation have been noted in different dialects of Spanish. For example fricative trills in Chile have been reported as less strong than the Andean dialect zone (Lipski 1994). Finally, velarization as well as lateralization of trills has been attested in some Spanish varieties. Quilis (1993) reports velarized variants are found in parts of Cuba, Puerto Rico, Panama, Mexico, Venezuela and Colombia and Lipski (1994) reports lateralization and velarization in Puerto Rico and the Dominican Republic and lateralization in Panama and Cuba. Lewis (2004) reports approximantization in Argentinean, Mexican, Chilean, and Peninsular Spanish and Colantoni (2006) in Argentinean Spanish.

A number of accounts of rhotic distribution in Farsi have been reported in the literature. For example, the IPA (1999) states that trills vary with approximants in Farsi. On the other hand, Samareh (1977) indicates that alveolar fricatives occur word initially, apical flaps occur intervocalically and voiceless alveolar fricative occur word finally and before consonants. Samareh (1985) also identifies the trill as the underlying rhotic in Farsi and identifies several allophones for it. However, none of these accounts are based on acoustic analysis. In order to better clarify the distribution of rhotics in Farsi, Rafat (2008) carried out a socio-phonetic investigation, where she tested five speakers and analyzed the data acoustically.

Rafat (2008) found that intervocalically, taps and fricatives correspond to the singleton rhotics in the orthographic system as in /arus/ ‘bride’ and trills and fricatives correspond to the orthographic diacritic for geminates. Word initially, the main variants included fricatives and approximants and post-consonantally, fricatives approximants and taps. She did not find any trills post-consonantally or in word initial positions.

Regarding duration, previous accounts on length contrast in Farsi are contradictory. Whereas Mahootian (1997) claims that geminates tend to neutralize in Farsi, Hansen (2004) has stated that length is contrastive in Farsi. Rafat (2008) found that the average trill duration was 137.5 ms and it ranged between 80-244 ms. Furthermore, although there was some evidence of length neutralization in coda position, there was no evidence of length neutralization in word medial position. In other words, the rhotics (trills and fricatives) corresponding to an intervocalic geminate rhotic in the orthographic system, maintained their length contrast with (taps and fricatives) corresponding to a singleton rhotic in the same position.

With regards to voicing, voiced, partially voiced and voiceless trills were found in both intervocalic and coda positions.

Social factors affecting trill production in intervocalic and word final positions include formality and gender. Both men and women produced more trills in more formal speech than in informal speech. In addition, men had a higher rate of trill production than women in more formal speech.

3. L2 Acquisition of Sounds

Several models have been proposed to account for the emergence of categories in L2 speech. One of the most prevalent models is the speech learning model (SLM). It is built on the premise that the ability to establish phonetic categories remains intact over the life span and can be applied to L2 learning. Within SLM, acquisition of a sound depends on the ability of the learner to correctly perceive the phonetic distance between the L2 sound and the L1 sound. In other words, if the sound is and 'old sound' it will not pose any difficulty for the learner, if it is a new sound (where the learner can perceive the difference between the L2 sound and the closest L1 sound), a new category will eventually be established, and if it is a similar sound (where the learner can not perceive the phonetic difference between the L2 sound and the closest L1 sound), it will present the learner with problem. It also predicts that sounds in the L1 and L2 are related perceptually to one another at a position-sensitive allophonic level, rather than at a more abstract phonemic level. This means that category establishment for a specific segment in a specific position in the L2 will depend on whether the sound is 'new', 'old' or 'similar' in the same position in the learners L1. Furthermore, it predicts that learners will be able to correctly produce a sound if they are able to correctly perceive it.

A different model of sound acquisition in L2 has been proposed by Colantoni & Steele (2007 b). This model takes into account the role of transfer at perception and production as well as the role of universal phonetic principles. As in the SLM, it is predicted that learners will use both acoustic and distributional patterns to categorize sounds as 'old' 'new' and 'similar'. Within this model, target-like representations and accurate gestural planning does not guarantee target-like outputs as articulatory constraints including aerodynamic and elasto-inertial requirements control production. Finally, this model proposes that learners compare their outputs further to their perceived inputs. If no differences are noticed between the two, categories become fossilized. This paper will take into account both models mentioned here.

4. Hypotheses

Word initially and post-consonantally, based on Flege (1995) and the fact that the trill does not exist in Farsi, the trill will be categorized as a 'new' sound and it will be acquired by Farsi-speaking learners of Spanish. On the other hand, post-consonantally, based on Colantoni and Steele (2007b) and Lewis (2004), learners will produce more trills in the following order: following /s/> following /l/> following /n/. In addition, based on Colantoni and Steele (2007 b) and Lewis (2004), more trills will be produced word initially than post-consonantally.

In intervocalic position, based on Flege (1995), and the fact that the trill exists in Farsi, albeit at a higher rate in more formal speech, it will be categorized as an 'old' sound and will not cause any difficulty for the learners. In addition, based on Colantoni and Steele (2007 b) and Solé (2002) trills should be favoured in this position in comparison with word initial and post-consonantal position.

Based on the fact that trills can have more than one allophone in the same position in Farsi, various types of rhotics will be observed in the Spanish production of trills by the learners.

5. Methodology

5.1 Subjects

The learners of Spanish were two adult males (M and T) who resided in Toronto and who had left Iran more than twenty years ago. M was a forty nine year old social worker and T was a forty eight year old full time teacher of English as a second language and a part time actor. M had spent a year in Spain in his early twenties and had maintained his contact with the language through his job on a daily basis as well as by socializing. He stated that he had learnt Spanish by communicative means and had never had any formal training in Spanish. T had spent six years in Nicaragua in his late twenties, where he had taken twenty courses in Spanish. In Toronto, he kept his contact with Spanish by the same means as M as well as by doing plays in Spanish. In addition to Farsi and Spanish, they were both fluent in English as they had both spent several years in Canada. English was their second language given they had both been exposed to it in school in Iran. The Spanish control subject was a forty year old male who was born in Mexico and resided in Toronto. He was a graduate student at the University of Toronto and spent most of his time speaking in Spanish.

5.2 Tasks and Measurements

The learners of Spanish were required to read a list of Spanish words as well as a separate list of words in Farsi. They were asked to read the Spanish list three times and the Farsi list twice.[1]

The Spanish stimuli consisted of 24 words that contained the target positions where the rhotic tends to be pronounced as a trill (see Appendix A). These contexts include the following: word initial position, such as /rama/ 'branch', intervocalic position, such as /perro/ 'dog' and the position following /n,l,s/, such as /alrededor/ 'around', /honra/ 'honour' and /disruptive/ 'disruptive'. There were five words per each context except for the context preceded by /l/, as this context is only found in four words in Spanish. Given the

[1] The Farsi list belonged to a larger experiment and was very long. Hence, given the time constraints they were not asked to read it three times.

scarcity of the words with the /n,l,s/ contexts, it was not possible to control for stress or the vocalic context. In addition, 25 distracters were used.

The set of Farsi stimuli that were used in this study consisted of 25 words[2]. They included the same three contexts that were used in the Spanish stimuli. Some examples include /rok/ 'honest', /barre/ 'lamb', /salruz/ 'anniverary', /ahanroba/ 'magnet', and /esrayil/ 'Israel' (see Appendix B). Given that words containing the /n,l,s/ context are sparse in Farsi, the stimuli were not balanced for stress or for context.

Wideband spectograms in PRAAT were used for the acoustic measurements. In data analysis, first, the tokens were coded for manner, namely trills, non-trilled fricatives and approximants. Second, the duration of trills were measured in milliseconds. Third, the number of closures were counted in trills. Fourth, the trills were coded for percentage of voicing. Fourth, the trilled tokens were coded as fully voiced, partially voiced and voiceless. Finally, in order to determine the role of English in the learners' Spanish production, intervocalic approximants in word medial position were coded for F3 lowering.

6. Results

6.1 Word Initial Position

The hypothesis based on Flege (1995) regarding the acquisition of trills in word initial position was not confirmed. As Figure 1 demonstrates both learners produced fricatives and approximants instead of trills in Spanish.

In addition, the results suggest transfer of articultory patterns in both subjects. Whereas the Spanish control's production consists of 100% trills, both M's and T's rhotic production in Spanish resembles their rhotic production in Farsi in terms of manner. Both M and T produced fricatives and approximants in Spanish and Farsi. Furthermore for M, transfer of articulatory patterns is also evident in terms of percentage of fricative and approximant production in both languages. However, this is not the case for T.

[2] In the larger experiment the total the stimuli consisted of 132 words including 40 distracters.

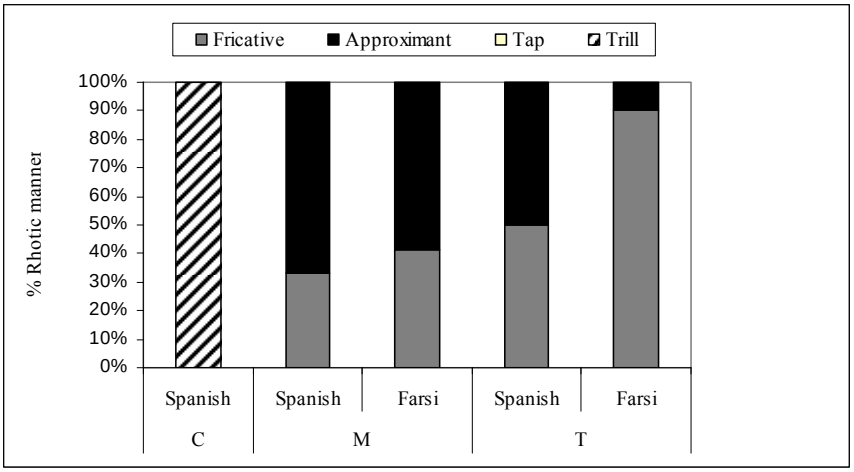

Figure 1: % Rhotic manner: word initial position

6.2 Word Medial Position: Post-alveolar Consonants

Given that no trills were produced in this context, the results were collapsed for contexts following /n/, /l/ and /s/. The hypothesis based on Flege (1995) regarding the acquisition of the trill in this position was not confirmed. Although, the trill was a new sound for the learners in this position, it was not acquired. Figure 2 demonstrates that whereas the control's results consisted of 87% trills and 13% fricatives, the learners produced fricatives, approximants and taps in Spanish.

As in word initial position, the results suggest transfer of articulatory patterns for both learners. Figure 2 indicates that M's Spanish rhotics resembles his Farsi rhotics in both manner and percentages. On the other hand, T categorically produced fricative, one of the two categories found in his Farsi production.

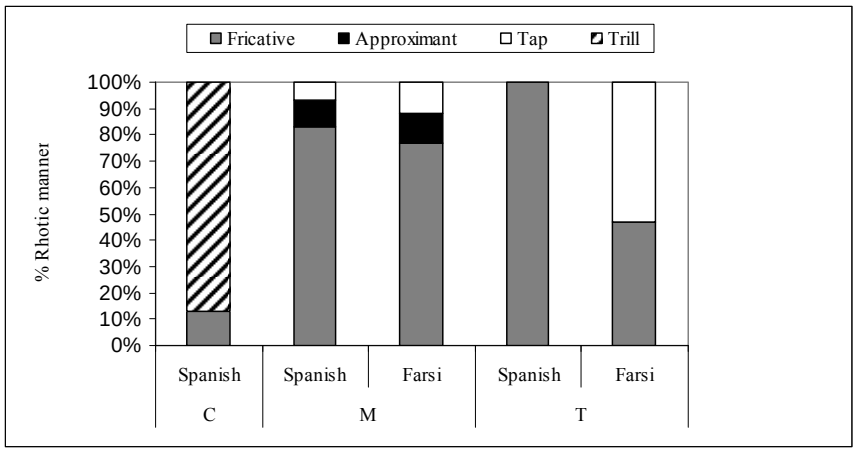

Figure 2: % Rhotic manner: post-consonantal position

6.3 Word Medial Position: Intervocalic Position

6.3.1 Manner

The hypothesis based on Flege (1995) that learners will not have any difficulty with trills in this position was only confirmed for one learner. Figure 3 indicates that whereas T produced both trills and fricatives, M did not produce any trills in Spanish. More interestingly, M did not produce any trills in intervocalic position in Farsi either. This finding was not expected at the time that the hypotheses were made based on Rafat (2008). It is possible that either the description of inter-speaker behaviour in Rafat (2008) is inadequate or M has suffered from attrition and has developed a different pattern of rhotic production. The Farsi data for M in intervocalic position calls for a re-statement and re-analysis of Flege's (1995) hypothesis. Based on the fact that M categorically produced fricatives in Farsi, Flege (1995) would predict that the trill would be categorized as a new sound and would be acquired. However, this hypothesis would also be rejected as M only produced approximants characterized by a low F3 in this position in Spanish. The fact that low F3 is characteristic of English rhotics (Delattre and Freeman, 1968; Lindau, 1985), together with the fact that approximant rhotics have not been attested in intervocalic position in Farsi (Rafat, 2008), suggest influence from English. The interference from English, could be due to a combination of the nature of the task, namely a word reading task, and the fact that he had never had any formal training in Spanish. While there is no evidence of trill production here, there is a possibility that the learner can produce it in more informal tasks where reading is not required.

Transfer of articulatory patterns is evident for T in terms of manner but not in terms of percentages.

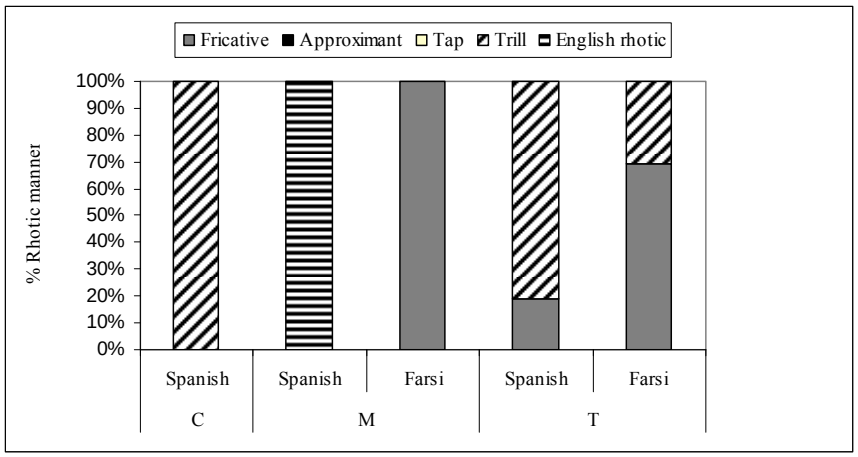

Figure 3: % Rhotic manner: intervocalic position

6.3.2 Trill Duration

T's trills in Spanish were hyper-articulated. Figure 4 shows that his average trill duration in Spanish (175 ms) was longer than his average duration in Farsi (151 ms), the control's average trill duration (115 ms), and the average trill duration that is generally agreed on in Spanish, 85 ms (Blecua, 2001; Quilis, 1983). Furthermore, his trills consisted of up to 5-6 closures which was not attested in the control's results and is higher than the highest number of contacts reported in intervocalic position in Spanish in the literature (see section 2). The learner's hyper-articulation of the length parameter could be explained in terms of the fact that words are in general longer in L2 production.

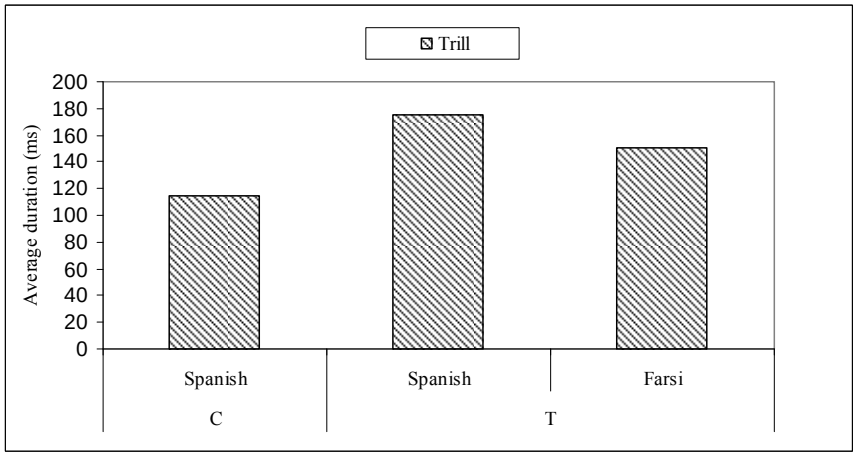

Figure 4: Average trill duration: intervocalic position

6.3.3 Trill Voicing

Figure 5 demonstrates that T's trills were 90% voiceless in Spanish and 100% voiceless in Farsi. This differs from the controls pattern of voicing, 57% voiceless and 43% partially voiced as well as the general pattern of voicing reported for trills in the literature, namely a voiced trill (Navarro Tomás, 1971).

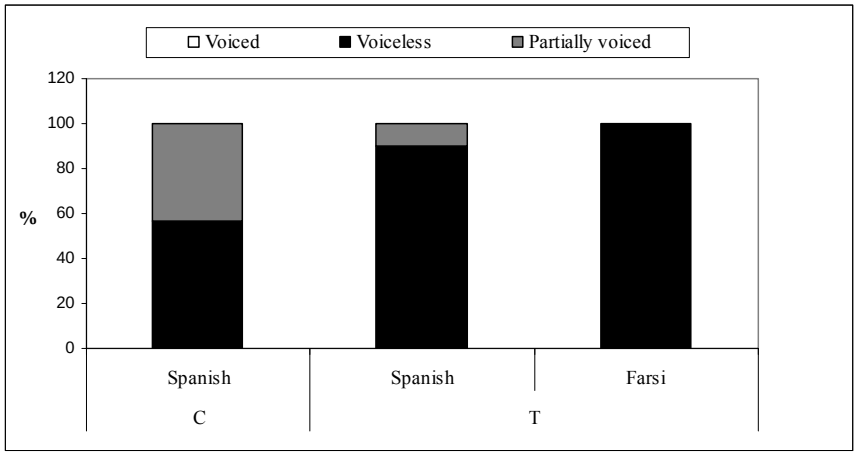

Figure 5: Voicing: intervocalic position

6.4 Influence of Articulatory Constraints

The hypotheses regarding the correlation between the rate of trill production and the effect of articulatory constraints regarding word initial and post-consonantal positions were not confirmed. Despite the fact that learners were supposed to have more articulatory control word initially in comparison with post-consonantal positions, they did not produce any trills in any of theses positions In other words, word initial and the post-consonantal position were equally problematic. Furthermore, there was no evidence that the nature of the preceding consonant controls rate of trill production. In other words, there was no difference in trill production based on whether the preceding consonant was an /s/, /l/ or /n/. Moreover, no conclusions could be drawn regarding the relative difficulty of intervocalic position in comparison with word initial and post-consonantal positions as the learner who did produce trills in this position in Spanish also produced them in Farsi, and the other learner who did not produce trills in Farsi, had transfer from English.

7. Discussion and Conclusion

The hypotheses based on Flege (1995) were only confirmed for the intervocalic trills for one speaker. The rest of the hypotheses based on Flege (1995), even when reformulated based on the findings in Farsi data pertaining to the subjects

in the experiment, were not confirmed. The findings of this study echo the findings of previous studies that trills are difficult segments and their production is influenced by learners' L1 categories. In addition, this study shows that trill production can also be affected by L2 categories. The variation that was observed in the Spanish production of the learners, was more similar to the allophonic variation observed in their Farsi production than to the allophonic variation in the Spanish control subject and to what has been attested in Spanish in general. Furthermore, acoustic measurements of some of some of the phonetic parameters of trills have provided a more detailed account of the behaviour of learners of Spanish. Specifically, the results have suggested that even when trills are produced, they are hyper-articulated. Moreover, there was no evidence to support that articulatory constraints play a role in trill production in word initial and post-consonantal positions. The effect of articulatory constraints in word medial position has to be further investigated.

In all, findings from such a small-scale study involving a single task should not be generalized. More subjects have to be tested and a conversational task should be included. In addition, this study takes into account the acquisition of sounds from a phonetic point of view. In future, the role of phonology and orthography should also be taken into account. Trills were only realized in intervocalic position, where the trill and tap appear in minimal pairs in Spanish and Farsi and the contrast is signalled in the orthographic systems of both languages. Furthermore, this study has to be followed up by a perception study to test the learner's perception of trills in different positions in Spanish. Moreover, in future hypotheses have to be formulated, taking to account inter-speaker variation. Finally, although the hypotheses were based on the findings in the socio-phonetic study carried out by Rafat (2008), this study would benefit from a socio-phonetic study in Farsi based on a larger number of speakers.

Appendix A
Spanish Stimuli
Word Initial

robo	'theft'
rama	'branch'
risa	'laughter'
rosa	'rose'
rata	'rat'

Intervocalic

perro	'dog'
trierra	'earth'
jarro	'jar'
morro	'nose'
borro	'I erase'

Post-consonantal

honra	'honour'
sonrisa	'smile'
monra	'theft'

sonreír	‘to smile’
enredo	‘decieve’
Israel	‘Israel’
desregulaciones	‘deregulations’
disruptiva	‘disruptive’
posrevolucionario	‘post-revolutionary’
posromantico	‘post-romantic’
malrotar	‘to destroy’
alrededor	‘around’
Ulrico	‘a name’
Dalriada	‘a name’
hola	‘hi’
bien	‘good’
luz	‘light’
jugo	‘juice’
Lima	‘Lima’
juego	‘game’
toco	‘touch’
choco	‘I clash’
modo	‘way’
fuego	‘fire’
mono	‘monkey’
mago	‘magician’
dedo	‘finger’
puedo	‘I can’
bebo	‘I drink’
lobo	‘wolf’
hago	‘I do’
todo	‘all’
fumo	‘I smoke’
fiesta	‘party’
fondo	‘bottom’
codo	‘elbow’
cabo	‘end’
zono	‘zone’
cielo	‘sky’

Appendix B

Farsi Stimuli

Word Initial

reshte	‘string’
raaz	‘secret’
rok	‘honest’
ru	‘face’
rish	‘beard’
rang	‘color’

Intervocalic

zorrat ‘corn’	
korre	‘young of animals’
farrox	‘a name’
ghaarre	‘continent’
darre	‘valley’
zarre	‘particle’
farrar	‘volatile’
farrash	‘school keeper’
jarrah	‘surgeon’
zarrin	‘golden’
Post-consonantal	
ahanroba	‘magnet’
xunrizi	‘bleeding’
salruz	‘anniversary’
golrox	‘a name’
esrar	‘ insistence’
esrayil	‘Israel’
masrur	‘ happy’
tasri	‘acceleration’
mera	‘half-verse’
Distractors	
Shemshak	‘name’
golabi	‘pear’
giyah	‘plant’
shadi	‘happiness’
gham	‘sadness’
ghiafe	‘looks’
balal	‘corn’
maxlut	‘mixed’
eshgh	‘love’
sandali	‘chair’
sadeghane	‘honestly’
baghiye	‘rest’
kalam	‘cabbage’
hodud	‘proximity’
saghe	‘stem’
neghab	‘mask’
taghat	‘tolerance’
moghe	‘time’
saghut	‘crash’
ostovane	‘cone’
olum	‘science’
damesgh	‘Damascus’
shahab	‘comet’
shetab	‘velocity’
joda	‘separate’

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