

**UNIVERSIDADE FEDERAL DE SANTA CATARINA  
PROGRAMA DE PÓS-GRADUAÇÃO EM INGLÊS: ESTUDOS  
LINGUÍSTICOS E LITERÁRIOS**

Mayara Tsuchida Zanfra

**PHONOLOGICAL CONTEXT AS A TRIGGER OF VOICING  
CHANGE: A STUDY ON THE PRODUCTION OF ENGLISH /s/  
AND /z/ IN WORD-FINAL POSITION BY BRAZILIANS**

Dissertação submetida ao Programa de  
Pós-Graduação em Inglês e Literatura  
Correspondente da Universidade  
Federal de Santa Catarina para a  
obtenção do Grau de Mestre em Letras  
Orientador: Prof. Dr. Rosane Silveira

Florianópolis

2013

Ficha de identificação da obra elaborada pelo autor,  
através do Programa de Geração Automática da Biblioteca Universitária da UFSC.

Zanfra, Mayara Tsuchida

Phonological context as a trigger of voicing change: :  
a study on the production of English /s/ and /z/ in word-  
final position by Brazilians / Mayara Tsuchida Zanfra ;  
orientadora, Rosane Silveira - Florianópolis, SC, 2013.  
111 p.

Dissertação (mestrado) - Universidade Federal de Santa  
Catarina, Centro de Comunicação e Expressão. Programa de Pós-  
Graduação em Letras/Inglês e Literatura Correspondente.

Inclui referências

1. Letras/Inglês e Literatura Correspondente. 2.  
Linguística aplicada. 3. Fonética e fonologia. 4. Ensino de  
língua estrangeira. I. Silveira, Rosane. II. Universidade  
Federal de Santa Catarina. Programa de Pós-Graduação em  
Letras/Inglês e Literatura Correspondente. III. Título.

To my family and my love,  
with all my heart and care.



## ACKNOWLEDGMENTS

After this incredible journey, it is pretty hard to recall all the people that went through this together with me, but there is one special person that made all the difference. I remember in the beginning of 2012, when I was just restarting my research (for we always have some details to add or to consider even after the study is done), and I wished that I was at the end of the process presenting my results, because at that time I thought I still had so much work to do. But now, after all things done and finished, I realize that it was not as hard as I thought, especially because I had the best and the most organized adviser I could ever have had. During the whole process Professor Rosane Silveira took me by the hand and led me down the path, guiding me (through the right way) and illuminating the dark shadows of my mind. Without her I would not be able to be where I am on my own, and my study would be only a research project. Hence, I would like to truthfully thank her for all the things she has done for me; I will be forever grateful for the lessons learned.

Other very important people I would like to thank are my loving family, my parents Marco and Mary, and my sister, Mariana, as well my beloved fiancé, Rodrigo, for their patience, cooperation and understanding during the time I needed them the most. Their support and love helped me to go through this hard process and I am really thankful and incredibly happy for having them by my side.

Last but not least, I would like to thank all the people that somehow helped with my study. I would like to thank my dearest friends Aline, Aleene, Cris, Gábi, Iris, Ju, Laila and Renata for helping me to test and check the website designed to collect data for this research; their opinions were very important to me. I would also like to thank my colleagues from the master's program, George, Karla, Marinho and Thais, who unwearingly helped me to pilot my study, as well as Geovane, who designed the website [www.l2pronunciation.com](http://www.l2pronunciation.com), a vital tool for this research. I would also like to thank all the people who tirelessly participated in this study, allowing me to record them and to use their data and information in order to conduct this research. And especially I would like to thank the PPGI (Programa de Pós Graduação em Inglês) and CAPES for giving me this opportunity to study what I love and allowing me to dedicate my time to something I believe in. Thank you all!

There are many other people I would like to thank for being part of this process, but I would rather finish this acknowledgment by

quoting a famous saying from Walt Disney: “All our dreams can come true – if we have the courage to pursue them”.

## RESUMO

O presente trabalho examinou a ocorrência da mudança no vozeamento em fricativas alveolares do Inglês produzidas por falantes de português-brasileiro (PB) em diferentes contextos fonológicos. Esta pesquisa foi conduzida por dois motivos principais: (a) existem poucos estudos sobre o tema com falantes de PB (Silveira, manuscrito em preparo; Zimmer, Silveira and Alves, 2009; Zimmer, 2004), e (b) há uma regra fonológica do PB que parece ser inconscientemente transferida para a pronúncia de palavras da L2. Os participantes analisados nesta pesquisa foram 12 alunos da graduação do curso de Letras-Inglês na Universidade Federal de Santa Catarina (UFSC), e 11 alunos da pós-graduação do Programa de Pós Graduação em Inglês (PPGI) na UFSC, divididos em dois grupos: intermediário e avançado, e mais 4 falantes nativos do Inglês Americano. Todos os participantes gravaram uma lista de 54 sentenças em inglês contendo os sons estudados através de um website produzido para esta pesquisa ([www.l2pronunciation.com](http://www.l2pronunciation.com)), e somente os falantes de PB gravaram uma lista de 16 frases em português contendo os sons estudados. Os dados foram analisados acusticamente utilizando o programa PRAAT através do isolamento dos sons e verificando como eles foram produzidos pelos participantes. Além disso, os dados foram analisados estatisticamente em termos da média da porcentagem da ocorrência da mudança no vozeamento, comparando os dados entre e dentro dos grupos, usando o software SPSS 16.0 para Windows. Os resultados confirmaram que os participantes no grupo avançado produziram um pouco menos de mudança no vozeamento do que os participantes no grupo intermediário. Outrossim, a ortografia, mais precisamente, a condição do –e mudo, influenciou a produção da mudança no vozeamento. Além disso, o contexto fonológico que desencadeou maiores taxas de desvozeamento do /z/ foram a pausa e a consoante desvozeada; e o contexto fonológico que desencadeou maiores taxas de vozeamento do /s/ foram a consoante vozeada e a vogal. Nesse sentido, os resultados corroboram com as hipóteses propostas, indicando que a mudança no vozeamento é um processo recorrente na interfonologia do PB-inglês.

**Palavras-chave:** Mudança de vozeamento. Interfonologia. Contexto fonológico. Transferência de regra fonológica.





## ABSTRACT

The present study examined the occurrence of voicing change in English alveolar fricatives produced by Brazilian-Portuguese (BP) speakers in different phonological contexts. This study was conducted because of two main reasons: (a) there are few studies on this topic with BP speakers (Silveira, unprepared manuscript; Zimmer, Silveira and Alves, 2009; Zimmer, 2004), and (b) voicing change is a phonological BP rule that seems to be unconsciously transferred to the pronunciation of L2 words. The participants analyzed in this study were 12 undergraduate students from the *Letras* English course at *Universidade Federal de Santa Catarina* (UFSC) and 11 graduate students from the *Programa de Pós Graduação em Inglês* (PPGI) at UFSC, who were divided into two groups: intermediate and advanced, and 4 native speakers of American English. All the participants recorded a list of 54 English sentences containing the target sounds using a website designed for this study ([www.l2pronunciation.com](http://www.l2pronunciation.com)), and only the BP speakers recorded a list of 16 Portuguese sentences containing the target sounds. The data were analyzed acoustically using the PRAAT software, through the isolation of the target sounds and checking how they were produced by the participants. Moreover, the data were statistically analyzed in terms of mean percentages of voicing change occurrence, comparing data across and within groups using SPSS software 16.0 for Windows. The results confirmed that the participants in the advanced group produced a little less voicing change than the participants in the intermediate group. In addition, orthography, more precisely, the silent –e condition, influenced the production of voicing change. Furthermore, the phonological context that triggered higher rates for devoicing with /z/ were a pause and a voiceless consonant, and the phonological context that triggered higher rates of voicing with /s/ were a voiced consonant and a vowel. In this sense, the findings corroborate the hypotheses proposed, indicating that voicing change is a recurrent process in the BP-English interphonology.

**Keywords:** Voicing change. Interphonology. Phonological context. Language transfer.



## List of figures

Figure 1. Waveform and spectrogram of the sound [z].	54
Figure 2. Waveform and spectrogram of the sound [s].	55



## List of tables

Table 1: English consonant chart displayed by place and manner of articulation and voicing features .....	23
Table 2: Allophones of /s/ and /z/ in BP (based on Cagliari's (2007) examples) .....	29
Table 3: Summary of the predictions based on the MDH and the SCH	40
Table 4: Total frequency and percentage of voicing occurrence with /s/ and devoicing occurrence with /z/ in word-final position .....	59
Table 5: Descriptive statistics and t-tests for voicing change occurrence with /s/ and /z/ in word-final position displayed by proficiency level .....	61
Table 6: Total frequency and percentage of voicing occurrence with /s/ and devoicing occurrence with /z/ according to orthography .....	64
Table 7: Descriptive statistics for voicing change frequency with /s/ and /z/ in word-final position according to orthography .....	65
Table 8: Percentage of non-target pronunciation displayed by word ....	67
Table 9: Total frequency and percentage of voicing and devoicing occurrence according to phonological context .....	69
Table 10: Descriptive statistics for voicing change occurrence with /s/ and /z/ in word-final position in different phonological contexts	70
Table 11: Wilcoxon test results comparing each pair of means for each sound .....	72
Table 12: Percentage of non-target pronunciation production with word-final /s/ displayed by word and phonological context .....	73
Table 13: Percentage of non-target pronunciation production with word-final /z/ displayed by word and phonological context .....	75
Table 14: Total amount of voicing, devoicing and voicing change .....	78



## List of appendices

Appendix I: Termo de Consentimento .....	94
Appendix II: Questionário.....	95
Appendix III: Consent Form .....	97
Appendix IV: Questionnaire .....	98
Appendix V: English Sentences .....	100
Appendix VI: Portuguese Sentences .....	102
Appendix VII: Original tables provided by SPSS.....	103
Appendix VIII: Table showing the number of the non-target productions displayed by participant and by spelling / context .....	111





## Table of Contents

<b>CHAPTER I.....</b>	<b>19</b>
1.1 Context of investigation and significance of the research ....	20
1.2 Objective of the investigation .....	24
<b>CHAPTER II.....</b>	<b>27</b>
2.1 The alveolar fricatives in American English and Brazilian Portuguese.....	27
2.2 Voicing change .....	30
2.3 Cross-linguistic interference .....	34
2.4 Structural Conformity Hypothesis Vs. Markedness Differential Hypothesis.....	36
2.5 The influence of orthography.....	41
2.6 The effect of the level of proficiency .....	43
2.7 The influence of phonological context.....	46
<b>CHAPTER III.....</b>	<b>50</b>
3.1 Participants.....	50
3.2 Instruments.....	51
3.3 Analysis.....	54
3.4 Pilot tests .....	56
4.1 The role of proficiency level .....	59
4.2 The role of orthography .....	63
4.3 The role of phonological context .....	68
4.3.1 Interaction between phonological context and orthography	73
4.3.2 Data analysis per participant.....	77
4.4 Summary of results .....	80
<b>CHAPTER V .....</b>	<b>84</b>
<b>REFERENCES.....</b>	<b>89</b>



## CHAPTER I

### INTRODUCTION

Each language has its own set of sounds, called a *sound system* (Christophersen, 1973), which is peculiar to that language, and no other language has the same sound system. When comparing two different languages, some of the sounds may be similar or identical, but others are very different. Furthermore, Yavas (2011) states that although two languages may have the same sounds, this does not mean that they have the same phonologies. The sound [tʃ], for example, is a phoneme in English, but an allophone<sup>1</sup> in Brazilian Portuguese (BP). That is to say, although both English and BP have the sound [tʃ], it has different distributions, hence in English, the use of this sound changes the meaning of a word, as demonstrated by the minimal pair *each* [i:tʃ]<sup>2</sup> and *eat* [i:t]; in BP, on the other hand, this sound simply represents a variant of /t/ (*tia* [tiə] / [tʃiə]<sup>3</sup>, ‘aunt’). For this reason, many people, when learning a second language (L2), are sometimes discouraged by the number of different sounds and sound sequences they have to deal with. But is English pronunciation accuracy so important for an utterance to be understood? One of the answers to this question is that people may be understood even when they mispronounce words, but often not immediately. Nevertheless, mispronunciations may lead to misunderstandings, and, in order to avoid them, finding the root of the problem and trying to solve it are good alternatives. Therefore, the results of studies such as the present one might contribute to the area of teaching and learning English as a foreign language.

Pronunciation errors that interfere with communication are one concern of the area of teaching and learning a foreign language. Research on the acquisition of English pronunciation has identified many difficulties that the learner faces when learning a foreign

---

<sup>1</sup> Allophones are sounds that are perceived as being different but that do not distinguish words (Celce-Murcia, Brinton & Goodwin, 2010). Or, as Trask (2007) explains, allophones are “one of two or more phonetically distinct segments which can realize a single phoneme in varying circumstances” (p. 16).

<sup>2</sup> English transcriptions were made based on the vowel and consonant chart proposed by Celce-Murcia, Brinton & Goodwin (2010).

<sup>3</sup> Brazilian Portuguese transcriptions were made based on the vowel and consonant chart proposed by Cristófar-Silva (2010).

language, such as voicing change (Silveira, 2010; Zimmer, 2004), consonant clusters (Bettoni-Techio, 2008; Cornelian Jr., 2003, Rauber, 2002), the approximant /l/ (Moore, 2008; Baratieri, 2006), interdental fricatives (Reis, 2006). Voicing change is one phenomenon that affects accuracy in English pronunciation when speakers of other languages, such as BP and German (Piroth & Janker, 2004; Silveira, 2010; Simon, 2010; Smith, *et al.*, 2009; Zimmer, 2004) are learning English as a foreign language. The notion of voicing change, central to this study, refers to the cases when a learner produces a consonant sound with the voicing feature different from the target; that is, a voiced consonant such as /d/ is produced as the voiceless /t/, or the voiceless /s/ is produced as the voiced /z/. According to Dickerson (1985), there are three reasons why more attention should be paid to voicing inaccuracies in English pronunciation. The first reason is that two-thirds of the consonant phonemes in English are only distinguished by voicing (e.g., /p-b; s-z; f-v; t-d/). The second reason is that English syllable structure permits closing syllables with almost all consonants, and the distinction between word pairs is through voicing (e.g., *send-sent; save-safe*). Finally, the third reason is that the majority of words cited in the previous examples are part of the basic vocabulary of English, so learners will learn them from the beginning. Briefly, word-final consonants are so recurrent in English that it is almost impossible to avoid them. For these reasons, the goal of this study is to investigate the extent to which Brazilian learners of English produce voicing change when producing /s/ and /z/, which is a typical phonological process in BP (see Section 2.2 for further details). This study will also examine whether the phonological context following the target consonants, as well as language experience, influence the rates of voicing change occurrence.

## 1.1 Context of investigation and significance of the research

Voicing is the main focus of this research, in view of the fact that it is the main difference between the two consonants analyzed, that is, the voiceless alveolar fricative /s/ and its voiced counterpart /z/. Sometimes, the difference between voiced and voiceless sounds can be clearly audibly recognizable, but sometimes the difference can only be perceived through careful acoustic analysis. The simplest way to

describe and differentiate voiced and voiceless sounds is with reference to the vibration of vocal folds; that is, in voiced sounds the vocal cords vibrate, and in the voiceless sounds they do not vibrate.

Several authors discuss the voicing feature of English consonants in different ways (Celce-Murcia, Brinton & Goodwin, 2010; Christophersen, 1973; Ladefoged, 2005; Yavas, 2011). Ladefoged describes voiceless consonants as sounds in which the vocal folds are held apart so that they do not vibrate, the noise being caused by the air forced through a narrow opening. The voiced consonants, in turn, are the sounds in which the vocal folds vibrate when they are produced. In addition, Celce-Murcia, Brinton and Goodwin (2010) mention that one way to perceive if the vocal cords are vibrating is to put the palm of the hand against the Adam's apple. If we feel the vocal cords vibrating, then it is a voiced sound, but if we feel nothing, the vocal cords are not moving and it is a voiceless sound. As these authors explain, the notion of voicing can be easily illustrated in this manner by asking learners to produce a continuous /s/ (hissing) sound and a continuous /z/ (buzzing) sound.

Yavas (2011) explains that some phoneticians use a different classification to differentiate voiceless and voiced sounds: *fortis* and *lenis*, respectively. According to Yavas, fortis consonants are pronounced “with more muscular energy (force), higher intra-oral pressure, and a stronger breath effort than lenis consonants” (Yavas, 2011, p. 58). He also points out that there are other characteristics that differentiate voiceless and voiced alveolar fricative sounds, and the difference in length of the preceding vowel or sonorant consonants (liquids /l, ɹ/; glides /w, j/; nasals /m, n, ŋ/) when followed by a voiceless/voiced alveolar fricative is one example. That is to say, the vowel/sonorant that comes before a voiced alveolar fricative /z/ is longer than the vowel/sonorant that comes before its voiceless counterpart /s/ (see Fullana & Mora, 2009). Lisker (1973) argues that vowels are shorter before voiceless consonants because these consonants are fortis, and this involves “an earlier onset of the articulatory closure” (Lisker, 1973, p. 228); that is, vowels before voiceless consonants are shorter because voiceless consonants are longer, requiring more energy. Before voiced consonants, on the other hand, vowels are lengthened in order to “allow time for laryngeal readjustment needed if voicing is to be maintained during oral closure” (Lisker, 1973, p. 230). In short, according to Lisker, vowels are longer before voiced consonants and

shorter before voiceless consonants because of the rule of constant energy expenditure for the syllable; that is, longer vowels and voiceless consonants spend more energy when produced.

One study conducted by Smith (1997) is related to the devoicing of /z/ in American English (AE). The author states that the voiced alveolar fricative /z/ is a sound that is difficult to produce because “voiced fricatives require that subglottal pressure be higher than oral pressure in order to maintain vibration of the vocal folds” (Smith, 1997, p. 472), and for this reason, it is expected that speakers would simplify the production of /z/, and devoicing is the most common simplification. She examined this process in productions of /z/ and /s/ by four speakers of AE. She obtained the productions by recording the participants using acoustic, airflow, and electro-glottographic (EGG) data. In the analysis, many tokens of /z/ showed almost no vocal fold vibration in the EGG signal, but the distinction between /z/ and /s/ was maintained in the durational and aerodynamic analysis. The participants varied in overall frequency of devoicing, but showed similar results for frequency of devoicing in different contexts. According to Smith (1997), devoicing was more frequent in two different environments: in the assimilation of an adjacent voiceless context (e.g., The noise level *falls perceptibly*.), and in the reduction of articulatory and aerodynamic effort (e.g., We should replace broken glass from the earthquake before any more of it *falls*.). She concludes by saying that the devoicing process is a complex but typical example of speech production that might be explained through the difficulty of the production of voicing and frication simultaneously, and it is not random, since it is “a function of segmental and prosodic structure, as well as the interplay between articulatory and aerodynamic conditions in the vocal tract” (Smith, 1997, p. 498).

The following consonant chart<sup>4</sup> shows the English consonants organized according to place of articulation, manner of articulation, as well as the voicing feature, where the first segment in each square is a voiceless consonant and the second segment a voiced consonant.

---

<sup>4</sup> The consonant chart is based on the consonant chart provided by Yavas (2011).

**Table 1**

*English Consonant chart displayed by place and manner of articulation and voicing features*

	Billabial	Labio-dental	Inter-dental	Alveolar	Retroflex	Palato-alveolar	Palatal	Velar	Glottal
Stop	p b			t d				k g	
Fricative		f v	θ ð	s z		ʃ ʒ			h
Affricate						tʃ dʒ			
Nasal	m			n				ŋ	
Liquid				l	ɹ				
Glide	w						j	w	

Source: Consonants of English, retrieved from Yavas, M. (2011). *Applied English Phonology*. Oxford: Wiley-Blackwell, p. 9.

Accurate pronunciation is important in order for the speaker to be intelligible and to avoid misinterpretations. Fullana and Mora (2009) state that speakers of some Romance languages (e.g. Catalan, Italian, Spanish) have difficulty in producing English consonant voicing in word-final position because of the non-existence of word-final stops in the speaker's first language (L1). Therefore, according to these authors, the learners "often resort to L1-based production strategies" (Fullana & Mora, 2009, p. 207), such as devoicing voiced stops in word-final position, or also deleting these sounds. Another study, conducted by Smith, Hayes-Harb, Bruss and Harker (2009), points out that "native Germans possess a phonological pattern of word-final consonant devoicing" (Smith *et al.*, 2009, p. 257); that is, they do not produce voiced consonants when they are in final position, and, when speaking English, they produce weaker acoustic signals (i.e., partially devoiced consonants) to word-final voicing than native English speakers do. Also, according to Christophersen (1973), some Africans, when speaking English, are likely to voice their *f*'s and *s*'s where these sounds would be voiced in their L1. This can occur in *If you come across it*, for example, pronounced [ɪv ju: kʌm ə'kɔ:z ɪt] instead of [ɪf ju: kʌm ə'kɔ:s ɪt]. The substitution of sounds illustrated with this example demonstrates how phonological processes that are automatized in the L1 can be transferred to the L2. These examples show a form of assimilation when the sounds surrounding /f/ and /s/ are voiced.

The phenomenon cited above, voicing change, is one type of voicing change, which, according to Silveira (unprepared manuscript), is a process that is extremely recurrent with the /s/ and /z/ for Brazilian learners of English. Indeed, as Silveira (unprepared manuscript) and Cristófaros-Silva (2010) explain, according to the phonological rules of BP, these two sounds assimilate to the voicing feature of the following sound (both within and between words), being produced as voiced if followed by a voiced consonant or a vowel, and produced as voiceless if followed by a voiceless consonant or a pause (e.g., *mesmo* [ˈmɛzmʊ], ‘same’; *os olhos* [uzˈoʎʊs], ‘the fingers’; *despesas* [desˈpɛzəs], ‘expenses’; *lápiz* [lˈapɪs]). Zimmer (2004) and Silveira (unprepared manuscript) have both shown that BP speakers tend to transfer this voicing assimilation pattern to the pronunciation of English words containing /s/ and /z/.

Although there are some studies on this matter involving other languages (Piroth & Janker, 2004; Silveira & Souza, 2011; Simon, 2010; Smith, 1997; Smith, *et al.*, 2009), voicing change has hardly been investigated in Brazilian Portuguese/English interphonology studies. For this reason, the main purpose of this research is to investigate and analyze the occurrence of voicing change as a phonological process in the production of BP learners of English, thus providing results which can be used to address this problem in L2 teaching. It is hoped that the application of the results of this study might make students aware of their own non-target pronunciation, so that they can act on it, and might affect the development of English teaching. In addition, the study may contribute to the discussion of the interdependency of proficiency level and speech production in a broad sense, and hence, help to understand the peculiarities of speech processing.

## 1.2 Objective of the investigation

The purpose of this study is to investigate the extent to which Brazilian learners of English resort to voicing change when producing /s/ and /z/. Based on previous studies (Silveira, unprepared manuscript; Zimmer, 2004), it was predicted that Brazilians would tend to rely heavily on the voicing assimilation process that is mandatory for the production of these sounds in certain phonological contexts in the L1. The phonological rules of BP determine that the consonants <s> and



<z> in word-final position assimilate to the voicing feature of the following sounds, being produced as voiced if followed by a voiced consonant or a vowel, and produced as voiceless if followed by a voiceless consonant or a pause. This characterizes regressive assimilation (Yavas, 2011), that is, a process in which the following sound influences the preceding sound. This study examines whether the phonological context following the target consonants influences the rates of voicing change as well as whether the silent –e grapheme affects the production of voicing change for intermediate and advanced students. In order to examine the effects of these three independent variables – following phonological context, spelling and proficiency level –, three research questions (RQ) guided the study:

RQ1: How does the level of proficiency influence the participants' production of the voicing contrast of /s/ and /z/ in word-final position?

RQ2: How does spelling affect voicing change with /s/ and /z/ in word-final position in the English samples provided by Brazilian Portuguese speakers?

RQ3: In what phonological contexts do Brazilian learners produce voicing change with the English sounds /s/ and /z/ in word-final-position?

Based on previous studies with BP speakers as well as with speakers of other languages (Fullana & Mora, 2009; Silveira, unprepared manuscript; Smith, 1997; Yavas, 1997; Zimmer, *et al.*, 2009; Zimmer, 2004), three different hypotheses (H) were proposed for this research. The following hypotheses were expected to result in answers to the RQs guiding this study:

H1: The performance of the participants classified as advanced would be better than those classified as intermediate; that is, advanced learners would not transfer the assimilation rule of BP as often as the participants classified as intermediate (Koerich, 1999, 2002; Silveira, 2012; Zimmer, 2004).

H2: Voicing would be more frequent with words spelled with the silent –e (e.g. *house*; *case*) than without this grapheme (e.g. *this*; *bus*). More specifically it was

expected that the sound /s/ would be voiced when the word was spelled with the silent –e (see details in Section 2.5). Moreover, devoicing would be less frequent with words spelled with the silent –e grapheme (e.g., *these*; *lose*) than without this grapheme (e.g. *does*; *moves*); that is, it was expected that the sound /z/ would be less frequently devoiced when the word was spelled with the silent –e grapheme (Silveira, 2009, 2012).

H3: Voicing change would occur in the following conditions: participants would voice the /s/ followed by a voiced consonant or a vowel, and devoice the /z/ followed by a voiceless consonant or a pause<sup>5</sup> (Cristófaros-Silva, 2010).

The present chapter introduced the main topic of this study, voicing change, raising relevant issues related to this topic and stressing the importance of this study to the area of phonetics and phonology as well as the area of L2 acquisition. Moreover, this chapter presented the objective of this study and also the research questions and hypotheses guiding this research. The following chapter reviews the relevant literature and covers the theoretical framework that gives support to the hypotheses proposed for this study.

---

<sup>5</sup> According to Smith (1997), native speakers of American English tend to devoice the final voiced consonants when followed by a pause. Moreover, Yavas (2011) states that some voiced consonants are only fully voiced when they are between vowels; in other places they are partially devoiced. Although this is considered a pattern in English, the pause variable will not be eliminated from the study, since it is important to analyze the production of Brazilian Portuguese learners of English in all phonological contexts proposed.

## CHAPTER II

### REVIEW OF LITERATURE

This chapter presents a concise overview of relevant issues of phonetics and phonology, as well as the theoretical basis that supports the hypotheses proposed for this research. More specifically, this section reviews the alveolar fricative sounds, studies on voicing change, the notion of cross-linguistic interference, the Markedness Differential Hypothesis (MDH) and Interlanguage Structural Conformity Hypothesis (SCH), the role of orthography and also the role of language experience on pronunciation.

#### **2.1 The alveolar fricatives in American English and Brazilian Portuguese**

The voiceless consonants in English, according to Ladefoged (2005), are produced with the vocal folds held apart so that they do not vibrate; the noise is made when the air is forced through a narrow opening. The consonant /s/, for example, is a voiceless fricative: voiceless because the vocal folds do not vibrate and fricative because the noise is produced by friction, that is, the resistance of the air as it rushes through a narrow opening. The voiceless fricative /s/ has a voiced counterpart /z/, the term voiced being used to describe the sounds produced by the vocal fold vibration. Both /s/ and /z/ are classified as alveolar sounds because they are produced with the blade of the tongue near the alveolar ridge.

Yavas (2011) adds that /s/ and /z/ are sibilants having high intensity (hissing), and possessing greater amounts of acoustic energy at higher frequencies. In addition, Yavas (2011) points out that the voicing feature needs careful attention, since the realization of this feature depends on the position of the sound in a word. In the words *zip* [zɪp] and *buzz* [bʌz], for example, the sound [z] is partially devoiced (hence the transcription with the diacritic mark ̥), because voiced consonants are partially voiced when in initial and final position, with very little vocal cord vibration. In the word *resume* [ʁəzʉ'm], on the other hand,

the sound /z/ is fully voiced, because, as Yavas adds, voiced consonants are only fully voiced in intervocalic position. He also points out that there are other characteristics that differentiate voiceless and voiced alveolar fricative sounds, such as the difference in length of the preceding vowel or sonorant consonant (liquids /l, ɹ/; glides /w, j/; nasals /m, n, ŋ/). That is, the vowel/sonorant that comes before a voiced alveolar fricative /z/ is longer than the vowel/sonorant that comes before its voiceless counterpart /s/. Moreover, there is another feature peculiar to alveolar fricatives. The consonants /s/ and /z/ can be palatalized and be produced as [ʃ] and [ʒ], respectively, when followed by a palatal glide /j/ (e.g. *I miss you* [aɪmɪʃju]; *I please you* [aɪplɪʒju]) (Yavas, 2011, p. 64). Hence, [ʃ] and [ʒ] can sometimes be considered allophones of /s/ and /z/, respectively.

Regarding the production of /s/ and /z/ in word-final position in some of the words used in this study (*does, goes, moves*), it is worth mentioning that the pronunciation of the <s> morpheme in these examples depends on a progressive assimilation; that is, the previous phonological context influences the production of the next (Yavas, 2011). The conjugation of the verbs in third person asks for an additional <s>, which is produced as /s/ when the previous segment is voiceless, and produced as /z/ when it is a vowel or a voiced consonant. The previous segments of the words used (verbs in third person) were a vowel and a voiceless consonant, hence, the <s> morpheme is produced as /z/.

The BP consonantal system also includes the phonemes /s/ and /z/, which are classified as alveolar fricatives as well, /s/ being voiceless and /z/ voiced. However, as shown in Table 2, consonants and vowels affect adjacent segments in BP, and in this sense, one segment can be modified by its phonological context (Cristófaró-Silva, 2010; Netto, 2001). Assimilation, for example, is a type of modification that a segment can suffer undergo because of its phonological context. In this case, some articulatory feature of one segment is shared by another adjacent segment (e.g., ‘cuspe’ [ˈkʊspɪ]; ‘vesga’ [ˈvezgɐ]). In the latter example, the segment /s/ assimilated the voicing of the following segment; that is, the segment /s/ in syllable-final position is devoiced

[s; ʃ] when followed by a voiceless consonant and voiced [z; ʒ] when followed by a voiced consonant. Therefore, /s/ and /z/ possess the four allophones [s, ʃ, z, ʒ], which are conditioned by the linguistic and non-linguistic environments, according to the BP dialect (Monaretto; Quednau & Hora, 1996; Cristófaró-Silva, 2010). When /s/ occurs at the end of a word, it is more common to produce it as the voiceless allophones [s] or [ʃ], depending on the speaker's BP dialect (Cagliari, 2007). The former, for example, is more common in the São Paulo dialect, and the latter in the dialect of Rio de Janeiro. According to Cagliari, there are also some BP speakers from Rio de Janeiro who start producing a voiceless alveolar fricative and end producing a voiceless palatal-alveolar fricative, which can be transcribed as /sʃ/ (e.g. *mas* [mas; maʃ; masʃ], 'but'). A similar process can also occur with voiced sounds (e.g. *mesmo* ['mezmʊ; 'meʒmʊ; 'mezʒmʊ], 'same'); thus [zʒ] and [sʃ] can also be considered allophones of the consonant <s>. Thus, BP has the following allophones for /s/ and /z/:

**Table 2**

*Allophones of /s/ and /z/ in BP (based on Cagliari's (2007) examples)*

Phoneme	Context	Allophones	Examples
/s/	Syllable-initial	[s]	<i>sapo</i> ['sapʊ], <i>massa</i> ['masa] 'frog', 'dough'
	Followed by a pause or a word or syllable beginning with a voiceless consonant	[s], [ʃ], [sʃ]	<i>mas</i> [mas], <i>mosca</i> ['moskə] 'but', 'fly', <i>meus olhos</i> ['meuz'ɔlus], <i>mesmo</i> [mezmʊ] 'my eyes', 'same'
/z/	Followed by a word or syllable beginning with a vowel or a voiced consonant	[z], [ʒ], [zʒ]	<i>alfazema</i> [aufa'zemə], <i>zarpar</i> [zar'pah] 'lavender', 'set sail'

## 2.2 Voicing change

Voicing change, according to Silveira (unprepared manuscript), is a process that is clearly exemplified by the /s/ and /z/ assimilation rules in BP, which are often transferred to English by Brazilians. As mentioned in Section 2.1, in BP when the alveolar fricative occurs before a pause, it is produced as a voiceless sound, although, if the segment /s/ in syllable or word-final position is followed by a voiced segment, the /s/ will necessarily be produced as a voiced sound (i.e., [z], [ʒ] or even [zʒ]), by regressive assimilation to the following segment (Netto, 2001). Silveira (unprepared manuscript) also explains that the transfer of voicing change to English is highly influenced by spelling, which delays the target-like production of English /s/ and /z/. Moreover, in Silveira's study, voicing change occurred less often with /z/ in the silent *-e* condition, that is, when a word was spelled with a final <e> grapheme (e.g., 'nose' [noʊz]). In contrast, the silent *-e* caused more voicing change for /s/, especially when the target sounds in this condition were spelled with <s> and were preceded by a vowel grapheme (e.g., 'mouse', 'house'). The voicing of /s/, in this situation, occurs in BP speakers' production because of the orthographic influence of BP rules (to be discussed in Section 2.5), considering that the grapheme <s> is produced as [z] when followed and preceded by a vowel (e.g., 'caso' ['kazu]). However, there is not much research on voicing change in Brazilian Portuguese-English interphonology. In most studies conducted on this subject, the L1 of the participants was not Brazilian Portuguese, and the focus was on devoicing, which occurs when a voiced word-final consonant is pronounced as a voiceless sound, for example, the word *dog* /dɔg/ being pronounced as [dɔk], or *does* /dʌz/ pronounced as [dʌs], as occurred in studies conducted with participants whose L1 was German (Grijzenhout, 2000; Piroth, *et al.*, 2003; Simon, 2010; Smith, *et al.*, 2009; Smith, 1997).

Voicing change has been the focus of English interphonology studies with speakers whose L1 were German and other languages, such as Dutch, Catalan and Spanish. Simon (2010), for example, examined the productivity of voicing and devoicing rules in Dutch-English

interlanguage. She explains that in Dutch coda obstruents can be devoiced in final position and suffer other voicing assimilation processes, depending on the phonological context; that is, obstruents can be devoiced in syllable-final and in word-final position, except when followed by a voiced stop, a vowel or a sonorant consonant (e.g., *rond* [t] ‘round’; *ronde* [d] ‘round (adj.)’), but this does not happen in English. Simon (2010) predicted that if voicing change was highly frequent in the L1, consequently it would be transferred into the L2. Hence, she analyzed the speech of casual Dutch and English conversation of native speakers of Dutch as well as data from these participants reading sentences in Dutch and English containing minimal pairs (e.g., *bet*–*bed*, *bit*–*bid*, and *bite*–*bide*), which revealed that there are differences in how voicing change occurs. These differences were explained by taking into account the universal principles of implicational markedness (discussed in Section 2.4). The degree of transfer of intra-word processes, such as final devoicing, was compared to the cross-word assimilation processes, such as voice assimilation. For this result, a crosslinguistic hypothesis proposed by Zsiga (2003, as cited in Simon, 2010) was used, which predicts that native speakers of Dutch that are learning English will “transfer intra-word final devoicing and also cross-word voicing assimilations, or will transfer only final devoicing and not voicing assimilations, but will not produce voicing assimilations and no final devoicing in L2 English” (Simon, 2010, p. 64). The analysis of the corpus showed that all processes produced in Dutch were transferred to the L2, not corroborating Zsiga’s hypothesis. However, Simon (2010) argued that this hypothesis was not confirmed because learners received explicit instruction on the absence of final obstruent devoicing in English, and also because of the awareness of learners of their realizations. She concluded, then, that the voiced realizations in Dutch are the result of prevocalic voicing assimilation, but in English they may be the result of transfer of this L1 assimilation rule.

Another study on voicing change was conducted by Smith, Hayes-Harb, Bruss and Harker (2009). After noting that German has a phonological pattern of word-final consonant devoicing, in which voicing contrast is neutralized in speech; that is, there is no difference between the production of /k/ and /g/, for example, in final position, questions were raised in relation to how well native speakers of German learning English would produce a voicing contrast in English considering the neutralization of the contrast, and especially how

German speakers would produce similar word pairs in the two languages (e.g., English: *rod / rot*; German: *Rad / Rat*). In their study they examined the speech of 13 native speakers of German producing words in both languages and 13 native speakers of English producing English words. The target words of this investigation were six minimal pairs that are phonologically and/or orthographically similar in German and English (German pairs: *Bad/bat*, *Leid/leit*, *Log/lock*, *Rad/Rat*, *seid/seit*, *Tod/tot*; English pairs: *bad/bat*, *lied/light*, *log/lock*, *rod/rot*, *side/sight*, *toad/tote*). Through acoustic analysis they observed that the native speakers of German showed more evidence of final voicing distinction when producing English words than for phonologically similar German words. Nevertheless, native speakers of German produced weaker acoustic cues to word-final voicing when speaking English than the native English speakers did. After the acoustic analysis, an auditory word identification task assessed intelligibility of English speech production of German speakers and native English speakers for German and English listeners. The results demonstrated that German listeners found native English speech to be more intelligible than German speakers of English for the English word-final voicing contrast. German listeners also did not find German speakers of English more intelligible than native English listeners did.

Fullana and Mora (2009) conducted a study on voicing change with native speakers of Catalan and Spanish. They investigated the perception and production of voicing contrasts in English word-final obstruents /s/-/z/, /p/-/b/, and /t/-/d/ by Catalan and Spanish speaking advanced learners of English in a formal learning setting. They also examined the effects of starting age of L2 learning and experience in English on the perception and production of English voicing contrasts. They claim that “Romance language native speakers have difficulty in perceiving and producing English consonant voicing in word-final position”, due to “the lack of word-final consonants in their L1 or to the non-occurrence of voiced consonants in word-final position” (Fullana & Mora, 2009, p. 207). As a result, Romance language speakers often produce specific sounds based on the L1 strategies, and they end up devoicing voiced obstruents in word-final position, and to a lesser degree, deleting those sounds. Their study was based on Flege’s Speech Learning Model (SLM), which affirms that “the earlier learners start acquiring the target language, the more likely they will be to detect phonetic differences between L1 and L2 segments” (as cited in Fullana & Mora, 2009, p. 208), and this may result in the creation of new



phonetic categories for L2 consonants. For the results, the researchers expected that the learners who started learning the L2 before the age of 8 and who had a greater amount of exposure to English would have better production results, and that the learners would show some perceptual difficulty in discriminating the word-final voicing contrasts /s/-/z/, /p/-/b/, and /t/-/d/. However, the results showed that neither starting age nor language experience had a significant effect on the correct discrimination scores for the three consonant contrasts. In addition, the percentage of voiced consonants that were fully devoiced (i.e., produced with no vocal cord vibration) was not very different from the percentage of voiceless consonants that were produced, which means that the participants' production of voiced stops and fricatives without vocal cord vibration conforms to the predicted production difficulties for Romance language speakers. The findings of the study pointed to the need for specific formal instruction that deals with the perception and production of English sounds.

Zimmer and Alves (2008) conducted a study with eight Brazilian female learners of English and three female native speakers of English focusing on two acoustic cues in the analysis that would distinguish voiceless from voiced stops in English: previous vowel length and amount of voicing in the final stop. In this research the authors believed that terminal devoicing was an interlanguage process where students generalized the rules of L1 transferring them to the L2, through grapho-phonetic-phonological transfer or phonetic-phonological transfer (Zimmer & Alves, 2008). Participants recorded minimal pairs, such as *bad* – *bat*, *bob* – *bop*, *rag* – *rack*, using a carrier sentence (Say \_\_\_\_). Results showed that all words presented a considerable difference concerning the percentage of voicing in the closure between the two groups, but more important, Brazilian participants' production did not show a neutralization of contrast between voiceless and voiced final stops. Regarding the vowel length preceding the obstruents, results showed a considerable difference between the two groups for only three of the six minimal pairs. Besides, in the Brazilian group's production, the length of the vowels that preceded voiceless obstruents was not reduced according to English patterns, but before voiced obstruents the vowel length was almost native-like. The researchers also noticed that the difference in vowel length preceding the obstruents varied depending on the target pair.

The studies reviewed in this section show the occurrence of voicing change in different languages, such as German, Spanish,

Catalan, Dutch, Brazilian Portuguese, and in different contexts, such as obstruents and sibilants in final position. Another point presented in this section is that the L1 seems to influence the production of voicing change in all the studies reviewed. In addition, this section also shows the importance of this type of research for the Second Language Acquisition (SLA) and Foreign Language Acquisition (FLA) areas, regarding the production and the perception of English sounds. The next section addresses one of the theoretical issues that might help us understand the findings of the present study: language transfer.

### **2.3 Cross-linguistic interference**

Trying to guess a speaker's origin based on his/her accent when speaking an L2 is common practice and, according to Odlin (1990), reveals how aware people are of L1 interference (or cross-linguistic influence) in L2 speech.

The notion of language transfer or cross-linguistic interference was thoroughly discussed by Odlin (1990), and it is an important concept used to develop this research. According to Odlin, language transfer can be “the result of falling back on old knowledge”, which means that instead of creating new language knowledge for the L2, the learner might resort to the L1 knowledge when L2 knowledge is missing. Language transfer can also be considered the influence that results from differences and similarities between the target language and any other language that has been previously acquired, especially the L1. Besides, language transfer can be considered an important issue of second language acquisition. However, according to Odlin, the role of language transfer in second language acquisition has been a controversial issue, in that not all researchers agree as to the degree of cross-linguistic influence. Nevertheless, the problem of transfer is an important issue for language teachers to consider. In fact, if teachers take into consideration the differences and similarities between different languages and different cultures, teaching can be more successful. Odlin (1990) states that research with results that show the same mistakes produced by different learners of the same L1 needs to be taken into consideration, since it might “help teachers to see better what may be difficult or easy for the person who is learning the language they are teaching” (Odlin, 1990, p. 4).

Regarding phonetic and phonological transfer, Odlin (1990) highlights that the same sound in two different languages may be very different from each other in terms of articulatory and acoustic characteristics, and when a learner of an L2 tries to produce a specific L2 sound, this production will be neither native-like nor target-like, but something in between the two sounds. As an example, he cites the difference between the length of the consonant /d/ in American English (AE) and Saudi Arabian Arabic (SAA). Odlin (1990) explains that in AE, this sound is shorter in word-final position (e.g., ‘bad’) compared to the SAA sound in the same position. Therefore, an Arabic speaker would produce this sound longer than the AE /d/ and shorter than the SAA /d/, thus, intermediate between the two sounds. Another important issue that Odlin mentions is the importance of a contrastive analysis of the cross-linguistic frequency of phonemes, that is, the frequency in which the phonemes occur in different languages. The AE phonemes /ð/ and /θ/ (e.g., ‘this’ /ðɪs/; ‘think’ /θɪŋk/), for example, do not exist in BP; therefore, these two sounds would be problematic for a Brazilian learner of English to produce. Likewise, a BP sound that does not exist in the AE sound system, the phonemes /ɲ/ and /ʎ/ (e.g., *banha* /ˈbɐɲa/ ‘fat’; *palha* /ˈpɐʎa/ ‘straw’), for example, would also be difficult for an American learner of Portuguese to produce. However, the degree of difficulty of these sounds would also depend on their frequency and occurrence in other languages, as we shall discuss in Section 2.4.

Odlin (1990) discusses voicing change as well, specifically devoicing, which he explains as being the result of turning certain voiced consonants at the end of words into voiceless ones in some languages. He uses as examples the German words *Rad* (‘wheel’) and *Rat* (‘advice’), where the final consonant in the former word is pronounced the same as the final consonant in the latter word, and it is believed that, since there is no distinction between these two final consonants in German, an L2 voiced consonant would become voiceless whenever it appears at the end of words.

Odlin mentions that Eckman (1981a, as cited in Odlin, 1990) found some speakers of Cantonese and Spanish who devoiced word-final stops in English, even though this does not occur in their L1, concluding that, “in some acquisition contexts, the devoicing rule has an existence somewhat independent of both L1 and target language” (Odlin, 1990, p. 122). Considering this, the independence of devoicing

from the rules of the L1 and L2 may imply that, in this case, language transfer did not influence devoicing, and Odlin explains that Eckman attributes these occurrences to syllable structure typology and universal markedness (see next section). Odlin then mentions that the devoicing of consonants at the end of words can also occur in the speech of speakers whose L1 does not have a devoicing rule for a different reason. He comments that Edwards (1979, as cited in Odlin, 1990) studied the acquisition of the L1 by small children, and found out that there is a tendency for the children to devoice the consonant at the end of words, such as the /z/ in shoes /ʃu:z/, which becomes [ʃu:s], as he exemplifies. More recently, Smith (1997) states that the voiced alveolar fricative /z/ is difficult to produce, and for this reason, it is expected that even English native speakers would simplify their production by devoicing them.

In this section I have reviewed important points related to language transfer, based on Odlin's work (1990). The role of the L1 influence when acquiring an L2, the importance of a contrastive analysis of two languages in order to find out the differences and similarities between them, predicting the problems that an L2 learner would face, and the devoicing occurrence without the interference of the L1, are examples of important issues covered in this section. In the next section I will discuss Eckman's hypotheses and their implications to the teaching and learning of an L2.

## **2.4 Structural Conformity Hypothesis Vs. Markedness Differential Hypothesis**

As explained in the previous section, although many studies have shown that the L1 influences the production of L2 sounds (Fullana & Mora, 2009; Piroth, *et al.*, 2003; Simon, 2010; Smith, *et al.*, 2009; Zimmer & Alves, 2008), L1 transfer does not account for all types of non-target pronunciation. Moreover, interphonology research has frequently resorted to the notion of markedness to explain the development of L2 phonology, as in the case of the Markedness Differential Hypothesis and the Structural conformity Hypothesis, which are the topics covered in this section. Eckman (2009) explains the notion of markedness by stating that "a structure X is typologically marked relative to another structure, Y, (and Y is typologically unmarked relative to X) if every language that has X also has Y, but every

language that has Y does not necessarily have X” (Gundel *et al.* 1986, p. 108, as cited in Eckman, 2009).

The Markedness Differential Hypothesis (MDH) and the Structural Conformity Hypothesis (SCH) were proposed by Eckman at different moments. The former, proposed in 1977, stated that “a phenomenon A (in some language) is more marked than B if the presence of A in a language implies the presence of B; but the presence of B does not imply the presence of A” (Eckman, 1987, p. 60), which can be related to the level of difficulty that learners have when acquiring an L2; that is, some elements are more difficult or later acquired than others due to their markedness status. For example, BP learners’ interphonology might contain /s/ clusters in word-final position (‘past’ [pæst]), but not in word-initial position (‘stop’, pronounced as [istop]). This initial /s/ clusters are more marked than final clusters in the world’s languages because of the jump of sonority of the consonants (/s/ = 3; /t/ = 1) (Yavas, 2011), as well as the non-existence of this type of cluster in some languages. Thus, learners who produce initial /s/ clusters accurately, also do so with word-final clusters, but not vice-versa (Kirk & Demuth, 2005). As could be perceived, the MDH focuses on the differences between two languages (native language and target language), which limits the use of this hypothesis to explain non-target occurrences with structures that exist in both languages. Therefore, another hypothesis, the SCH, was proposed in 1991 as a complementation and at the same time a response to the criticism against the MDH, stating that “the universal generalizations that hold for the primary languages hold also for interlanguages” (Eckman, 1991; 2009), and interlanguage, in this case, is the knowledge that the learner has of the L2. Eckman (2009) states that the SCH is not connected to any school of thought, hence, it would go along with any research that uses linguistic universals, since the SCH affirms that “interlanguages and primary languages are similar in at least one important respect: they both obey the same set of universal generalizations” (Eckman, 2009, p. 13). To illustrate what he just mentioned, Eckman cites several studies such as Eckman (1991), Carlisle (1997, 1998) and Eckman and Iverson (1994), which focused on consonant clusters in onsets or codas, where the L2 allowed a higher number of clusters and more marked clusters than the L1. All studies cited supported the SCH, considering that in each study the interlanguage grammars contained more errors with the

more marked clusters, showing that the acquisition of L2 clusters is influenced by markedness.

This study will base part of its hypotheses on the MDH and the SCH. With the support of the MDH, it would be possible to predict the difficulties that a learner of a specific language will have by comparing the structure of the learner's L1 and of the L2 being learned. Moreover, for Eckman (2009), the MDH refers to possible learners' difficulty when acquiring a foreign language; that is, focusing on the areas of difference between the L1 and the L2, the marked structures would be more difficult than the corresponding unmarked structures. In other words, a feature of the L2 that is different from the L1 and is more marked in the L2 (i.e., less frequent, later acquired), will consequently be more difficult for the learner to acquire. In BP, for example, there are not any stops in final position. The sequence VC (vowel-consonant), then, is more marked than CV (consonant-vowel), since the former, containing stop consonants, is not part of the BP word structure. Therefore, one of the phenomena that may occur in this case, when a native speaker of BP is learning English, is vowel paragoge (Yavas, 1994), which is the insertion of an extra vowel, and in this case, the vowel will be inserted after the final stop (i.e., VC becomes VCV). Koerich (2002) explains that loan words ending in consonants tend to be incorporated into BP with the addition of a final /i/ represented in the orthography of the language by 'e' as in '*clube*' from club, and in '*surfe*' from surf.

Eckman (1987; 2009) explains that the MDH can predict the areas of difficulty that a language learner will have, such as:

- (a) those areas of the target language which differ from the native language and are more marked than the native language will be difficult; (b) the relative degree of difficulty of the areas of difference of target language which are more marked than the native language will correspond to the relative degree of markedness; and (c) those areas of the target language which are different from the native language, but are not more marked than the native language will not be difficult (Eckman, 1987, p. 61; 2009, p. 6).

In other words, the difficulties that the learner of an L2 will face depend on the differences between the L1 and the L2 and also on the degree of markedness of the L2 structure. However, Eckman (1991,

2009) argues that the differences between the L1 and the L2 used in the MDH are necessary, but they are not sufficient, considering that, although this hypothesis claims that marked structures are more difficult than the unmarked structures, not all differences between L1 and L2 will cause difficulty, and not all difficulties will be caused by the differences between L1 and L2. In addition, Eckman (2009) argues that one of the problems of MDH is that the hypothesis can make predictions only “when the marked and unmarked structures in question occurred in an area of difference between the NL and TL” (p. 11), hence, if the structures were found in both languages, then, the hypothesis cannot make any prediction. In this sense, Eckman (1991) argues that the SCH is a stronger hypothesis since it makes predictions based on implicational universals (universal grammar), not taking into consideration the differences between the learner’s L1 and the target language.

Eckman’s (1991, 2009) SCH, then, is related to universal rules, and the hypothesis affirms that the universal generalizations that are appropriate to L1s are also appropriate to interlanguages. In addition, according to Eckman (2009), this hypothesis affirms that interlanguages and primary languages (L1) are similar because they follow the same set of universal rules. Thus, evidence that could support the SCH could be an interlanguage pattern that is not similar to L1 or to L2, but yet follows the universal patterns found in the world’s languages. Furthermore, the SCH argues that interlanguages will follow L1 universals, and in this case, if the universal principle affirms that a voice contrast in the end of a word implies a voice contrast in the middle and beginning of a word in the L1, for example, then this must be true for interlanguages as well (Eckman, 1991).

This section reviewed two hypotheses proposed by Eckman at two different times in his career, the MDH, which predicts the problems and difficulties learners will face with structures different from their L1, according to the markedness status of the L2 structures, and the SCH, which expects universal generalizations regarding markedness to govern interlanguage. These two hypotheses may help us to understand the results in relation to the role of the phonological context in the production of /s/ and /z/ (see RQ3). As explained in Section 2.1, both BP and English have [s] and [z] in word-final position (which implies that both languages also have these sounds in initial and medial position). However, these sounds have different allophones, depending on the phonological environment following them. In English, /s/ is

always produced as a voiceless sound, different from BP, in which it can be voiced or voiceless, depending on the following phonological context. Furthermore, the English /z/ can be fully voiced (between vowels) or partially devoiced (in syllable-initial and word-final position) (Yavas, 2011). In BP, /z/ can also be voiced and devoiced depending on the following sound. A universal generalization about the sounds being analyzed here is that [z] is more marked than [s], because voiced sounds are less frequent in the world's languages. If the SCH prediction is correct, the English words ending in [z] will yield more non-target pronunciations than the words ending in [s] in the BP speakers' interphonology. Consequently, we would expect it to cause no problems to the BP learners of English. However, the English /z/ is more likely to cause pronunciation problems, since it is always voiced or partially voiced.

Table 3 summarizes the predictions based on the premises of the MDH and the SCH.

**Table 3**

*Summary of the predictions based on the MDH and the SCH*

	/s/	/z/
MDH	Not marked. /s/ will cause no problem.	More marked. /z/ will cause mispronunciation.
SCH	Interphonology will contain no or few voicing change, because voiceless sounds are less marked in word-final position.	Interphonology will include cases of devoicing because voiced sounds are more marked in word-final position.

As can be seen in Table 3, the predictions made by the MDH and the SCH are very similar, with both pointing out that /s/ will be easier to acquire than /z/. Thus, when discussing the results for RQ3, I will not make a distinction between the predictions of the two hypotheses; rather, I will refer to the role of the SCH, as this hypothesis is broader than the MDH. The next section will present the issue of orthographic influence on L2 speech production as well as studies that testify this influence.



## 2.5 The influence of orthography

One of the aspects that were taken into consideration in the present study was the influence of orthography on the pronunciation of L2 sounds. Previous studies (Silveira, unprepared manuscript; 2012; 2009; 2007; 2004; Zimmer, 2004) have shown orthography as a variable influencing the pronunciation of English sounds, by BP learners, especially because of reliance on L1 spelling-sound correspondence. The results obtained by these studies will be reviewed in this section.

To start with, Zimmer's (2004) study investigated the L1–L2 transfer of grapho–phonic–phonological knowledge, showing that it is not only phonological knowledge<sup>6</sup> that is transferred to L2 speech, but also the principles of the L1 alphabetic systems. Thus, when Brazilian learners are speaking or reading in the L2, they have a tendency to rely on the sound-spelling correspondence of their L1, due to their rooted L1 alphabetic knowledge.

Silveira (2004) tested the hypothesis that orthography is an important variable that contributes to the occurrence of vowel epenthesis in English words ending in a silent –e grapheme (e.g., *take*). She collected data from Brazilian EFL learners, separating them in two groups: the control group, who participated in the pre and post-test without any treatment, and the experimental group, who also participated in the pre and post-test, receiving instruction and exercises related to the silent –e grapheme. Her results show that orthography seems to be a relevant factor in the rate of vowel epenthesis, since words ending with a consonantal grapheme followed by a silent ‘e’ caused higher epenthesis rates than those words ending only in a consonantal grapheme.

In a case study, Silveira (2007) investigated how orthography could explain the pronunciation difficulties that Brazilian learners were having when producing English words. She analyzed the speech of one participant who started learning English as an adult. Data were recorded on two different situations when the participant was having private lessons with a native speaker of British English (free–speech task), and

---

<sup>6</sup> Phonological knowledge is defined in the present study, as well as in Zimmer (2004), as the knowledge of speech sounds that adults and children are exposed to when learning the L1 and the L2, relating them to orthographic representations of the words.

in another occasion reading a text aloud (reading-aloud task). The recordings were analyzed with the intention of identifying consonants that contained non-target pronunciation caused by the transfer of the L1 sound-spelling correspondence. Moreover, she checked if the consonants were pronounced in a different way in the free-speech and reading-aloud tasks. The results presented in this study suggest that there is a strong effect of L1/L2 grapho-phonico-phonological transfer, that is to say that orthography had a great influence on the non-target production of the participant of this research.

In addition to these two studies, Silveira (2009) conducted another study analyzing the role of both orthography and task-type. This study follows Young-Scholten and Archibald (2000) recommendation to test the effects of task-type and input-type, considering that most L2 learners are literate adults whose contact with the L2 includes a great deal of written material, especially for those who are not in a country where the L2 is spoken. According to Silveira (2009), the access to the orthographic representations of words may lead learners to rely heavily on L1 spelling and pronunciation correspondences when pronouncing L2 words.

In 2012, Silveira also analyzed the effect of orthography, among other variables, on the pronunciation of final consonants by BP learners of English. She discovered that the existence of a final silent *-e* grapheme might reduce the realization of certain L2 phonological processes (i.e., vocalization of nasal and delateralization), and conduce to a more target-like production of the word-final consonants (e.g., ‘name’, ‘whale’). Nevertheless, her study shows that the silent *-e* condition might also induce the BP learners of English to resort to vowel paragoge more frequently, hindering the target-like production of some word-final consonants.

Finally, concerning the occurrence of voicing change, Silveira (unprepared manuscript) explains that the occurrence of voicing change in English is influenced by orthography, since it hinders the target-like production of word-final /s/ and /z/. According to the author, voicing change occurred less frequently with /z/ when followed by the silent *-e* grapheme (e.g.: ‘nose’ [nouz]). On the other hand, the silent *-e* grapheme caused more voicing change for /s/ (e.g., ‘mouse’). According to Silveira (unprepared manuscript), the voicing of /s/ (as well as of /z/) occurs in BP speakers’ speech due to the orthographic influence of BP

rules, since the grapheme <*s*> is produced as /z/ when followed and preceded by a vowel.

In conclusion, based on the aforementioned studies, it can be said that orthography plays a role in L2 pronunciation. That is to say, BP learners tend to rely on the same sounds they use when speaking or reading in their L1, for they are rooted in their L1 alphabetic knowledge. This fact occurs more frequently when reading; for this reason, it is good to pay attention to the task-type chosen to collect data. Moreover, the presence of a final silent *-e* grapheme seems to inhibit the production of certain phonological processes, and lead to a more target-like production of word-final consonants. However, the silent *-e* condition might also hinder the target-like production of some word-final consonants, since it induces the participants to resort more often to vowel paragoge. This section reviewed important studies which considered orthography as a variable. In the next section the focus will be on the effect of language experience, which is also an important variable that influences learners' performance.

## **2.6 The effect of the level of proficiency**

Many variables are likely to affect the performance of the participants in this study, and language experience is one of them. It is expected that language experience may affect the frequency of voicing change occurrence in the speech produced by L2 learners in the intermediate and advanced group. Several studies have shown significant correlations between the level of proficiency and the production of L2 speech (Koerich, 1999; 2002; Silveira, 2012; Zimmer, 2004). The present section reviews these studies, showing how the level of proficiency affects student's performance.

To begin, regarding the effect of the level of proficiency on the relationship between perception and production, Koerich (2002) comments that Flege's (1999), and Flege and Schmidt's (1995) studies, among other studies, show significant correlations between the two abilities for highly experienced L2 speakers (those with longer experience in the L2 country), whereas the correlations for non-experienced speakers did not reach significance. In addition, Koerich (1999) investigated the effect of L2 proficiency on the perception of English word-final consonants by BP speakers. She believed that the level of proficiency would exert a positive effect on the participants'

performance. Her focus was on the discrimination of CVC and CVCV English words by Brazilian students. The results indicated that L2 proficiency had an effect on perception, considering that the percentage rates on the discrimination between CVC and CVCV words increased with level of instruction.

Another study (Silveira, 2012) examined how proficiency level, among other variables, would influence the production of English word-final consonants by Brazilians living in an L2 context. Silveira (2012) analyzed the production of three English word-final consonants ([m, n, l]), checking the occurrence of phonological processes resulting from transfer of L1 sound-spelling correspondence into the L2. In addition, she investigated if transfer was related to learners' proficiency level as well as their background (i.e., length of residence in the L2 country, age of arrival in the L2 country, education, chronological age, use of English with native speakers, and attendance in EFL and ESL courses). The results show that the rate of L1 phonological process use decreases radically as proficiency level increases. It seems that it is the development of L2 proficiency that induces the production of English word-final consonants in a more target-like fashion.

The last study reviewed in this section was conducted by Zimmer (2004). She investigated the rate of use of graphic-phonological transfer processes from BP (L1) into English (L2) among 156 Brazilian learners of English of different English proficiency levels (i.e., 50 at basic level, 57 at intermediate level, 34 at upper-intermediate level, and 15 at advanced level). All the participants had to take a placement test (TOIEC) in order to participate in the research. Zimmer's focus was on the use of phonological processes transferred from BP into English during a task of naming words and nonwords, as well as the differences in the occurrence of the phonological processes according to the participants' proficiency level. She grouped all the processes according to their rate of use; thus, the order is the following: (1) consonant cluster simplification (e.g., 'school' [isku] instead of [skul]); (2) schwa paragoge (e.g., 'dog' [dogi] instead of [dog]); (3) consonant change (e.g., 'the' [dø] instead of [ðə]); (4) vocalization of final nasals (e.g., 'beam' [biỹ] instead of [bi:m]); (5) terminal devoicing (e.g., 'does' [dʌs] instead of [dʌz]); (6) vowel assimilation (e.g., 'put' [pʌt] instead of [put]); (7) deaspiration (e.g., 'tea' [ti:] instead of [tʰi:]); (8) delateralization (e.g., 'well' [wew] instead of [wel]); (9) velar

consonantal paragoge (e.g., ‘wing’ [wɪŋg] instead of [wɪŋ]). Processes 1, 2, 3 and 4 were classified as processes of low rate of use compared to the other processes analyzed in this study. Processes 5 and 6 were classified as processes of intermediate rate of use. Processes 7, 8 and 9, in turn, were classified as processes of high rate of use by Brazilian learners of English, even among the most proficient learners. The results show that the rate of inappropriate phonological process use decreases as the level of proficiency increases, but the difference of rates between the different levels of proficiency varies according to the phonological process. The consonant cluster simplification process, for example, achieved a rate of 16.7% for the basic level and 0.0% for the advanced. The delateralization process, in turn, obtained a rate of 89.7% for the basic level and 54.4% for the advanced level. The terminal devoicing process, which is the focus of the present study, achieved a rate of 22.9% for the basic level, while the advanced level obtained a rate of 18.5%.

It must be noted that measuring the level of ‘language experience’ can sometimes be considered difficult since it takes into consideration different variables, such as writing production, language background, and amount of exposure and use of the language per day/week, along with other variables, such as evaluators’ profile and number of evaluators, which can also influence the measurement of language experience (Silveira, 2011a). Other times, L2 proficiency level can be assessed through specific tests, or determined according to specific criteria (e.g. TOEFL, IELTS, and Cambridge). In Flege and Schmidt (1995), for example, L2 proficiency was characterized by degree of perceived foreign accent in English sentences judged by the researchers conducting the study. Since many studies in this field were conducted in naturalistic settings, that is, with immigrants in countries where the target language was spoken as the L1, length of residence in the country was taken as the criterion to measure the level of proficiency.

In this research, in order to investigate the influence of language experience on pronunciation development, language experience was measured by evaluating the learners’ profiles in terms of how long they had been studying the L2, whether they had spent time in an English-speaking country, and how much they reported using English on a weekly basis (see Section 3.1 for details).

This section reviewed important interphonology studies that take the level of proficiency into consideration (Koerich, 1999; 2002;

Silveira, 2012; Zimmer, 2004). Based on the findings of those studies, we can assume that the level of proficiency affects the learners' production as well as perception of L2 speech. We also observed that the rates of phonological processes transferred from L1 rules decrease as the level of proficiency increases, and the present study is expected to yield similar results. The next section will cover another variable that is also expected to affect learners' performance: the phonological context, which, according to BP assimilation rules, tend to affect the production of adjacent sounds (Cristófaró-Silva, 2010).

## **2.7 The influence of phonological context**

It is believed that the phonological context might influence the pronunciation of adjacent sounds, especially because of the transfer of L1 phonological rules. Several studies have considered the phonological context as a variable (Carlisle, 1991; Edge, 1991; Fullana & Mora, 2009; Silveira, unprepared manuscript; Simon, 2010; Smith. Hayes-Harb, Bruss & Harker's, 2009; Zimmer & Alves, 2008). Likewise, one of the research questions of the present study addresses the phonological context as a variable that influences the occurrence of voicing change with /s/ and /z/. Thus, this section will review previous studies that took the phonological context into consideration, explaining why I am giving especial attention to this variable as well.

The first study mentioned in this section is not concerned with the occurrence of voicing change, but with the role of phonological context in the production of L2 sound sequences. Carlisle (1991), in a study with native speakers of Spanish living in the USA, examined the occurrence of vowel epenthesis before three word-initial onsets of the form /sC/ (i.e., /st/, /sk/, and /sp/), checking if this occurrence was influenced by the phonological context preceding the cluster (word-final consonants, word-final vowel, and silence). Data were collected through the reading of topically unrelated sentences. He observed that participants inserted a vowel before all three onsets, which provided evidence that they were transferring the syllable structure conditions and the rule of epenthesis from their L1. Carlisle also observed that the occurrence of vowel epenthesis before the English onset /sC/ was conditioned by the phonological context, occurring significantly more frequently when the /sC/ cluster was preceded by consonants than by vowels.

Edge (1991), focused on terminal devoicing of voiced obstruents (i.e., /b, d, g, v, z, ʒ, dʒ/), taking the phonological context (i.e., before a pause, a vowel, a voiced consonant, and a voiceless consonant) into consideration. She analyzed story-telling and oral reading data from a group of native speakers of Japanese and another group of native speakers of Cantonese. Her results showed that most cases of devoicing were found before a pause. The next environment that yielded a high rate of devoicing was the voiceless consonant, followed by the voiced consonant. Finally, the vowel following the target consonants was the least propitious environment for devoicing of final obstruents.

Additionally, Fullana and Mora (2009), with one group of native speakers of Catalan and another group of Spanish advanced learners of English, investigated the perception and production of voicing contrasts in English word-final obstruents (i.e., /s/-/z/, /p/-/b/, /t/-/d/). They predicted that Romance language native speakers would have problems in perceiving and producing English consonant voicing in word-final position because there are no voiced consonants in word-final position in their L1. The results of their study confirmed that the participants devoiced the voiced obstruents in word-final position, according to the predicted production difficulties for Romance language speakers.

Moreover, Silveira (unprepared manuscript), tested the occurrence of voicing change in three different phonological contexts (i.e., followed by a vowel, a consonant, and a pause). Her results show that English /s/ was frequently voiced when her BP participants were reading the words ‘us’ [ʌz] and ‘chess’ [tʃɛz] followed by words beginning with a voiced consonant. One interesting point she mentions is that the <s> grapheme can be pronounced as [s] or [z] in BP, but the *ss* grapheme is always realized as [s] (e.g., *passo* [pasu] ‘step’), nevertheless, the word ‘chess’ was mispronounced as [tʃɛz]. She believes that the combination of a less familiar word followed by a voiced consonant induced some participants to produce *ss* as a voiced alveolar fricative.

Simon (2010) also examined the occurrence of voicing change rules in Dutch–English interlanguage. She analyzed informal Dutch and English conversation of native speakers of Dutch, and discovered that there are differences in how voicing change occurs, depending on the

phonological context. According to her, coda obstruents can be devoiced in final position in Dutch (e.g., *rond* [t] ‘round’), especially when followed by a pause, and this voicing change was also transferred to the L2. Simon (2010) points out that the voiced realizations in Dutch are the result of prevocalic voicing assimilation, and concluded that in English they might be the result of transfer of this L1 assimilation rule. Prevocalic voicing assimilation, in this case, is the influence of the following vowel in the preceding sound (e.g., ‘wash it’ [wɔʒ it] instead of [wɔʃ it]).

In a similar study, Smith, Hayes-Harb, Bruss and Harker (2009), noting that in German the voicing contrast with final consonants is neutralized in speech, decided to check whether native speakers of German learning English would produce a voicing contrast in English, especially with similar word pairs in the two languages (e.g., English: *rod* / *rot*; German: *Rad* / *Rat*). They found, using acoustic analysis, that the participants produced a distinction between the voiceless and voiced word-final consonants when producing English words, but not for German words; however, the final consonants were only partially devoiced.

Furthermore, returning to BP interphonology studies, Zimmer and Alves (2008) focused on two acoustic cues that should distinguish the production of voiceless from voiced stops in English: previous vowel length and amount of voicing in the final stop. Results indicated that Brazilian participants’ production did not show a neutralization of contrast between voiceless and voiced final stops, and also that the vowel length preceding the stops yielded significant difference for only three of the six minimal pairs (e.g., *bad* – *bat*, *bob* – *bop*, *rag* – *rack*).

As could be perceived from the aforementioned studies, phonological context has a great influence on the pronunciation of sounds and sound sequences. This influence was seen in the pronunciation of segments in word-final position, due to the transfer of the L1 assimilation rules. It was also seen that voiced and voiceless segments in word-final position influence previous vowel length. The two studies dealing with BP speakers indicated that these learners, contrary to the predictions of Fulana and Mora (2009) about the interphonology of Romance language speakers, can produce both voiced and voiceless consonants in word-final position. Nevertheless, the production of the voicing contrast depends on factors such as orthography and phonological environment following the target consonant, and, very often, L1 rules are transferred into the L2.



This chapter reviewed the literature that is going to be used as theoretical framework to support the hypotheses proposed for the present study as well as to explain the occurrence of certain phonological processes found in the data analysis. It also reviewed previous empirical studies of similar nature. The next chapter will cover the method used to conduct this research, including information about the profile of the participants of the present study, the description of the instruments used to collect data, as well as details of the data analysis.

## CHAPTER III

### METHOD

The method of a quantitative study is an extremely important item, considering that the whole plan for the conduction of the research, step by step, from the designing of the material for collecting data, the participants' profile, and the analysis of the results, and the results, must be thoroughly considered (Dorney, 2007; Gass, 2010; Seliger & Shohamy, 1989). This section presents a description of the participants that were involved in this study, the instruments that were used for collecting data, the procedures adopted to analyze the participants' productions of /s/ and /z/, as well as the statistical analysis adopted in this study.

#### 3.1 Participants

There were 27 participants in this study. 12 of them were native speakers of Brazilian Portuguese (NBP) undergraduate students of the third and fifth semesters of the *Letras e Literaturas de Língua Inglesa* Program of the *Universidade Federal de Santa Catarina* (UFSC), 11 were NBP graduate students in the first semester of the *Programa de Pós-Graduação em Inglês* (PPGI) at UFSC, and four of the participants were native speakers of American English (NE). The NBP participants came from different parts of Brazil<sup>7</sup>: (a) Santa Catarina (16), (b) Paraná (2), (c) São Paulo (2), (d) Rio Grande do Sul (1), (e) Mato Grosso do Sul (1), and (f) Brasília (1), but all of them were living in Florianópolis at the time of the data collection. Concerning their gender, 17 were female and six male. Their age ranged from 17 to 46 years at the time of data collection ( $M = 27.58$ ). In relation to the NE participants, there were three males and one female, who came from different places in the United States: (a) Michigan (2), (b) Illinois (1), and (c) California (1), and two of these participants were living in Florianópolis at the time of

---

<sup>7</sup> Although the NBP participants speak different dialects, and allophones such as /ʃ/ and /ʒ/ may occur in dialects from Florianópolis, for example, these sounds realizations did not occur in the English sentences, therefore, they were not considered in the data analysis.

data collection. Their ages ranged from 27 to 49 at the time of data collection ( $M = 39$ ).

The participants were divided into three different groups: (a) one control group, formed by NE speakers, and (b) two experimental groups formed by NBP speakers divided into intermediate and advanced levels of English proficiency, in order to check for possible effects of the level of proficiency on voicing change occurrence. The level of proficiency was determined by a questionnaire (see Appendix II) filled out by the participants, as well as according to their educational background. That is, undergraduate students were classified as intermediate students, and graduate students were classified as advanced students. In this study, the level of proficiency was considered an independent variable, since it was expected to affect the performance of the participants. The dependent variable, in turn, was the performance of the participants, that is, how often they resorted to L1 voicing rules when producing the target sounds.

### 3.2 Instruments

Data for this study were collected through a website ([www.l2pronunciation.com](http://www.l2pronunciation.com)) designed for the study in order to facilitate the storage of the data. This process of collecting data was divided into two different stages after the participant logged in: (1) administration of a questionnaire, and (2) recording of a sentence-reading test. The objective of the questionnaire (see Appendix II) was to elicit participants' profiles regarding city of origin, age, education, length of contact with the target language, attendance in EFL courses, and so on. Through the profiles of the participants, it was possible to classify them according to their language proficiency as well as to verify peculiarities about L1 dialect and its influence on L2 production. The sentence reading task was divided into two phases: (1) the English sentence reading task and (2) the Portuguese sentence reading task. The NE group only recorded the English sentences; the NBP groups recorded both English and Portuguese sentences.

The sentence-reading test consisted of a list of 54 sentences written in English and 16 sentences written in Portuguese (see Appendix V). The sentences in English contained monosyllabic words ending in <*s*> and <*se*> in different combinations of following phonological context: (a) the voiceless consonant /p/ (e.g., '*This paper is mine*'); (b)

the voiced consonant /b/ (e.g., ‘The *house backyard* is huge’); (c) the /aɪ/ diphthong (e.g., ‘*Does irony* count?’); and a pause (e.g., ‘If you play, you might *lose*.’). The sentences were designed with focus on the expected pronunciation of the <s> and <se> graphemes at the end of the words (i.e., [s], as in *this* and *house*, or [z] as in *does* and *lose*), and on the spelling of the monosyllabic words (i.e., final <s> , as in *this*, *miss*, *bus*, *goes*, *does* and *moves*, or final or <se>, as in *mouse*, *house*, *case*, *these*, *those* and *lose*). The words following the target sounds were also chosen carefully, with control of the phonological environment, as described above. The independent variables were, thus, spelling, with two levels, and phonological context, with four levels. Moreover, the first and last three sentences of the list of English sentences were distractor trials.

In this study, the phonological context following the target consonant was classified as an independent variable (with four levels: voiceless consonant, voiced consonant, vowel, pause), considering that it was expected to influence the rates of non-target productions by participants.

The sentences in Portuguese were also controlled orthographically and phonologically (see Appendix V), containing words ending in the <s> and <z> graphemes also in different combinations of following phonological contexts: (1) followed by the voiceless consonant /p/ (e.g., ‘*Deve-se usar menos papel*’); (2) followed by the voiced consonant /b/ (e.g., ‘*Talvez beleza* não seja importante’); (3) followed by the vowel /a/ (e.g., ‘*Ele faz aniversário* amanhã’); and (4) followed by a pause (e.g., ‘*Você podia falar menos*’). These contexts were induced because the production of the written graphemes <s> and <z> in the Portuguese sentences depends on the following phonological context in which the word with the target sound is inserted.

The BP data were used as a baseline in order to verify if the participants’ voicing assimilation patterns followed the patterns predicted in the literature, that is, if they produced the graphemes <s> and <z> as [z] when followed by a vowel or a voiced consonant, and as [s] when followed by a pause or a voiceless consonant. After the acoustic analysis of the data provided by each participant, the results obtained showed that the rate of devoicing with <z> was only 3.12% of the total, while [s] was always produced as a voiceless phoneme when followed by a pause or a voiceless consonant. That is to say that the

majority (96.88%) of the recorded sentences followed the patterns predicted in the literature, assimilating the voicing of the following segment. However, few occurrences of voicing change were found, and this happened only with [z] in the sentences 9, 10, 11 and 12 (Appendix V), when it was spelled with <z> and followed by a voiced consonant or a vowel. This non-expected production may have been influenced by the task-type used to collect data: reading sentences. It is believed that this type of task might affect participants' production, since they tend to speak more carefully and more slowly when reading, thus, inserting pauses between the target words and the following ones. As discussed in Sections 2.1 and 2.2, pauses lead to devoicing of word-final [z].

The lists of sentences were recorded individually by the participants using the Nanogong software at 24.000 kHz. The participants had access to this software through the website previously mentioned. Since the NE group was the control group, they recorded only the first test; that is, they recorded only the English sentences, which would make it possible to analyze the extent to which their productions match the pronunciation predicted in the literature for the target sounds in the four phonological contexts (followed by a vowel, a voiced consonant, a voiceless, consonant, and a pause) for native speakers' pronunciation. Moreover, their productions were compared with the NBP groups' productions. Likewise, NE participants also recorded the list of English sentences using Nanogong software at 24.000 kHz through the website designed for this study.

Regarding the analysis of the data provided by NE speakers, the results show that the total amount of devoicing occurrence with /z/ was 10.41%. The phonological contexts in which the devoicing with /z/ occurred were a voiceless consonant and a pause. In fact, the target sound when followed by a pause was partially devoiced by almost all NE participants. These results were expected, considering that, according to Smith (1997), the voiced alveolar fricative is difficult to produce; thus, it is expected that even native speakers of English would simplify their production by devoicing it. Furthermore, she states that the probable explanation for the devoicing of /z/ is that simultaneous voicing and frication are difficult to produce.

### 3.3 Analysis

Once the production data were collected, the target sounds were transcribed phonetically and the results were displayed by participants and by phonological contexts. In addition to the phonetic transcription, the data were submitted to acoustic analysis, with the use of PRAAT, with the objective of facilitating and giving reliability to the auditory judgment data. With this program it was possible to isolate the target sounds to see how they were produced by the participants. Whenever there was a doubt in relation to whether the target sound produced by the participants was voiceless or voiced, PRAAT helped with the visualization of the spectrograms. Figure 1 illustrates the voiced alveolar fricative, /z/, and Figure 2 illustrates the voiceless alveolar fricative, /s/. Note that the voiced alveolar fricative (Figure 1) can be distinguished from its voiceless counterpart by the pulses (vertical lines in the wave form at the top) as well as by the dark bar (voicing bar) in the lower frequencies of the spectrogram at the bottom of the spectrum. Figure 2 (voiceless alveolar fricative) does not present these elements.

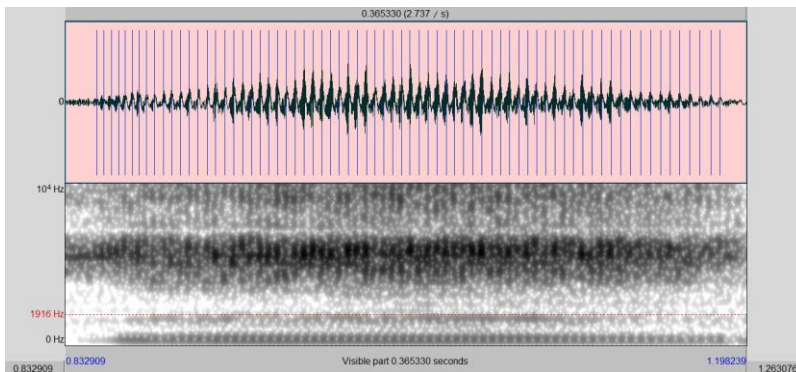


Figure 1. Waveform and spectrogram of the sound [z].

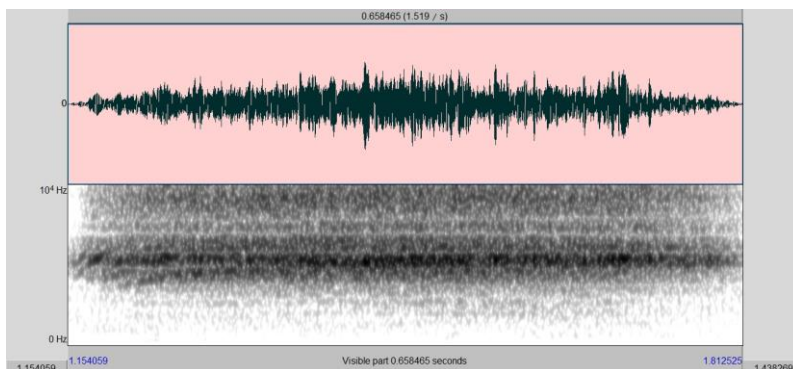


Figure 2. Waveform and spectrogram of the sound [s].

After that, the data were statistically analyzed in terms of mean percentages of voicing change occurrence, comparing data across and within groups, using the Statistical Package for Social Sciences (SPSS) software 16.0 for Windows. The comparison across groups made it possible to check whether voicing change is a recurrent process across proficiency levels, and the comparison within groups made it possible to check whether voicing change occurrence stemmed from inappropriate L1 transfer, that is, if the target sounds were produced the same way in different phonological contexts in English as well as in Portuguese.

After running the descriptive statistics, the data were examined to check for normal distribution. In order to check if the data were normally distributed, Shapiro-Wilk tests were run considering the different orthographies (i.e., <s> pronounced as [s] or [z] and <se> pronounced as [s] or [z]) and the four phonological contexts (i.e., followed by a pause, a vowel, a voiced consonant, and a voiceless consonant). The Shapiro-Wilk tests indicated that the variables were not normally distributed (for details see appendix VI). For this reason non-parametric tests were used to analyze most of the dataset.

With the intention of answering RQ1 (How does the level of proficiency influence the participants' production of /s/ and /z/ in word-final position?), the means obtained from the sentence-reading test provided by the participants in the two groups, intermediate and advanced, were compared through an independent-samples t-test because the data was normally distributed, using the SPSS software 16.0. The independent-samples t-test presumes that the two mean scores are independent of each other, having exactly two variables (Larson-

Hall, 2010). One of the variables has to be independent and categorical, and in this study this variable is the level of proficiency of the participants. The other variable is dependent and continuous, and in the present study it is the result of the performance of the participants concerning the number of non-target pronunciation occurrences.

In order to answer RQ2 (How does spelling affect voicing change with /s/ and /z/ in word-final position in the English samples provided by Brazilian Portuguese speakers?), considering that the data for this research question was not normally distributed, a Wilcoxon test was run to compare the means of <s> versus <se> (pronounced as [s] and pronounced as [z]). The Wilcoxon test is the non-parametric version of the independent-samples t-test (see explanation above).

Finally, to answer RQ3 (In what phonological contexts do Brazilian learners produce voicing change with the English sounds /s/ and /z/ in word-final-position?), the results were separated by phonological context and the means were obtained using the SPSS software 16.0. After that, in order to confirm if the differences in means in the different phonological contexts (i.e., a pause, a vowel, a voiceless consonant or a voiced consonant) were significant, a Friedman test was used because the data was not normally distributed. As Larson-Hall explains (2010), the Friedman test is a non-parametric version of the one-way ANOVA. The one-way ANOVA is used when the researcher wants to test if the means of three or more groups, or conditions differ statistically. A one-way ANOVA test has two variables: (a) one variable is categorical with three or more levels and it is the independent variable, and in the case of the present study the categorical variable is the different phonological contexts of the English sentences (four levels: voiceless consonants, voiced consonants, vowel, pause); and (b) the other variable is a continuous and dependent variable, and in this study it is the rate of non-target pronunciation produced by the participants. Afterwards, Wilcoxon tests were run with the intention of identifying which means were really significant, comparing each pair of means for each sound.

### 3.4 Pilot tests

The participants of the pilot of this study were four Brazilian master's students of the *Programa de Pós-Graduação em Língua*



*Inglesa* (PPGI) at UFSC, two male and two female with ages ranging from 22 to 26 years ( $M=24,5$ ,  $SD=1,92$ ). Two of them were from the south region of Brazil, and the other two from the northeast. All the participants had started learning English by the age of 11 to 13 years, and they were all considered advanced learners of English according to length of contact with the language as well as amount of language use on a daily basis.

The results of the pilot test are not discussed here. Nevertheless, the pilot helped to check the problems of the instruments and to redesign the test to collect data. With this pilot it was also possible to verify the phonological contexts in which voicing change almost never occurred. The words ‘miss’ and ‘false’ stood out from the other words, considering the expected lack of voicing change occurrence with these two words, was based on BP orthographic influence. In other words, in BP, when the letter <s> is preceded by another consonant grapheme, such as <n>, <r>, <g>, and <l>, the <s> will be pronounced as [s], that is, a voiceless sound (Cagliari, 2007). In the case of former word, ‘miss’, the <s> that comes before the final <s> makes the final <s> to be pronounced as [s], and with the latter, ‘false’, the <l> that comes before the <s> also makes the <s> to be pronounced as [s] by BP speakers. Due to this orthographic interference on the results, the word ‘false’ was removed from the test and replaced for the word ‘case’ [keis]. The word ‘miss’, on the other hand, continued in the test, since it showed non-target pronunciation in the pilot results.

## CHAPTER IV

### RESULTS AND DISCUSSION

The first motivation of this study was the observation of different English speech production patterns by people who speak different varieties of Portuguese as a first language (L1), as well as by speakers of other L1s. For example, I noticed how people from the northeast and from the south of Brazil would pronounce some English vowels (e.g., ‘observe’ /əb’zɜrv/ pronounced as [əb’zɜrv] or [ɔb’zɜrv]), and how different people from Japan and from Brazil would pronounce some English consonants (e.g., ‘rice’ /raɪs/ pronounced as [raɪs] or [haɪs], respectively). These differences are just a snapshot of how the study of phonology can be important in the field of L2 acquisition to both language teachers and learners, as being aware of these differences helps to improve English pronunciation.

In addition, the focus of this study, the occurrence of voicing change in the production of /s/ and /z/ in word-final position in English, is an important topic within the study of interphonology studies, as demonstrated in previous studies (Fullana & Mora, 2009; Silveira (unprepared manuscript); Simon, 2010; Smith, Hayes-Harb, Bruss & Harker, 2009; Zimmer & Alves, 2008). Thus, the research questions posed in this study aimed at investigating the influence of (a) proficiency level, (b) following phonological context (a pause, a vowel, a voiced and a voiceless consonant), and (c) spelling (the silent –e grapheme) on the production of voicing change.

The first hypothesis stated that the participants in the advanced-level group would perform better than those in the intermediate group; that is, there would be less occurrence of voicing change in the advanced group than in the intermediate group. The second hypothesis stated that words spelled with the silent –e grapheme (e.g., ‘house’) would cause more voicing than words without this grapheme (e.g., ‘bus’); that is, the phoneme /s/ would be more frequently voiced if the word containing it were spelled with the silent –e grapheme. On the other hand, the phoneme /z/ would be less often devoiced if the word containing it were spelled with the silent –e grapheme (e.g. ‘lose’) than if the word did not contain this grapheme (e.g., ‘goes’). The last hypothesis investigated the role of the phonological context following

/s/ and /z/, and it stated that the /s/ would be more frequently voiced when followed by a vowel or a voiced consonant, and the /z/ would be more frequently devoiced when followed by a pause or a voiceless consonant. For example, the word ‘bus’ /bʌs/ would be more likely to be voiced when followed by words such as ‘I’ (a vowel) or ‘belongs’ (beginning with a voiced consonant); but the word ‘goes’ /goz/ would be more likely to be devoiced in contexts such as ‘partying’ (beginning with a voiceless consonant) or followed by a pause. In the following sections I attempt to answer each research question and discuss their accompanying hypotheses by presenting the results of the present study and contrasting them with previous studies.

#### 4.1 The role of proficiency level

The first research question posed for this study was related to the influence of proficiency level on the participants’ production of voicing change with /s/ and /z/ in word-final position, and, based on previous studies (Koerich, 2002; Silveira, 2012; Zimmer, 2004), the hypothesis predicted that participants classified as advanced would produce less voicing change than participants classified as intermediate; that is, participants in the advanced group would not transfer the assimilation rule of BP as often as participants in the intermediate group. Tables 4 and 5 display the results obtained from the data analyzed: Table 4 displays the total frequency and percentage of voicing and devoicing occurrence, and Table 5 shows the descriptive statistics and the results from the t-tests.

**Table 4**

*Total frequency and percentage of voicing occurrence with /s/ and devoicing occurrence with /z/ in word-final position*

Group	Voicing frequency of /s/	Devoicing frequency of /z/	Total
Intermediate	110 (38.19%)	155 (53.82%)	265 (46.01%)
Advanced	93 (35.23%)	135 (51.13%)	228 (43.18%)
Total	203 (36.77%)	290 (52.53%)	493 (44.65%)

a. Total tokens = 1104 (552 for /s/ and 552 for /z/)

b. N intermediate = 12 / N advanced = 11 (N total = 23)

Table 4 shows that there is a tendency for intermediate participants to have slightly higher rates of overall non-target production. Specifically, the participants in the intermediate group voiced /s/ 38.19% of the time, compared to 35.23% for the advanced group. Likewise, the intermediate group devoiced /z/ in 53.82% of occurrences, while the advanced group did so 51.13% of the time. Overall, the total percentage of devoicing (52.53%) was considerably higher than the total percentage of voicing (36.77%).

Despite the fact that there was a tendency for advanced participants to have slightly lower rates of non-target production, the difference between the two groups is not significant. Table 5 shows that the mean occurrence of voicing of /s/ per participant in the intermediate group was 9.16 (min. = 4; max. = 13), while the mean per participant in the advanced group was 8.45 (min. = 2; max. = 14). The difference between the mean occurrence of devoicing of /z/ between the two groups is slightly smaller, being 12.91 (min. = 9; max. = 17) for the intermediate group and 12.27 (min. = 8; max. = 20) for the advanced group. Independent-sample *t*-tests showed that the difference between the non-target productions of the two groups was not statistically significant ( $p > .05$ ) for either of the target sounds: /s/  $t = .502$ ,  $p = .622$ ; /z/  $t = .525$ ,  $p = .606$ . Thus, it is possible to affirm that the hypothesis proposed for the first research question was not confirmed; that is, contrary to what previous studies have shown, the level of proficiency did not have much influence on participants' performance, and participants classified as advanced still transferred the assimilation of phonological context rule of BP almost as often as participants classified as intermediate.

**Table 5**

*Descriptive statistics and t-tests for voicing change occurrence with /s/ and /z/ in word-final position displayed by proficiency level*

	Proficiency Level	N <sup>a</sup>	Mean	SD <sup>b</sup>	Min.	Max.	t-test
Total	Intermediate	12	9.16	2.69	4	13	t = .502
/s/	Advanced	11	8.45	3.93	2	14	(p=.622)
Total	Intermediate	12	12.91	2.27	9	17	t = .525
/z/	Advanced	11	12.27	3.43	8	20	(p=.606)

a. N = Number of participants

b. SD = Standard Deviation

The hypothesis regarding the effect of proficiency level on voicing change production was based on previous studies, which also considered proficiency level as a variable but did not focus on voicing change. As mentioned before, Koerich's (1999; 2002) studies show a significant correlation between level of proficiency and perception and production of English word-final consonants. More precisely, she found that the discrimination of the target words increased with the level of proficiency (Koerich, 1999), and there was an improvement in the accurate production of the target words as the level of proficiency increased (Koerich, 2002), hence, showing a positive relationship between L2 proficiency and perception performance. Furthermore, Silveira's (2012) study investigated how proficiency level, among other factors, can influence the production of English word-final consonants by Brazilians living in an English speaking country, and her results show that the amount of transfer of BP phonological processes (syllable simplification and delateralization) into English decreases significantly as the level of proficiency increases. In addition, Zimmer (2004) investigated the rate of phonological transfer processes (consonant cluster simplification, terminal devoicing, consonant change, vocalization of final nasals, vowel assimilation, among others) from the L1 into the L2 among Brazilian learners of English and she divided the participants into 4 groups based on their level of proficiency (basic, intermediate, upper intermediate, and advanced). The results show that the rate of phonological transfer processes decreases as the proficiency level increases in most of the processes analyzed. Terminal devoicing, for example, which is the focus of the present study, obtained an intermediate rate of use, in which participants from the basic group

obtained a 22.9% rate of use, while participants from the advanced group obtained a 18.5% rate of use of terminal devoicing.

In accordance with what the aforementioned studies have shown, the level of proficiency influenced slightly the amount of voicing change produced by the NBP for this study. That is to say that, indeed there was a slight difference between the mean occurrence of voicing change between participants in the intermediate and advanced groups (voicing = 9.16 / 8.45; devoicing = 12.91 / 12.27), but this difference was not significant. This slight difference might be due to the unconscious transfer of BP assimilation rules, that is, the assimilation of the voicing feature of the following phonological context (i.e., the production of *meus olhos* ['mɛuz'ɔʎus] instead of ['mɛus'ɔʎus], 'my eyes', in which the /s/ assimilates the voicing feature of the following vowel /ɔ/). This type of assimilation is automatic, natural and uncontrolled for NBP speakers, and processes like these are highly resistant to change and harder to be modified in a learner's interlanguage (Cristófaró-Silva, 2010; Netto, 2001). Another possible explanation for these results is the lack of proficiency tests to classify the participants in the appropriate groups. The present study used the participants' profile to classify them in the intermediate and advanced groups, which may be considered an inadequate criterion for evaluating proficiency level, and participants might be classified in the incorrect group.

This section presented the results obtained from the data analyzed in order to answer Research Question One, which concerns the role of the proficiency level in the production of non-target pronunciations of /s/ and /z/ in word-final position. As can be perceived, the results did not support the hypothesis based on previous studies, as the level of proficiency had no significant effect on the amount of voicing change produced by the participants of this study, probably because of the involuntary transfer of the BP assimilation rule or the inadequate criteria for evaluating proficiency level. Keeping this in mind, the data obtained for this study were no longer analyzed considering the two different groups' production: intermediate and advanced. Instead, the data were analyzed considering one group of 23 participants with varied background and language knowledge skills, but whose production of /s/ and /z/ was similar. Whenever there was a need to examine a possible role for language proficiency, correlational

analyses were conducted to answer the remaining research questions, as done in Koerich (1999, 2002) and Silveira (2012).

The next section discusses the role of orthography in the production of non-target pronunciation; that is, whether the silent *-e* grapheme influenced or not the production of voicing change with /s/ and /z/ in word-final position.

## 4.2 The role of orthography

Considering the results obtained for the first research question, the data from the two groups, intermediate and advanced, were collapsed before running the statistical tests for research question 2, which is concerned with the influence of spelling on the production of voicing change with /s/ and /z/ in word-final position, more specifically, the influence that the silent *-e* can have on the production of voicing change. The silent *-e* condition was tested with words that are spelled with a final *<e>*, but this final grapheme is not pronounced by native speakers of English (e.g., ‘mouse’; ‘case’). It was believed that words spelled with the silent *-e* would cause more voicing of /s/ than the words without this grapheme (e.g., ‘bus’; ‘this’), and also that words with the silent *-e* grapheme (e.g., ‘these’, ‘lose’) would cause less devoicing with /z/ than the words without this grapheme (e.g., ‘goes’, ‘moves’).

The grounds for this hypothesis were taken from Silveira’s (2012) study, which, among other topics, analyzed the effect of orthography on the production of L2 word-final consonants by NBP learners of English. She discovered that although the existence of a final silent *-e* grapheme might reduce the production of some phonological processes (i.e., vocalization of nasal and delateralization) and thus lead to a more target-like production of certain word-final consonants (e.g., ‘name’, ‘whale’), the silent *-e* condition might also induce the NBP learners of English to resort to vowel paragoge (i.e., addition of a vowel in word-final position) more frequently, hindering the target-like production of some word-final consonants. Another study by Silveira (2004) is also very important for this issue of the influence of orthography in the pronunciation of NBP learners of English as it shows that orthography seems to be influential in the frequency of vowel paragoge production. She discovered that words containing the silent *-e*

grapheme (e.g., ‘take’) in word-final position induced higher epenthesis rates than those without the grapheme (e.g., ‘risk’).

Thus, it is possible to predict that orthography will have a big influence on other aspects of English pronunciation of NBP learners, given that the sound-spelling correspondence between the two languages presents some differences. Table 6 shows the total frequency and percentage of voicing and devoicing occurrence displayed by orthography.

**Table 6**

*Total frequency and percentage of voicing occurrence with /s/ and devoicing occurrence with /z/ according to orthography*

voicing		devoicing		Total
/s/	/s/-e	/z/	/z/-e	
48	155	180	110	493
(17.39%)	(56.16%)	(65.21%)	(39.85%)	(44.65%)

a. Total tokens = 1104 (276 for each orthography)

b. N = 23

Through a comparison of the total frequency and percentage of voicing change occurrence of /s/ versus /s/-e and /z/ versus /z/-e displayed in Table 6, it can be concluded that orthography played an important role in the voicing of /s/ and the devoicing of /z/ in word-final position. That is, the frequency of voicing in the context of silent –e was much higher than the frequency in the context without this grapheme, 155 (56.16%) against 48 (17.39%). Moreover, the frequency of devoicing of /z/ in word-final position between the words with and without the silent –e grapheme also shows a great difference, 110 (39.85%) against 180 (65.21%), respectively. Although the difference of the devoicing frequency was smaller, both results show that NBP learners of English rely on L1 sound-spelling correspondence transferring the BP assimilation rule to the L2. The difference between the two results will be discussed below based on the markedness hypothesis (Eckman, 2009), which predicts that voiced consonants such as /z/ are more difficult to produce in word-final position. The descriptive statistics regarding voicing change for /s/ and /z/ in words with and without the silent –e grapheme are displayed in Table 7.



**Table 7**

*Descriptive statistics for voicing change frequency with /s/ and /z/ in word-final position according to orthography*

	Tokens <sup>a</sup>	Mean	SD <sup>b</sup>	Min.	Max.	Wilcoxon test
/s/	12	2.08	1.20	0	4	w = -4.08 ( <i>p.</i> = .001)
/s/-e	12	6.73	2.61	1	11	
/z/	12	7.82	1.58	5	11	w = -4.13 ( <i>p.</i> = .001)
/z/-e	12	4.78	1.78	2	9	

a. Number of tokens per participant and per orthography

b. SD = Standard Deviation

c. N = 23

It can be seen in Table 7 that the mean voicing frequency of /s/ in word-final position in the context without the silent –e was 2.08 (min. = 0; max. = 4), while the mean voicing frequency in the context of –e was much higher: 6.73 (min. = 1; max. = 11). This difference is most likely due to orthographic influence and L1 sound-spelling transfer (Silveira, 2012). The Wilcoxon<sup>8</sup> test compared the means of /s/ versus /s/-e and indicated that the difference was significant (/s/ vs. /s/-e: w = -4.08, *p.* = .001).

Moreover, as Silveira (2009) points out, the task-type used when collecting data can also influence the results obtained, considering that most language learners in a foreign-language learning context have more contact with the L2 in its written form, and this contact might induce learners to rely on L1 spelling and pronunciation correspondences when pronouncing L2 words. Thus, in the case of the target words used in this study, learners tended to assimilate the voicing feature of the following segment when producing /s/, due to the spelling of the silent –e grapheme. That is, they ended up producing ‘mouse’ as [mauz] instead of [maʊs], for example, as though there were actually a vowel phoneme represented by the <e>.

On the other hand, the results in Table 7 support Hypothesis 2 regarding devoicing, showing that indeed the mean of devoicing with /z/ in word-final position with words without the silent –e grapheme was

<sup>8</sup> A non-parametric test used to compare pairs of means within groups when the data is not normally distributed (similar to a dependent-sample t-test).

higher (7.82; min. = 5; max. = 11) than the mean of devoicing with words with the silent –e grapheme (4.78; min. = 2; max. = 9). The Wilcoxon test compared the means of /z/ versus /z/-e, the results indicating that the comparison was significant (/z/ vs. /z/-e:  $w = -4.13$ ,  $p = .001$ ).

Although the overall results for /s/ and the role of spelling follow the expected trend, thus, confirming Hypothesis 2, it is interesting to point out the considerable amount of devoicing found for the /z/, even in words spelled with <e>. L2 learners rely considerably on L1 spelling and pronunciation correspondences when pronouncing L2 words. In this sense, the words spelled with the silent –e grapheme would have caused the BP speakers to unconsciously produce the target words more accurately; that is, produce the segment in word-final position as /z/ and not as /s/. The fact that this does not happen as frequently as expected may be explained with reference to the Markedness Differential Hypothesis (MDH), which, according to Eckman (2009), can predict the degree of difficulty of acquiring L2 structures pointing out marked and unmarked structures through the differences between the L1 and the L2. In this case, the /z/ in word-final position does not exist in BP unless when followed by a vowel or a voiced consonant (*os olhos* [u.zɔ.ʌʊs] ‘the eyes’) and is more marked than /s/. Therefore, it is more difficult for NBPs to produce /z/ in word-final position accurately, and, as a consequence, they simplify the production by devoicing the /z/ or by adding a paragodic vowel. Although the MDH can explain why /z/ was produced accurately less frequently than /s/, it could not explain why L2 learners chose to simplify the production of the marked structure by devoicing the /z/ (Eckman, 2009), instead of, for example, adding a paragodic vowel, which is also a recurrent syllable simplification strategy used by NBP learners of English (Koerich, 2002; Silveira, 2004). One possible explanation for the devoicing of /z/ may be that the paragodic vowel is more recurrent with syllables ending in stop consonants (Silveira, 2004), and since the BP inventory has /s/ in word-final position, it makes more sense for the participants to apply the devoicing rule than paragoge. These results are not in agreement with the predictions of the SCH, since voicing change is present in the participants’ interphonology for

both the voiced consonant /z/ (as expected), and for the voiceless consonant /s/.

For a more detailed analysis I looked into the percentage of voicing change for each word. The results displayed in Table 8 show the percentage occurrence of voicing change in each target word.

**Table 8**

*Percentage of non-target pronunciation displayed by word*

	this	miss	bus	mouse	house	case
Total	32.6%	2.17%	17.39%	55.43%	52.17%	60.87%
	goes	does	moves	these	those	lose
Total	73.91%	68.48%	52.17%	52.17%	41.3%	25%

It can be perceived that the /s/ words that yielded higher voicing rates were ‘case’ (60.87%), followed by ‘mouse’ (55.43%) and ‘house’ (52.17%), as predicted in the hypothesis, since all contained the silent <e>. Furthermore, the /s/ words that caused less voicing were ‘miss’ (2.17%), followed by bus (17.39%) and ‘this’ (32.6%). Likewise, the /z/ words that yielded higher devoicing rates were ‘goes’ (73.91%), followed by ‘does’ (68.48%). Through the individual analysis of each word it was possible to verify that the type of task used, reading non-topic-connected sentences, might have influenced their performance, since many participants read each sentence carefully, which induced unnatural pauses between the target sounds and the following word, characterizing mechanical rather than natural speech, and preventing them from linking the sounds. However, the words that had the same percentage of devoicing were ‘these’ and ‘moves’ (52.17%), although their spellings followed different patterns (i.e., only the first word ended with the silent –e grapheme). Some participants actually pronounced the word ‘these’ as its singular form ‘this’ [ðɪs], not only devoicing the final consonant, but also replacing /i/ with /ɪ/. The word ‘those’ (41.3%) also caused more devoicing than expected, perhaps for the same reason of the abovementioned word: markedness (which was discussed previously in this section). The word ‘lose’ (25%), in turn, presented an expected low percentage of devoicing, as the <s> grapheme, when surrounded by vowel graphemes, is pronounced as a voiced consonant in BP. Perhaps this is related to the fact that English learners tend to mix the pronunciation of ‘lose’ /luz/ with ‘loose’ /lus/.

This section aimed at answering Research Question Two, which was concerned with the influence of spelling (i.e., the silent –e grapheme) in the production of voicing change with /s/ and /z/ in word-final position. As could be perceived from the results obtained, corroborating the hypothesis proposed, the silent –e grapheme influenced the amount of voicing production; that is, the /s/ was more frequently voiced when the word was spelled with the silent –e grapheme, compared to the words that do not have the silent –e. The silent –e grapheme also influenced the amount of devoicing production decreasing its occurrence when the word was spelled with the grapheme; that is, the /z/ was less often devoiced when the word was spelled with the silent –e grapheme, compared to the words without this grapheme.

The following section is concerned with the role of phonological context in the production of voicing change with /s/ and /z/ in word-final position. More precisely, the following section aims at investigating which phonological context (i.e., a pause, a vowel, a voiced or a voiceless consonant) induces more voicing change production.

### **4.3 The role of phonological context**

For research question three, the focus was on the phonological context that followed the English sounds /s/ and /z/ in word-final position. More precisely, the intention was to determine in what phonological contexts (i.e., followed by a vowel, a voiceless consonant, a voiced consonant, or a pause) the Brazilian learners would produce voicing change with the target sounds. The hypothesis predicted that participants would voice the /s/ followed by a voiced consonant or a vowel and devoice the /z/ followed by a voiceless consonant or a pause. There were several studies which focused on voicing change using the phonological contexts as variable (Edge, 1991; Fullana & Mora, 2009; Silveira, unprepared manuscript; Simon, 2010; Smith, Hayes-Harb, Bruss & Harker, 2009; Zimmer & Alves, 2008), and most results reported that voicing change occurrence was due to L1 influence.

The results of the present study for the role of the phonological context following /s/ and /z/ are discussed below. To start with, Table 9 displays the total frequency and percentage of voicing change

occurrence according to the different phonological contexts used in this study (/aɪ/, /b/, /p/, \_\_ (pause)).

**Table 9**

*Total frequency and percentage of voicing and devoicing occurrence according to phonological context*

voicing				devoicing				Total
s__	s/aɪ/	s/b/	s/p/	z__	z/aɪ/	z/b/	z/p/	
8	73	82	40	129	43	23	95	493
5.80	52.90	59.42	28.98	93.48	31.16	16.66	68.84	44.65
%	%	%	%	%	%	%	%	%

a. Total tokens = 1104 (138 for each phonological context)

b. N = 23

It can be perceived from the results displayed in Table 9 that, supporting the hypothesis proposed, the phonological contexts that yielded the highest rates of voicing with /s/ in word-final position are a voiced consonant (59.42%) and a vowel (52.90%). In addition, the phonological contexts that yielded the highest rates of devoicing with /z/ in word-final position are a pause (93.48%) and a voiceless consonant (68.84%). These results can be explained by the Structural Conformity Hypothesis (SCH) (Eckman, 2009) as well as by cross-linguistic influence (Odlin, 1990), also known as language transfer. The SCH states that a rule that is valid for the world's languages is also valid for the interlanguages (Eckman, 2009). Indeed the voicing assimilation patterns found in the participants' interlanguage match the expected tendencies found in the world's languages, although the assimilation patterns may display unexpected results as well. On the other hand, the language transfer is concerned with the influence that the L1 has on the L2 (Odlin, 1990). In the case of this study, participants tended to transfer the BP assimilation rule (Cristófaró-Silva, 2010), assimilating the voicing feature of the following segment. As a consequence, they ended up voicing the /s/ when followed by a voiced consonant and a vowel, and devoicing the /z/ when followed by a pause and a voiceless consonant.

Table 10 displays the descriptive statistics for voicing change occurrence with the target sounds (i.e., /s/ and /z/) in word-final position according to the different phonological contexts analyzed in this study.

**Table 10**

*Descriptive statistics for voicing change occurrence with /s/ and /z/ in word-final position in different phonological contexts*

	Tokens <sup>a</sup>	Mean	SD <sup>b</sup>	Minimum	Maximum
/s/pause	6	.34	.64	0	2
/s/vowel	6	3.17	1.52	0	5
/s/vdC	6	3.56	1.23	1	5
/s/vlC	6	1.73	1.17	0	3
/z/pause	6	5.60	.58	4	6
/z/vowel	6	1.86	1.45	0	5
/z/vdC	6	1.00	1.12	0	3
/z/vlC	6	4.13	1.09	2	6

a. Number of tokens per participant, target sound and phonological context

b. SD = Standard Deviation

c. N = 23

As can be seen in Table 9, the target sound /s/, when followed by a vowel or a voiced consonant, is voiced over 50% of the time, as predicted in the hypothesis. Furthermore, Table 10 shows that the mean voicing occurrence with /s/ in word-final position per participant for both cases are, respectively, 3.17 (min. = 0; max. = 5) and 3.56 (min. = 1; max. = 5). The other phonological contexts following the target sound (i.e., a voiceless consonant and a pause) also obtained the voicing of /s/, at a lower rate though. The mean voicing occurrence with the target sound in word-final position was 0.34 (min. = 0; max. = 2) for the pause context, and 1.73 (min. = 0; max. = 3) for the voiceless consonant context. It is believed that the voiceless consonant context had little influence on the voicing of the target sound because the consonant tested (i.e., /p/) shares the same voicing feature of the word-final consonant /s/. Furthermore, the pause context also leads to devoicing in the L1. Therefore, some other variables may have influenced the occurrence of voicing of /s/ in these contexts, such as the silent –e grapheme (to be discussed in Section 4.3.1).

The results concerning the devoicing of the target sound /z/, also displayed in Table 10, are in accordance with what was predicted in the hypothesis. It was expected that two phonological contexts following the target sound would cause the participants to devoice /z/ in word-final

position: a pause, whose mean devoicing occurrence was 5.60 (min. = 4; max. = 6); and a voiceless consonant, whose mean devoicing occurrence was 4.13 (min. = 2; max. = 6). As expected, the devoicing of /z/ followed by a pause had a very high mean, thus confirming a natural tendency in the L2, given that native speakers of American English also devoice /z/ in word-final position when followed by a pause (Smith, 1997), or, at least, partially devoice /z/ in word-final position (Yavas, 2011). Although partially devoiced /z/ were not verified acoustically in this study, nonetheless these results offer support for the SCH predictions and highlight the role of L1 transfer.

Table 10 also shows the mean results regarding the other two phonological contexts following /z/ in word-final position: a vowel, whose mean devoicing occurrence was 1.86 (min. = 0; max. = 5); and a voiced consonant, whose mean was 1.00 (min. = 0; max. = 3). The devoicing of the target sound followed by these two phonological contexts, although minimal, was not predicted in the hypothesis proposed. Nevertheless, it is believed that other aspects influenced the devoicing of /z/ in word-final position when followed by a vowel and a voiced consonant, such as the conditions in which data were obtained and the type of task applied to collect data (i.e., controlled environment and sentence-reading task), which may have led the participants to pause after reading the target word, thus changing the phonological context. Nevertheless, these unexpected pauses were not verified acoustically.

In order to confirm whether the comparison of means in the different phonological contexts (i.e., a pause, a vowel, a voiceless consonant or a voiced consonant) was significant, a Friedman test<sup>9</sup> was used. The test compared the means of non-target productions of /s/ and /z/ in each phonological context, and the results indicated a significant difference ( $X^2 = 115.36$ ,  $p = .001$ ). With the intention of identifying which means were really significant, it was necessary to run Wilcoxon tests comparing each pair of means for each sound. Due to the multiple means comparisons, Bonferroni adjustment<sup>10</sup> (Larson-Hall, 2010) was performed and the  $p$  value was only considered significant if it was

---

<sup>9</sup> A Friedman test is used in order to compare multiple means within a single group. It is a non-parametric test equivalent to a Repeated-measures ANOVA.

<sup>10</sup> Larson-Hall (2010) recommends using Bonferroni adjustment to correct the  $p$  value when several comparisons are made. In the present analysis, there were 4 variables for each sound, multiplied by three phonological contexts. Thus, the original  $p$  value (.05) was divided by the number of tests run (i.e., 12), resulting in .004.

equal to or lower than .004. As Table 11 shows, the results of the Wilcoxon tests indicate that most phonological context means presented significant differences ( $p < .004$  in most cases), except for the vowel <ai> (e.g., *The bus I need is late; Does irony count?*) versus the voiced consonant <b> (e.g., *This bottle is half empty; Paul goes babysitting.*) for both /s/ and /z/ in word-final position ( $p = .164$  and  $p = .008$ , respectively). This lack of significance in both cases was probably due to the BP rule, which is the same for both cases (/s/-vowel = 3.17 versus /s/-voiced consonant = 3.56; /z/-vowel = 1.86 versus /z/-voiced consonant = 1.00).

**Table 11**

*Wilcoxon test results comparing each pair of means for each sound*

	W	p
s /aɪ/ - s __	-4.13	<.001
s /b/ - s __	-4.22	<.001
s /p/ - s __	-3.51	<.001
s /b/ - s /aɪ/	-1.39	.164
s /p/ - s /aɪ/	-3.17	.002
s /p/ - s /b/	-3.86	<.001
z /aɪ/ - z __	-4.13	<.001
z /b/ - z __	-4.23	<.001
z /p/ - z __	-3.71	<.001
z /b/ - z /aɪ/	-2.66	.008
z /p/ - z /aɪ/	-3.87	<.001
z /p/ - z /b/	-4.07	<.001

Previous studies that investigated the influence of phonological context (Carlisle, 1991; Edge, 1991; Silveira, unprepared manuscript; Simon, 2010) presented evidence that this variable plays an important role in the production of L2 sounds, especially because the phonological processes that occur in different phonological contexts are likely to be automatically transferred from the L1 to the L2 (as language learners are not aware of this transfer). All previous studies considered the learner's L1 (i.e., Spanish, Japanese, Cantonese, BP, and Dutch) and their phonological and structural rules, and they concluded that the



phonological context adjacent to the target sounds influences the production of the target sounds at different levels, depending on the L1's phonological rules and on the target sounds. Thus, the results of the present study concerning the role of the phonological context in the occurrence of voicing change corroborate the results from the studies aforementioned.

#### 4.3.1 Interaction between phonological context and orthography

In order to triangulate the results for the roles of orthography and phonological context, Table 12 was created showing the percentage of voicing with /s/ in word-final position for each target word. These results may help us understand the unexpected occurrences of voicing change for certain phonological contexts, as discussed in Section 4.3.

**Table 12**

*Percentage of non-target pronunciation production with word-final /s/ displayed by word and phonological context*

Words/ Context	this	miss	bus	mouse	house	case
Pause	0%	0%	0%	13.04%	17.39%	4.35%
Vless Cons.	0%	0%	0%	65.22%	39.13%	69.56%
Vced Cons.	69.56%	4.35%	39.13%	73.91%	78.26%	91.30%
Vowel	60.87%	4.35%	30.43%	69.56%	73.91%	78.26%

It is possible to see in Table 12 that the words ‘*this*’, ‘*miss*’, and ‘*bus*’, when followed by a pause or a voiceless consonant, did not lead participants to produce non-target pronunciation. On the other hand, when they were followed by a vowel or a voiced consonant, the percentage of voicing production with /s/ in word-final position was high, except for the word ‘*miss*’, whose spelling <ss> influenced the target-like production of participants (4.35%), considering that in BP the <ss> is always pronounced as [s] (Cristófaró-Silva, 2010), and, in this case, most participants resorted to L1 sound-spelling transfer to pronounce the word accurately. The word ‘*this*’ obtained the highest rates for voicing (vowel context = 60.87%; voiced consonant context = 69.56%), followed by the word ‘*bus*’, whose rates were almost half of the word ‘*this*’ (vowel context = 30.43%; voiced consonants context =

39.13%). A possible explanation for the higher percentage of voicing with *'this'* may be the fact that the pronunciation of this word is often confused with the pronunciation of *'these'*, which ends in /z/. It is believed that participants do not worry about the plural form of this word, hence they have difficulties in pronouncing differently the vowels /ɪ/ and /i/, producing [ɪ] as [i] (Rauber, 2006; Nobre-Oliveira, 2007). Indeed, a closer look at the productions of the NBP participants revealed that they tend to pronounce [ðiz].

Of the /s/ words which have the silent -e grapheme, *'mouse'*, *'house'*, and *'case'*, all of them underwent voicing change in word-final position. To begin, the word *'mouse'* obtained a low rate of voicing occurrence when followed by a pause (13.04%). On the other hand, when this word was followed by the other phonological contexts (i.e., a voiceless consonant, a voiced consonant, and a pause), the percentage of non-target production was similarly high (65.22%, 73.26% and 69.56%, respectively). Likewise, the word *'house'* presented high rates when followed by a voiced consonant and a vowel (78.26% and 73.91%, respectively), and lower rates when followed by a pause (17.39%). However, when the word *'house'* was followed by a voiceless consonant, the percentage was nearly 40%, not close to the results presented for the pause phonological context, nor close to the results presented for the vowel and voiced consonant contexts. The word *'case'*, in turn, obtained the highest and the lowest rates of voicing with /s/ in word-final position: when followed by a voiced consonant (91.30%) and when followed by a pause (4.35%). The other phonological contexts (i.e., a vowel and a voiceless context) obtained rates similar to the other words (78.26% and 69.56%, respectively).

After observation of the results displayed in Table 12, Table 9 and Table 10, it can be concluded that the phonological context that yielded the highest rates of voicing with /s/ in word-final position was the voiced consonant. Furthermore, the phonological context that yielded the lowest rates of voicing was a pause. Clearly, orthography plays a major role in the production of words containing the silent <e>, leading participants to voice /s/ in phonological contexts where this was not expected to happen if they were merely transferring the BP phonotactic rules. Moreover, orthography can have a positive effect as well, as shown by the results with the word *'miss'*, which yielded the lowest percentages of voicing change in all phonological contexts due to the <ss> spelling.

Now we turn to the results for /z/ devoicing, observing the interaction between phonological context and orthography. Table 13 shows the percentage of devoicing with /z/ in word-final position for each target word.

**Table 13**

*Percentage of non-target pronunciation production with word-final /z/ displayed by word and phonological context*

Words /Context	goes	does	moves	these	those	lose
Pause	100%	95.65%	100%	95.65%	95.65%	69.56%
Vless Con.	100%	100%	78.26%	78.26%	39.13%	17.39%
Vced Con.	43.48%	13.04%	8.69%	17.39%	17.39%	0%
Vowel	52.17%	65.22%	21.74%	17.39%	13.04%	13.04%

It can be seen from the results displayed in Table 13 that two phonological contexts, a pause and a voiceless consonant, induced almost 100% of devoicing for nearly all the words ending in <s> (i.e., 'goes', 'does', and 'moves'), except for the word 'moves', whose percentage of devoicing occurrence was 78.26%. However, the same words (i.e., 'goes', 'does', and 'moves') obtained different results when followed by a voiced consonant or a vowel. Of these words, the word that presented the highest rates for devoicing when followed by a voiced consonant was 'goes' (43.48%), and when followed by a vowel was 'does' (65.22%), which lead us to think that some other factors, such as the type of task used to collect data (i.e., reading sentences), may have induced these high rates of devoicing, as the participants might have paused after reading these target words. The word 'goes' also presented a high rate of devoicing when followed by a vowel (52.17%). On the other hand, the word 'moves' presented the lowest rates of devoicing (vowel = 21.74%; voiced consonant = 8.69%), followed by the word 'does', whose rate of devoicing occurrence when followed by a voiced consonant was also low (13.04%).

Whereas these results somehow support the hypothesis proposed for the third research question, especially for the pause context. The high rates that do not support the hypothesis might be explained by the manner in which the data were collected. That is, reading sentences in a controlled environment might have led the participants to make more pauses between the target sounds and the

following word, which may have prevented them from linking the sounds and applying the BP rules that would lead to target-like production. A deeper analysis of the data using PRAAT allowed the verification that the NBP participants produced a longer pause between the target sound in word-final position and the following phonological context. One of the participants of the advanced group produced a 0.014 seconds of pause after the target sound /z/ in the sentence ‘*Does irony count?*’. In addition, another participant of the intermediate group produced a 0.540 seconds of pause in the same sentence, while the NE participant presented no pause after the target sound. This analysis showed evidence that reading sentences induce participants to produce more pauses than in a natural speech. Another possible explanation is markedness, as /z/ in word-final position is less frequent in the world’s languages than /s/ (Eckman, 2009), and therefore more difficult to be produced in word-final position, being often devoiced.

Table 13 also displays the results for the words with the silent –e grapheme, ‘*these*’, ‘*those*’, and ‘*lose*’. It can be seen that the phonological context that yielded the highest rates for devoicing with /z/ in word-final position was a pause, whose percentage of devoicing occurrence with the words ‘*these*’ and ‘*those*’ was almost 100% (95.65%). The result presented for the word ‘*lose*’ was lower than the previous ones (69.56%). In addition, the voiceless consonant context also presented a high rate of devoicing for the word ‘*these*’ (78.26%), which was actually the highest rate among the words containing the silent –e. On the other hand, the same phonological context that yielded high devoicing rates for the word ‘*these*’, also yielded lower rates for the words ‘*those*’ (39.13%) and ‘*lose*’ (17.39%). Perhaps it was not only the phonological context that influenced the non-target production, but also the target word itself, considering that many participants confuse the pronunciation of ‘*these*’ and ‘*this*’, pronouncing the former as [ðɪs] instead of [ðɪ:z], as mentioned before. Furthermore, the word that yielded the lowest rate for devoicing when followed by a voiced consonant was ‘*lose*’ (0%). The other words basically presented the same devoicing rates: (1) 17.39% was the percentage of devoicing occurrence for the word ‘*these*’ when followed by a vowel and a voiced consonant, and also for the word ‘*those*’ when followed by a voiced consonant; (2) 13.04% was the percentage of devoicing occurrence for the word ‘*those*’ as well as for the word ‘*lose*’ when followed by a vowel. In conclusion, the phonological contexts that yielded the lowest

and the highest devoicing rates were a voiced consonant and a pause, respectively, and the words that yielded the lowest and the highest rates of devoicing were ‘lose’ and ‘these’, respectively. This leads us to state again that it is not only the phonological context that influences the non-target production, but also the target word itself.

The interaction between orthography and phonological context is not very clear for the /z/ devoicing results. The results displayed in Table 13 show a trend that is similar for both words with and without the silent <e>, with the pause and voiceless consonant contexts yielding the highest rates of devoicing, as expected. Nevertheless, it is also possible to observe a facilitative effect of orthography, since the silent <e> words obtained lower rates of devoicing in nearly all contexts. Nevertheless, we cannot overlook the predictions of the SCH, since the results with /z/ indicate that this sound yields high percentages of voicing change in all phonological contexts, with all words tested, regardless of their spelling.

#### **4.3.2 Data analysis per participant**

The results reported so far show a broad view of the data obtained with the recording of 23 Brazilian participants who volunteered to contribute with data for this research. Nevertheless, each participant had a different background that certainly influenced in his/her performance. The results per participant displayed by orthography and phonological context can be seen in Appendix VII. As that table has too many details, I will focus on the most important results. Table 14 displays only the total amount of voicing change per participant. The participants who had the highest scores for voicing change were SP04, SP14 (56.25%), and SP11 (54.16%). Participants SP04 and SP11 belonged to the intermediate group, while participant SP14 belonged to the advanced group, but they have similar profiles and backgrounds. As the analysis of data gathered with a questionnaire shows, they all started learning English by the age of 11, they had not been to an English speaking country at the time of data collection, and they were constantly in contact with the language (i.e., through songs, movies, internet, friends, classes, and so on). On the other hand, the participants who had the lowest scores for voicing change were SP15 (29.16%) and SP23 (31.25%). Both participants belonged to the advanced group and also had similar profiles and backgrounds. They started learning English

when they were 11 and 12 years old, SP23 had not been to an English speaking country at the time of data collection, but SP15 had, and they both reported being frequently in contact with the language. Participant SP15 is bilingual; that is, he/she speaks BP and French as L1s, and perhaps this influenced his/her performance somehow.

**Table 14***Total amount of voicing, devoicing and voicing change*

Participant	Level <sup>a</sup>	Total Voicing <sup>b</sup>	Total Devoicing <sup>b</sup>	Total Voicing change <sup>c</sup>
SP01	1	11 (45.83%)	13 (54.16%)	24 (50%)
SP02	1	12 (50%)	11 (45.83%)	23 (47.92%)
SP03	1	9 (37.5%)	9 (37.5%)	18 (37.5%)
SP04	1	10 (41.66%)	17 (70.83%)	27 (56.25%)
SP05	1	10 (41.66%)	14 (58.33%)	24 (50%)
SP06	1	6 (25%)	12 (50%)	18 (37.5%)
SP07	1	6 (25%)	14 (58.33%)	20 (41.66%)
SP08	1	4 (16.66%)	15 (62.3%)	19 (39.58%)
SP09	1	11 (45.83%)	10 (41.66%)	21 (43.75%)
SP10	1	8 (33.33%)	12 (50%)	20 (41.66%)
SP11	1	13 (54.16%)	13 (54.16%)	26 (54.16%)
SP12	1	10 (41.66%)	15 (62.3%)	25 (52.08%)
SP13	2	7 (29.16%)	12 (50%)	19 (39.58%)
SP14	2	12 (50%)	15 (62.3%)	27 (56.25%)
SP15	2	5 (20.83%)	9 (37.5%)	14 (29.16%)
SP16	2	9 (37.5%)	9 (37.5%)	18 (37.5%)
SP17	2	14 (58.33%)	11 (45.83%)	25 (52.08%)
SP18	2	2 (8.33%)	20 (83.33%)	22 (45.83%)
SP19	2	12 (50%)	8 (33.33%)	20 (41.66%)
SP20	2	8 (33.33%)	13 (54.16%)	21 (43.75%)
SP21	2	9 (37.5%)	15 (62.3%)	24 (50%)
SP22	2	12 (50%)	11 (45.83%)	23 (47.92%)
SP23	2	3 (12.5%)	12 (50%)	15 (31.25%)

a. Proficiency level: 1 = intermediate / 2 = advanced

b. N=24 / c. N=48

Regarding the highest and lowest scores for voicing and devoicing, Table 14 shows that the results are somewhat different from the results presented in the previous paragraph. The participants who presented the highest scores for voicing with /s/ in word-final position were SP11 (54.16%) and SP17 (58.33%). They belonged to different groups, intermediate and advanced, respectively, but had similar profiles and backgrounds. They both started learning English when they were 11 years old and were constantly in contact with the language. However, SP11 had not been to an English-speaking country at the time of data collection, but SP17 had been to an English-speaking country and had studied there for one semester. Moreover, the participants who obtained the lowest scores for voicing occurrence were SP18 (8.33%) and SP23 (12.5%). They both belonged to the advanced group and they informed similar profiles and backgrounds. They all started learning English when they were 11/12 years old and were constantly in contact with the language. Nevertheless, SP23 had not been to an English-speaking country at the time of data collection, but SP18 had. In addition, regarding the scores for devoicing, the participants who obtained the highest scores for devoicing with /z/ in word-final position were SP18 (83.33%) and SP04 (70.83%). These two participants as well as their profiles and backgrounds were already mentioned above: (1) SP04 presented the highest score for voicing change; (2) SP18 presented the lowest score for voicing with /s/; therefore, it can be concluded that this participant controlled his/her pronunciation so that he/she would produce /s/ in all circumstances. Moreover, the participant who obtained the lowest score for devoicing occurrence was SP19 (8 from 24 tokens, 33.33%). This participant belonged to the advanced group, started learning English at the age of 10, had been to and studied at a University of an English-speaking country, and was frequently in contact with the language.

All things considered, it can be concluded that devoicing with /z/ in word-final position is more frequent than voicing with /s/, for their highest and lowest scores vary greatly (devoicing: max. = 20 and min. = 8; voicing: max. = 14 and min. = 2). These results corroborate the SCH, as they suggest that producing the voiced consonant /z/ is more difficult than producing the voiceless /s/ (Eckman, 2009). Considering that in BP, /z/ in word-final position occurs only when followed by a vowel or

a voiced consonant (i.e., when it assimilates the voicing feature of the following segment), the production of this sound in English is more difficult for NBP than /s/, who end up facilitating the production of /z/ by devoicing it in word-final position.

Section 4.3 discussed the results obtained from the data analysis with the intention of answering research question three, which was concerned with the influence of the phonological context on the production of voicing change with /s/ and /z/ in word-final position. In accordance with what was predicted in the hypothesis proposed, the results displayed in Tables 9 and 10 show that the phonological contexts that induced more voicing occurrence with /s/ are a voiced consonant and a vowel, respectively. Furthermore, the phonological contexts that induced more devoicing occurrence with /z/ are a pause and a voiceless consonant, respectively. Moreover, after all considerations based on the SCH, it can be concluded that the occurrence of devoicing with /z/ is more frequent than the occurrence of voicing with /s/. To enrich the analysis, I also discussed possible interactions between orthography and phonological contexts, thus examining the results per each word tested. A closer examination of the data set was also presented by discussing the results per participant.

The following section presents the summary of the results found from the data analyzed as well as an overview of the theoretical framework that helped to build this study and its relation with the results obtained.

#### **4.4 Summary of results**

The results from this study showed that voicing change with /s/ and /z/ in word-final position is a recurrent pronunciation issue that does not decrease to a great extent after a longer period of instruction; that is, learners from different levels of proficiency produced almost the same amount of non-target pronunciation regarding voicing change occurrence due to L1 transfer. Moreover, L1 sound-spelling transfer also plays a role in the occurrence of voicing change, as shown by the influence of the silent –e grapheme especially on the production of the target sound /s/ in word-final position. Furthermore, although there are



other factors that might influence the accurate production of /s/ and /z/ in word-final position, such as the type of task used for collecting data and the carrier words included in the test, the phonological contexts that yielded the highest voicing rates with /s/ are a voiced consonant and a vowel, respectively. In addition, the phonological contexts that yielded the highest rates of devoicing with /z/ are a pause and a voiceless consonant. These results support the claim that transfer of L1 phonological processes is a recurrent process in learners' L2 speech.

The results obtained for the first research question indicated that the automatic transfer of assimilation of the voicing feature of the following segment does not decrease significantly after a longer period of instruction; that is, advanced learners of English do not have a much better performance than intermediate learners of English. In this sense, these results are contrary to the results of previous studies (Koerich, 2002; Silveira, 2012; Zimmer, 2004), which suggested that the performance (perception and production) of the learners improves after a longer period of instruction. In other words, in Koerich (2002) advanced learners of English produced and perceived the word-final consonant better than intermediate learners, and in Silveira (2012) and Zimmer (2004), advanced learners of English resorted less often to L1 phonological processes (i.e., delateralization, vocalization of nasals, syllable simplification, among others) in L2 speech than intermediate learners of English. The results of the present lead us to conclude that the level of proficiency does not always affect the performance of L2 learners, especially when the pronunciation problem is based on the transfer of automatic phonological processes, such as the case of the assimilation of the voicing feature. But we cannot rule out the fact that proficiency level may not have been successfully measured in this study, as no specific proficiency test was given to the participants. Moreover, the sample size investigated here was rather small.

With the results obtained for the second research question as well as the results of previous studies (Silveira, 2004; 2009; 2012), it can be perceived that orthography plays an important role in L2 pronunciation. One of the studies (Silveira, 2012) showed that, despite the fact that the presence of a final silent –e grapheme in some cases might reduce the production of some phonological processes and lead to a more target-like production, it might also lead the NBP learners of English to resort to vowel paragoge more frequently, thus, hindering the target-like pronunciation. Another study (Silveira, 2004) showed evidence that orthography has an influential role in the pronunciation of

NBP learners of English, since the results showed a higher production of vowel epenthesis rates with words containing the silent –e grapheme compared to words without this grapheme. Furthermore, the type of task used to collect data can also influence L2 pronunciation, taking into account that normally L2 learners have more contact with the L2 in the written form, and this type of contact might lead learners to rely on L1 spelling and pronunciation correspondences when pronouncing L2 words (Silveira, 2009), especially when performing reading-aloud tasks. All things considered, the results from this study corroborate previous studies regarding this issues for it was concluded that the presence of the silent –e grapheme influenced the occurrence of voicing change with /s/ and /z/ in word-final position. Therefore, these results lead us to conclude that pronunciation problems stemming from inadequate transfer of L1 sound-spelling correspondence into the L2 are an important issue to be considered in L2 acquisition.

Regarding the phonological context that most often triggers the occurrence of voicing change, the results obtained from the data analyzed confirmed the hypothesis proposed. In other words, as predicted in the hypothesis based on the BP assimilation rule (i.e., consonants and vowels affect adjacent segments) (Cristófaró-Silva, 2010), the phonological context that yielded the highest rates of voicing with /s/ in word-final position were a voiced consonant (mean = 3.56), followed by a vowel (mean = 3.17). In addition, the phonological context that yielded the highest rates of devoicing with /z/ in word-final position were a pause (mean = 5.60), followed by a voiceless consonant (mean = 4.13). In this sense, it can be concluded that these results corroborate the results from Zimmer and Alves (2008), since their results also showed that Brazilian participants' production did not show a neutralization of contrast between voiceless and voiced final stops. In another study, Edge's (1991) results showed that most cases of devoicing were found before a pause, followed by the voiceless consonant, and then the voiced consonant. In this case, the results of the present study corroborate the results of the second aforementioned study, concerning the influence of the phonological context on the production of L2 sounds, rule transferred from the L1.

Carlisle (1991) verified the influence of the phonological context on the occurrence of vowel epenthesis. The author noticed that the occurrence of vowel epenthesis before the English onset /sC/ was conditioned by the phonological context, which provided evidence that

they were transferring the syllable structure conditions and the rule of epenthesis from their L1, which corroborates the results found in the present study, where the phonological context as well as the L1 influence play a role on the L2 production.

Nevertheless, in a study conducted by Silveira (unprepared manuscript), the results showed that the /s/ was predominantly voiced when the /s/ words were followed by words beginning with a voiced consonant. Silveira's results corroborate the present study, for the former indicates that the /s/ is voiced when followed by a voiced consonant. In addition, Fullana and Mora's (2009) results showed that the participants' production of voiced stops and fricatives with no vocal fold vibration matches the predicted difficulties for Romance language speakers. Therefore, they would produce particular sounds based on L1 strategies. Furthermore, Simon (2010) she found that voicing change was highly frequent in the L1 depending on the phonological context, and consequently was transferred into the L2. The last three studies corroborate the results obtained in the present study. Besides, devoicing with /z/ in word-final position was shown to be more frequent than voicing with /s/, and this result corroborates the SCH proposed by Eckman (1991, 2009) in that this hypothesis predicts that interlanguages would also display the same universal principles of the natural languages (in this case, the markedness of voiced consonants).

In short, these results showed that there are several issues that influence L2 pronunciation such as, orthography, phonological context, the type of task used to collect data, and the target words used in the sentences. Furthermore, accurate pronunciation is an important subject to be taken into consideration when teaching an L2, not only because of the fact that mispronunciation can hinder communication, but also because accurate pronunciation, as well as phonetics and phonology lessons, conduce learners to higher awareness and familiarity with the L2 they are learning, and these two things combined might help L2 learners with the arduous process of acquiring an L2 sound system.

## CHAPTER V

### SUMMARY AND CONCLUSIONS

This study investigated the occurrence of voicing change with /s/ and /z/ in word-final position by NBP learners of English. In order to guide this study, three research questions and three hypotheses were proposed. It was believed that three variables would interfere in the production of voicing change with /s/ and /z/ in word-final position by NBP learners of English, namely: (1) level of proficiency (i.e., intermediate and advanced); (2) orthography (i.e., silent –e condition); and (3) phonological contexts following the target sounds (i.e., a pause, a vowel, a voiced consonant and a voiceless consonant). In this chapter I will briefly mention the results of the data analysis as well as their relation with previous studies and theories. Moreover, I will also comment about the implications of the findings for the acquisition of an L2, more precisely the acquisition of L2 sounds. Finally, I will present the implications of this study for the BP / English interphonology field, the limitations of this study, and also give some suggestions for future research.

Results from the data analysis suggest that the level of proficiency has little influence on the amount of voicing change produced by participants classified in the intermediate and advanced groups based on their profile background. This result is contrary to those of previous studies that investigated the pronunciation of NBP learners of English using the level of proficiency as a variable (Koerich, 1999; 2002; Silveira, 2012; Zimmer, 2004), considering that all studies showed evidence that the level of proficiency had a positive relation with the pronunciation of NBP, that is, the more proficient the learners, the better their pronunciation.

Regarding orthography, results confirmed the hypothesis proposed presenting evidence that the silent –e grapheme played a role in the production of voicing of /s/ in word-final position and of devoicing of /z/ this position, though the latter was to a lesser degree. This influence might be caused by L1 sound-spelling rule transfer, inducing the NBP to assimilate the voicing feature of the silent –e grapheme and producing non-target sounds in the case of /s/ words, and causing them to unconsciously produce the target words more accurately

in the case of /z/ words. Furthermore, the results of this study concerning orthographic influence on voicing change of /s/ and /z/ in word-final position corroborate the results of previous studies (Silveira, 2009, 2012), in which orthographic representations of words contributed to the higher rates of vowel epenthesis in English words ending in the silent -e grapheme.

Concerning the influence of phonological context on the production of voicing change of /s/ and /z/ in word-final position, results from the data analysis confirmed the hypothesis proposed: the phonological contexts that yielded higher rates of voicing of /s/ in word-final position were a voiced consonant and a vowel, and those that yielded higher rates of devoicing with /z/ in word-final position were a pause and a voiceless consonant. The results of previous studies that investigated the phonological context as variable (Carlisle, 1991; Edge, 1991; Silveira, unprepared manuscript; Simon, 2010) suggest that it plays a role in the accurate production of target sounds, depending on the speaker's L1. In the case of this study, NBP transfer the BP assimilation rule of the voicing feature of the following segment (Cristófaró-Silva, 2010). For this reason, it can be said that the results of this study corroborate the results of previous studies, regarding the production of voicing change as well as the influence of the phonological contexts in the production of L2 sounds.

Moreover, the higher frequency of voicing change occurrence with /z/ may be explained by the SCH (Eckman, 1991, 2009), which can predict the level of difficulty of acquiring L2 structures based on markedness principles of the world's languages. Thus, since [z] is more marked than [s] in final position, the English words ending in /z/ yielded more non-target pronunciations by the learners in this study than the words ending in /s/.

To conclude, the goals of the present study were achieved, considering that now there is a better understanding of voicing change of alveolar fricatives in word-final position in BP/English interphonology. This knowledge may help us to understand the acquisition of the English phonological system and may also be very useful, for teachers to be aware of the possible non-target pronunciations their students are likely to produce, so that they can provide help to minimize the transfer of L1 processes that lead to non-target production. The occurrence of voicing change with /s/ and /z/ in word-final position

is an automatic L1 process that is transferred to the L2, sometimes resulting in non-target productions, which learners are not aware of. Considering this, pronunciation materials should be designed for specific audiences, focusing on the probable problems that particular L2 learners are likely to have when acquiring the L2 sound system, and in this case, the production of alveolar fricatives in word-final position. Being aware of this issue can also make students more concerned about their pronunciation, leading them to possibly invest more time trying to pronounce word-final alveolar fricatives in a more target-like fashion.

Although this study has its hypotheses based on previous research and overall succeeded in answering the proposed research questions, there are some limitations that are worth mentioning. To begin, the task used to collect data (i.e., reading non-topic-related sentences) might have biased the participants' production, thus, influencing the results. Data were collected using controlled speech to make sure the participants would produce the target sounds in specific phonological contexts. Since this allows the participants to control better their pronunciation, the production might also sound mechanical, containing more pauses than natural speech (Bygate *et al.*, 2001; Derwing *et al.*, 2003; Ellis, 1990; Robinson, 1996; as cited in Silveira, 2007). Conversely, when we use non-controlled speech, it is possible to have natural speech, but it is difficult to obtain the production of the target sounds in specific phonological contexts. Although the task used to collect data is more guaranteed in the sense that it is possible to control the production of the target sounds, the speech did not sound as natural and fluent as desired and pauses may have been more frequent than expected.

The number of participants is another limitation of the present study that is worth mentioning. In total there were 25 participants, but two of them had their recordings ruined, leaving the final number of participants as 23: 12 in the intermediate group and 11 in the advanced group. This number is still a small sample size, since the larger the number of participants in a study, the more reliable the results are. Unfortunately, the number of participants is something difficult to control, for the researcher depends on the willingness of volunteers to participate in the research, and in the case of this study, due to the non-expected longer period of collecting data material preparation, the data had to be collected in a shorter period of time.

Another limitation considered in this study which is worth mentioning is the restricted use of the PRAAT program for acoustic analysis. PRAAT was basically used to verify if the target sounds

produced were voiceless or voiced, therefore this was the only acoustic analysis conducted for this study. The lack of familiarity with the program limited a deeper acoustic analysis of the data provided by the participants, which could be useful to understand and explain some of the findings. Perhaps, for a further research, it would be valid to consider all the tools provided by PRAAT for the acoustic analysis.

In addition, although there are limitations to this study, the results and conclusions enrich the BP/English interphonology area, considering that the focus of this study, voicing change, has hardly been investigated in BP/English interphonology studies. Therefore, it is hoped that other researchers might use the focus of the present study in order to conduct their own research, also focusing on voicing change and the variables that might influence its occurrence, but also broadening their perspective and improving their method. In this sense, it is important to highlight what other aspects are worth considering when conducting research focusing on voicing change.

First of all, the type of task used to collect data is influential. Therefore, I believe that reading sentences is a good way to control for the target sounds, but recording a casual conversation as well and comparing these speech samples is a way to check if the results obtained with a reading task are in accordance with the production of alveolar fricatives in a non-scripted task. Reading and memorizing the sentences before recording them is also a good method to collect more natural speech samples. Another factor that would be worth considering is pronunciation instruction. In other words, the research could focus on the voicing change occurrence before and after treatment, and the process of collecting data would be in three stages: (1) recording of sentences containing the target sounds; (2) explicit instruction about the pronunciation problem and opportunity for practice; (3) second recording of sentences containing the target sounds. With these procedures, it would be possible to check whether voicing change occurrence would decrease after treatment, verifying if it is useful to resort to explicit pronunciation teaching of the target sounds. The length of the vowel that comes before the target sound is another variable that should be taken into consideration when producing consonants in word-final position, for it is also possible to check whether the speaker differentiates the production of voiceless and voiced consonants through the length of the previous vowel, considering that the vowel that comes before a voiceless consonant is shorter than the vowel that comes before a voiced consonant (Lisker, 1973). Finally, studies could investigate the effects of voicing change on listeners' perception, that is, on how

intelligible and comprehensible a speech that contains voicing change is for the listener, whether a native speaker of English or not. This would be helpful to verify the effect of a mispronunciation for the listener. In this case, controlling for previous vowel length is also useful to check if the listener also relies on this feature to distinguish the production of a voiced consonant from a voiceless consonant.

In conclusion, the role of phonological context and orthography should be taken into careful consideration in BP/English interphonology studies, considering that the results presented in this study draw attention to their role in the production of L2 sounds. In fact we saw in this study that these variables are so naturally transferred from the L1 to the L2 speech that even more proficient learners are subject to their interference as much as less proficient learners of English. These findings emphasize the necessity of providing learners of English with pronunciation instruction focusing on their particular needs, and including sound-spelling correspondence comparisons between the two languages, in this case, BP and English, so that learners could be made aware of the different sound-spelling correspondences. Thus, the results presented here can be useful in order to improve the design of specific pronunciation materials for Brazilian learners, focusing on the usual pronunciation problems that Brazilian learners face when acquiring an L2, and also taking into consideration the issues of orthography and phonological context influence.



## REFERENCES

- Baratieri, J. P. (2006). *Production of /l/ in the English coda by Brazilian EFL learners: An acoustic-articulatory analysis*. (Unpublished master dissertation). Universidade Federal de Santa Catarina, Florianópolis.
- Barreiro, S.C. (1999). Perception of fricative "voicing" and "place of articulation" in English sibilants, in *Actes del I Congrés de Fonètica Experimental*. Tarragona, 22, 23 i 24 de febrer de 1999. Universitat Rovira i Virgili - Universitat de Barcelona. pp. 111-118.
- Bettoni-Techio, M. (2008). *Perceptual training and word initial /s/-clusters in Brazilian Portuguese/English interphonology*. (Unpublished doctoral dissertation). Universidade Federal de Santa Catarina, Florianópolis.
- Bosch, L. & Sebastián Gallés, N. (2003). Language experience and the perception of a voicing contrast in fricatives: infant and adult data, in *Proceedings of the 15th International Congress of Phonetic Sciences*. Barcelona 3-9 August 2003. pp. 1987-1990.
- Cagliari, L. C. (2007). *Elementos de fonética do português brasileiro*. São Paulo: Paulistana.
- Carlisle, R. S. (1991). The influence of the environment on vowel epenthesis in Spanish/English interphonology. *Applied Linguistics*, vol. 12, no. 1, 76-95. Oxford University Press.
- Celce-Murcia, M., Brinton, D. & Goodwin, J. M. (2010). *Teaching pronunciation*. New York: Cambridge University Press.
- Christophersen, P. (1973). *An english phonetics course*. London: Longman.
- Cornelian Jr., D. (2003). *Brazilian learners' production of initial /s/ cluster: Phonological structure and environment*. (Unpublished master dissertation). Universidade Federal de Santa Catarina, Florianópolis.
- Cristófaros-Silva, T. (2010). *Fonética e fonologia do português: roteiro de estudos e guia de exercícios*. São Paulo: Editora Contexto.
- Dorney, Z. (2007). *Research methods in applied linguistics*. Oxford University Press: Oxford.
- Dickerson, W. B. (1985). A spelling approach to word-final voicing. *FORUM*, vol. 23, no. 1, 29-33.
- Eckman, F. R. (1987). Markedness and the contrastive analysis hypothesis. In: G. Ioup and E. S. H. Weinberger (Eds.), *Interlanguage*

- phonology: the acquisition of a second language sound system*. New York: Newbury House, 55-69.
- Eckman, F. R. (1991). The structural conformity hypothesis and the acquisition of consonant clusters in the interlanguages of ESL learners. *Studies in Second Language Acquisition*, vol. 13, no. 1, 23-41.
- Eckman, F. R. (2009). Typological markedness and second language phonology. In: Hansen, J. G. E.; Zampini, M. L. (Ed.), *Phonology and Second Language*. Philadelphia: John Benjamins, 95-115.
- Edge, B. A. (1991). The production of word-final voiced obstruents in English by L1 speakers of Japanese and Cantonese. *Studies in Second Language Acquisition*, 13, 377-393. Cambridge University Press.
- Flege, J. E. (1995). Second language speech learning: Theory, findings, and problems. In: Strange, W. (Ed.), *Speech Perception and Linguistic Experience: Issues in Cross-Language Research*. Timonium, MD: York Press, 233-277.
- Fullana, N. & Mora, J. C. (2009). Production and perception of voicing contrast in English word-final obstruents: Assessing the effects of experience and starting age. In: Watkins, M. A.; Rauber, A. S.; Baptista, B. O. (Org.) *Recent Research in Second Language Phonetics/Phonology: Perception and Production*. Cambridge: Cambridge Scholars Publishing, 97-117.
- Gass, S. (2010). Experimental research. Paltridge, B. & Phakiti, A. (Org.) *Continuum companion to research methods in applied linguistics*. Continuum International Publishing group. New York, pp. 7-21.
- Grijzenhout, J. (2000). Voicing and devoicing in English, German, and Dutch; evidence for domain-specific identity constraints. *Two papers on constraint domains*, 116. Retrieved from: <http://user.phil-fak.uni-duesseldorf.de/~grijzenh/sfb116-voice.PDF>
- Kirk, C. & Demuth, K. (2005). Asymmetries in the acquisition of word-initial and word-final consonant clusters. *Journal of Child Language*, v. 32, n. 4, pp. 709-734.
- Koerich, R. D. (1999). *Assessing nonnatives' discrimination of English #CVC# and #CVCV# sequences*. (Unpublished manuscript). Universidade Federal de Santa Catarina, Florianópolis.
- Koerich, R. D. (2002). *Perception and production of word-final vowel epenthesis by Brazilian EFL students*. (Unpublished doctoral dissertation). Universidade Federal de Santa Catarina, Florianópolis.
- Ladefoged, P. (2005). *Vowels and consonants: an introduction to the sounds of languages*, Second Edition. California: Blackwell Publishing.
- Larson-Hall, J. (2010). *A guide to doing statistics in second language research using SPSS*. New York: Routledge.

- Lisker, L. (1973). *On “explaining” vowel duration variation*. Paper presented at the winter meeting of the Linguistic Society of America, San Diego, CA. 28-30 December.
- López Bascuas, L.E., Rosner, B.S. & García Albea, J.E. (2003). Voicing and temporal order perception by Spanish speakers, in *Proceedings of the 15th International Congress of Phonetic Sciences*. Barcelona 3-9 August 2003 pp. 403-406.
- Major, R. (2009). Transfer in second language phonology. In: Hansen, J. G. E.; Zampini, M. L. (Ed.), *Phonology and Second Language*. Philadelphia: John Benjamins, 63-94.
- Mateus, M. H. and d’Andrade, E. (2000). *The phonology of Portuguese*. Oxford University Press.
- Miller, J.L., Green, K.P. & Reeves, A. (1986). Speaking rate and segments: a look at the relation between speech production and speech perception for the voicing contrast, *Phonetica*, 43, 106-115.
- Monareto, V. N. O., Quednau, L. R. and Hora, D. da (1996). As consoantes do português. In: Bisol, Leda (Editor) *Introdução aos estudos de fonologia do português brasileiro*. Porto Alegre: EdIPUCRS.
- Moore, D. H. (2008). *The perception of English word-final /l/ by Brazilian learners*. (Unpublished master dissertation). Universidade Federal de Santa Catarina, Florianópolis.
- Netto, W. F. (2001). *Introdução à fonologia da língua portuguesa*. São Paulo: Hedra.
- Nobre-Oliveira, D. (2007). *The effect of perceptual training on the learning of English vowels by Brazilian Portuguese speakers*. (Unpublished doctoral thesis). Universidade Federal de Santa Catarina, Florianópolis.
- Odlin, T. (1990). *Language transfer: cross-linguistic influence in language learning*. New York: Cambridge University Press.
- Piroth, H. G. and Janker, P. M. (2004). Speaker-dependent differences in voicing and devoicing of German obstruents. *Journal of Phonetics*, 32, 81-109.
- Rauber, A. (2002). *The production of English initial /s/ clusters by Portuguese and Spanish EFL speakers*. (Unpublished master dissertation). Universidade Federal de Santa Catarina, Florianópolis.
- Rauber, A. (2006). *Perception and production of English vowels by Brazilian EFL speakers*. (Unpublished doctoral thesis). Universidade Federal de Santa Catarina, Florianópolis.
- Reis, M. S. (2006). *The perception and production of English interdental fricatives by Brazilian EFL learners*. (Unpublished master dissertation). Universidade Federal de Santa Catarina, Florianópolis.

Seliger, H. W. & Shohamy, E. (1989). *Second language research methods*. New York: Oxford University Press.

Silveira, R. (2004). *The influence of pronunciation instruction on the perception and production of English word-final consonants*. (Unpublished doctoral thesis). Universidade Federal de Santa Catarina, Florianópolis.

Silveira, R. (2007). The role of task-type and orthography in the production of word-final consonants. *Revista de Estudos da Linguagem*, v. 15, p. 143-176.

Silveira, R. (2009). Investigating the role of orthography in the acquisition of L2 pronunciation: A case study. In: Michael A. Watkins, Andreia S. Rauber, Barbara O. Baptista. (Org.). *Recent Research in Second Language Phonetics/Phonology: Perception and Production*. Newcastle upon Tyne: Cambridge Scholars Publishing, p. 270-290.

Silveira, R. (2011a). Avaliando a proficiência oral em língua inglesa: o papel do perfil dos avaliadores e dos informantes. In M. B. Mota, J. M. Bergsleithner & J. Weissheimer (Org.), *A formação de professores de Línguas: novos olhares* (pp. 73-95). Campinas: Pontes Editores.

Silveira, R. (2011b). Pronunciation Instruction and Syllabic-Pattern Discrimination. *DELTA (Documentação de Estudos em Linguística Teórica e Aplicada)*. v. 27, p. 5-22, PUCSP.

Silveira, R. and Souza, T. (2011c). A percepção e a produção das fricativas alveolares da língua portuguesa por hispano-falantes. *Revista de Estudos da Linguagem*, v. 19, p. 167-184.

Silveira, R. (2012). L2 production of English word-final consonants: the role of orthography and learner profile variables. *Trabalhos em Linguística Aplicada*.

Silveira, R. (unprepared manuscript). *Voicing change in the production of alveolar fricatives by Brazilian*. Unpublished manuscript. Florianópolis: Univesidade Federal de Santa Catarina.

Simon, E. (2010). Phonological transfer of voicing and devoicing rules: evidence from L1 Dutch and L2 English conversational speech. *Language Sciences*, 32, 63-86.

Smith, B. L., Hayes-Harb, R., Bruss, M. & Harker, A. (2009). Production and perception of voicing and devoicing in similar German and English word pairs by native speakers of German. *Journal of Phonetics*, 37, 257-275.

Smith, C. L. (1997). The devoicing of /z/ in American English: effects of local and prosodic context. *Journal of Phonetics*, 25, 471-500.

- Temperly, M. S. (1983). The articulatory target for final –s clusters. *TESOL QUARTERLY*, vol. 17, no. 3, 421-436.
- Trask, R. L. (2007). *A dictionary of phonetics and phonology*. London and New York: Routledge.
- Yavas, M. (1994). Final stop devoicing in interlanguage. In: Yavas, Mehmet (Ed.). *First and second language phonology*. San Diego, CA: Singular Publishing Group, Inc.
- Yavas, M. (1997). The effects of height and place of articulation in interlanguage final stop devoicing. *International Review of Applied Linguistic*, vol. 35, no. 2, 115-125.
- Yavas, M. (2011). *Applied English Phonology*. Oxford: Wiley-Blackwell.
- Zimmer, M. (2004). *Transferência do conhecimento fonético-fonológico do português brasileiro (L1) para o inglês (L2) na recodificação leitora: uma abordagem conexionista*. 2004. Unpublished doctoral dissertation. Porto Alegre: Pontifícia Universidade Católica do Rio Grande do Sul.
- Zimmer, M. & Alves, U. K. (2008). On the status of terminal devoicing as an interlanguage process among Brazilian learners of English. *Ilha do Desterro*, no. 55, 41-62.
- Zimmer, M., Silveira, R. & Alves, U. K. (2009). *Pronunciation instruction for Brazilians: bringing theory and practice together*. UK: Cambridge Scholar Publishing.

**Appendix I****TERMO DE CONSENTIMENTO****Prezado Participante,**

Este questionário é parte de uma pesquisa de mestrado conduzida sob a supervisão da Professora Doutora Rosane Silveira, no Programa de Pós-Graduação em Inglês da Universidade Federal de Santa Catarina. Eu, Mayara Tsuchida Zanfra, gostaria de convidá-lo(a) para participar da coleta de dados desta pesquisa, cujo foco é na pronúncia. Os dados coletados servirão como base para a conclusão de minha dissertação, a ser defendida em dezembro de 2012. Mais informações sobre o estudo poderão ser fornecidas após a coleta de dados, de forma que as mesmas não influenciem seu desempenho e escolhas ao responder as perguntas.

**É importante lembrar que a sua identidade não será revelada, bem como qualquer informação pessoal que possa identificá-lo(a).** Caso você concorde em participar desta pesquisa, você será requisitado a: **1)** responder perguntas sobre alguns dados pessoais (ex.: idade, cidade onde reside, conhecimento de línguas estrangeiras, etc.) e **2)** ler 54 frases em inglês e 16 frases em português (**com gravação de áudio**). Primeiramente você terá tempo para ler sobre os procedimentos e clarificar qualquer dúvida que venha a ter. Ao final da pesquisa/defesa da dissertação, os dados serão publicados (com a sua identidade protegida).

Agradeço desde já a sua colaboração.

**Atenciosamente,**  
**Mayara Tsuchida Zanfra**

Eu **concordo** em participar desta pesquisa e permito que o pesquisador utilize os dados por mim fornecidos.

## Appendix II

### QUESTIONÁRIO

Por favor, responda às perguntas abaixo. Este questionário visa somente obter informações que serão utilizadas para direcionar a análise dos dados da pesquisa conduzida. Salientando que em nenhuma hipótese os nomes dos participantes serão divulgados. Solicito informar nome e e-mail somente para, no caso de necessitar alguma informação adicional, poder entrar em contato com você posteriormente.

1. NOME:
2. IDADE:
3. SEXO: FEMININO / MASCULINO
4. EMAIL:
5. CURSO:
6. SEMESTRE:

Responda às perguntas abaixo tendo em mente que o objetivo é traçar um perfil de seu contato com o inglês. Tente ser o mais específico(a) possível. Faça qualquer tipo de comentário que julgar interessante para dar uma visão fiel deste contato.

7. Estudou inglês no colégio? SIM / NÃO
8. Desde que série?
9. Qual a sua idade na época?
10. As aulas exploravam comunicação escrita e oral?
11. Fez outro curso de inglês? SIM / NÃO
12. Qual curso/escola?
13. Em que ano começou?
14. Em que ano terminou/parou?
15. Quantas horas por semana tinha o curso em média?
16. Qual o curso de inglês que frequenta no momento?
17. Qual nível/semestre/fase que frequenta no momento?
18. Quantas horas semanais tem este curso?
19. Quantas horas por semana, além do curso, você dedica ao estudo da língua inglesa / atividades para aperfeiçoar seu inglês?
20. Tem vivência em país de língua inglesa? (mais de 1 mês) SIM / NÃO
21. Por quanto tempo?
22. Qual sua idade na época?
23. Frequentou escola naquele país? SIM / NÃO

24. Que tipo de escola/curso?
25. Conversa com frequência em inglês com outros brasileiros? SIM / NÃO
26. Conversa com frequência em inglês com falantes nativos? SIM / NÃO
27. Assiste a filmes sem dublagem com frequência? SIM / NÃO
28. Ouve músicas em inglês com frequência? SIM / NÃO
29. Canta? Sim / não
30. Transcreve (tira) letras de músicas? SIM / NÃO
31. Estuda, estudou, ou tem contato com outra língua estrangeira? SIM / NÃO
32. Em que contexto? (escola, na família...)
33. Qual língua?
34. Em que cidade e estado foi criado/a?
35. Acrescente qualquer informação que julgar interessante.



## Appendix III

### CONSENT FORM

**Dear participant,**

This questionnaire is part of a Master's research conducted under the supervision of Professor Doctor Rosane Silveira, in the *Programa de Pós-Graduação em Inglês* of the *Universidade Federal de Santa Catarina*. I, Mayara Tsuchida Zanfra, would like to invite you to participate in the data collection of this research, which focuses on pronunciation. Collected data will be used to support the conclusion of my dissertation to be defended in December, 2012. More information about this study can be provided after the data collection in order not to bias your performance and choices when answering the questionnaire.

**It is important to emphasize that your identity will remain anonymous, as well as any information that can identify you.** In case you agree in participating in this research you will be required to: **1)** answer questions about your personal profile (ex.: age, city where you live, foreign language knowledge, etc.) and **2)** read 54 sentences in English (**audio recording**). First you will have time to read the procedures and clarify any question that you might have. By the end of the research, data will be published.

Thank you for your cooperation and participation.

**Cordially,  
Mayara Tsuchida Zanfra**

I **agree** to participate in this research and I allow the researcher to use the data provided by me.

## Appendix IV

### QUESTIONNAIRE

Please, answer the questions below. This questionnaire aims to collect information that will be used to guide the data analysis of the present research. I would like to emphasize that the names of participants will not be disclosed. It is important to inform your name and e-mail in case additional information is necessary afterwards, so that I can contact you later.

1. NAME:
2. AGE:
3. GENDER: FEMALE / MALE
4. E-MAIL:
5. SCHOOLING:
6. MAJOR:

Answer the questions below keeping in mind that the objective is to outline your profile and background. Try to be as precise as possible. Comment anything that you think is important to help to define your profile and background.

7. Do you speak another language fluently? YES / NO
8. If yes, which language(s)?
9. When did you start to learn this language?
10. Have you ever studied a foreign language? YES / NO
11. If yes, which language(s)?
12. How old were you when you studied this language?
13. When did you stop studying this language?
14. How many hours per week did the course have?
15. Do you study any foreign language currently? YES / NO
16. If yes, which language(s)?
17. Which level are you?
18. How many hours per week does the course have?
19. How many hours per week do you study this language besides the regular course hours?
20. Have you been to a foreign country whose official language is not English? (more than 1 month) YES / NO
21. For how long?

22. What was your age at that time?
23. Did you attend any course in the country? YES / NO
24. What kind of course?
25. Where were you born (city, state)?
26. Where did you live most part of your life (city, state)?
27. Add any information that you think is important.

## Appendix V

Type	English Sentences
Distractor trials	1. It's going to rain tomorrow.
	2. I don't like rice and beans.
	3. The book I want is too expensive.
Monosyllabic words pronounced with the voiceless /s/	4. <i>This ice</i> melted fast.
	5. They <i>miss ideas</i> for their work.
	6. The <i>bus I</i> need is late.
	7. The <i>mouse I</i> saw is white.
	8. The <i>house icon</i> is perfect.
	9. Is this the <i>case I</i> was looking for?
	10. <i>This paper</i> is mine.
	11. We'll always <i>miss Paris</i> .
	12. The <i>bus passed</i> by really fast.
	13. Where is the <i>mouse pad</i> ?
	14. I had my <i>house painted</i> yesterday.
	15. The <i>case problem</i> was fixed.
	16. <i>This bottle</i> is half empty.
	17. I <i>miss being</i> with my family.
	18. The <i>bus belongs</i> to the city.
	19. A <i>mouse broke</i> my glasses.
	20. The <i>house backyard</i> is huge.
21. Let's discuss the <i>case before</i> they go out.	
22. Let me show you <i>this</i> .	
23. It's a show you can't <i>miss</i> .	
24. Let's get the <i>bus</i> .	
25. Look at the <i>mouse</i> .	
26. That's our new <i>house</i> .	
27. We will go in any <i>case</i> .	
Monosyllabic words pronounced with the voiced /z/	28. This jacket <i>goes ideally</i> with these pants.
	29. <i>Does irony</i> count?
	30. Mary <i>moves ideally</i> to the future.
	31. <i>These ideas</i> are very interesting.
	32. <i>Those eyes</i> never lie.
	33. We can <i>lose ideology</i> with that.

	34. Paul <i>goes babysitting</i> .
	35. What <i>does Brenda</i> think of it?
	36. John <i>moves both</i> arms to call attention.
	37. <i>These brownies</i> look delicious.
	38. <i>Those bathrooms</i> are so dirty.
	39. Let's not <i>lose balance</i> .
	40. She <i>goes partying</i> every day.
	41. <i>Does Paula</i> know how to do it?
	42. The cat <i>moves perfectly</i> through the branches.
	43. <i>These pancakes</i> are great.
	44. Are <i>those problems</i> real?
	45. I'm about to <i>lose patience</i> .
	46. I won't go if he <i>goes</i> .
	47. I don't cook like she <i>does</i> .
	48. I like the way she <i>moves</i> .
	49. Are they like <i>these</i> ?
	50. Nick used to hate <i>those</i> .
	51. If you play, you might <i>lose</i> .
	52. My favorite dish is <i>pizza</i> .
Distractor trials	53. Let's play a new game?
	54. The new film with Jim Carrey is really good.

## Appendix VI

<b>Portuguese Sentences</b>
1. Coloque <i>menos açúcar</i> , por favor.
2. <i>Vamos adicionar</i> produto reciclável.
3. Tem bem <i>menos bolas</i> aqui.
4. <i>Vamos brincar</i> de pega-pega?
5. Deve-se usar <i>menos papel</i> .
6. <i>Vamos pagar</i> a conta e sair.
7. Você podia falar <i>menos</i> .
8. Vocês vão à festa, nós não <i>vamos</i> .
9. Ele <i>faz aniversário</i> amanhã.
10. <i>Talvez amanhã</i> eu vá à festa.
11. <i>Faz bastante</i> tempo que não o vejo.
12. <i>Talvez beleza</i> não seja importante.
13. <i>Faz pouco</i> que ele saiu.
14. <i>Talvez possa</i> ser assim.
15. Qualquer um, tanto <i>faz</i> .
16. Hum, chocolate com cereja <i>talvez</i> .

## Appendix VII

Original tables provided by SPSS

### Tests of Normality

Prof#_Level	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Total_s 1,00	,205	12	,175	,942	12	,528
2,00	,180	11	,200*	,942	11	,543
Total_z 1,00	,100	12	,200*	,984	12	,995
2,00	,168	11	,200*	,919	11	,311

a. Lilliefors Significance Correction

\*. This is a lower bound of the true significance.

### Group Statistics

Prof#_Level	N	Mean	Std. Deviation	Std. Error Mean
Total_s 1,00	12	9,1667	2,69118	,77688
2,00	11	8,4545	3,93354	1,18601
Total_z 1,00	12	12,9167	2,27470	,65665
2,00	11	12,2727	3,43776	1,03652

## Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Total	Equal variances assumed	1,703	,206	,511	21	,615	,71212	1,39457	-2,18805	3,61229
	Equal variances not assumed			,502	17,494	,622	,71212	1,41780	-2,27274	3,69698
Total	Equal variances assumed	1,046	,318	,534	21	,599	,64394	1,20534	-1,86270	3,15057
	Equal variances not assumed			,525	17,129	,606	,64394	1,22702	-1,94335	3,23123



### Descriptives

Prof#_Level	Statistic	Std. Error
Total_s 1,00 Mean	9,1667	,77688
95% Confidence Interval for Mean	Lower Bound Upper Bound	7,4568 10,8766
5% Trimmed Mean	9,2407	
Median	10,0000	
Variance	7,242	
Std. Deviation	2,69118	
Minimum	4,00	
Maximum	13,00	
Range	9,00	
Interquartile Range	4,50	
Skewness	-,615	,637
Kurtosis	-,368	1,232
2,00 Mean	8,4545	1,1860 1
95% Confidence Interval for Mean	Lower Bound Upper Bound	5,8120 11,0971
5% Trimmed Mean	8,5051	
Median	9,0000	
Variance	15,473	
Std. Deviation	3,93354	
Minimum	2,00	
Maximum	14,00	
Range	12,00	
Interquartile Range	7,00	
Skewness	-,343	,661

	Kurtosis		-,960	1,279
Total_z 1,00	Mean		12,9167	,65665
	95% Confidence Interval for Mean	Lower Bound	11,4714	
		Upper Bound	14,3619	
	5% Trimmed Mean		12,9074	
	Median		13,0000	
	Variance		5,174	
	Std. Deviation		2,27470	
	Minimum		9,00	
	Maximum		17,00	
	Range		8,00	
	Interquartile Range		3,50	
	Skewness		-,044	,637
	Kurtosis		-,260	1,232
2,00	Mean		12,2727	1,0365 2
	95% Confidence Interval for Mean	Lower Bound	9,9632	
		Upper Bound	14,5822	
	5% Trimmed Mean		12,0808	
	Median		12,0000	
	Variance		11,818	
	Std. Deviation		3,43776	
	Minimum		8,00	
	Maximum		20,00	
	Range		12,00	
	Interquartile Range		6,00	
	Skewness		1,053	,661
	Kurtosis		1,404	1,279

### Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
s	23	2,0870	1,20276	,00	4,00
z	23	7,8261	1,58551	5,00	11,00
se	23	6,7391	2,61495	1,00	11,00
ze	23	4,7826	1,78266	2,00	9,00

### Tests of Normality

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
s	,224	23	,004	,907	23	,035
z	,152	23	,179	,947	23	,256
se	,235	23	,002	,920	23	,068
ze	,235	23	,002	,925	23	,085

a. Lilliefors Significance Correction

### Test Statistics<sup>c</sup>

	se - s	ze - z
Z	-4,088 <sup>a</sup>	-4,131 <sup>b</sup>
Asymp. Sig. (2-tailed)	,000	,000

a. Based on negative ranks.

b. Based on positive ranks.

c. Wilcoxon Signed Ranks Test

**Test Statistics<sup>a</sup>**

N	23,000
Chi-Square	50,300
df	3,000
Asymp. Sig.	,000

a. Friedman Test

**Descriptive Statistics**

	N	Minimum	Maximum	Mean	Std. Deviation
spause	23	,00	2,00	,3478	,64728
svowel	23	,00	5,00	3,1739	1,52709
svdC	23	1,00	5,00	3,5652	1,23679
svlC	23	,00	3,00	1,7391	1,17618
zpause	23	4,00	6,00	5,6087	,58303
zvowel	23	,00	5,00	1,8696	1,45553
zvdC	23	,00	3,00	1,0000	1,12815
zvlC	23	2,00	6,00	4,1304	1,09977
Valid N (listwise)	23				

**Tests of Normality**

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
spause	,444	23	,000	,590	23	,000
svowel	,150	23	,193	,909	23	,039
svdC	,203	23	,015	,887	23	,013
svlC	,206	23	,012	,835	23	,001
zpause	,401	23	,000	,665	23	,000
zvowel	,203	23	,015	,903	23	,029
zvdC	,291	23	,000	,795	23	,000
zvlC	,199	23	,018	,916	23	,056

### Tests of Normality

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
spause	,444	23	,000	,590	23	,000
svowel	,150	23	,193	,909	23	,039
svdC	,203	23	,015	,887	23	,013
svlC	,206	23	,012	,835	23	,001
zpause	,401	23	,000	,665	23	,000
zvowel	,203	23	,015	,903	23	,029
zvdC	,291	23	,000	,795	23	,000
zvlC	,199	23	,018	,916	23	,056

a. Lilliefors Significance Correction

### Test Statistics<sup>c</sup>

	svo wel - spa use	svd C - spa use	svlC - spa use	svd C - svo wel	svl C - svo wel	svl C - svd C	zvo wel - zpa use	zvd C - zpa use	zvlC - zpa use	zvd C - zvo wel	zvl C - zvo wel	zvl C - zvd C
Z	- 4,13 3 <sup>a</sup>	- 4,22 5 <sup>a</sup>	- 3,51 4 <sup>a</sup>	- 1,3 91 <sup>a</sup>	- 3,1 71 <sup>b</sup>	- 3,8 61 <sup>b</sup>	- 4,13 9 <sup>b</sup>	- 4,23 1 <sup>b</sup>	- 3,71 2 <sup>b</sup>	- 2,6 67 <sup>b</sup>	- 3,8 75 <sup>a</sup>	- 4,0 71 <sup>a</sup>
Asy mp. Sig. (2- taile d)	,000	,000	,000	,16 4	,00 2	,00 0	,000	,000	,000	,00 8	,00 0	,00 0

a. Based on negative ranks.

**Test Statistics<sup>c</sup>**

	svo wel - spa use	svd C - spa use	svlC - spa use	svd C - svo wel	svl C - svo wel	svl C - svd C	zvo wel - zpa use	zvd C - zpa use	zvlC - zpa use	zvd C - zvo wel	zvl C - zvo wel	zvl C - zvd C
Z	- 4,13 3 <sup>a</sup>	- 4,22 5 <sup>a</sup>	- 3,51 4 <sup>a</sup>	- 1,3 91 <sup>a</sup>	- 3,1 71 <sup>b</sup>	- 3,8 61 <sup>b</sup>	- 4,13 9 <sup>b</sup>	- 4,23 1 <sup>b</sup>	- 3,71 2 <sup>b</sup>	- 2,6 67 <sup>b</sup>	- 3,8 75 <sup>a</sup>	- 4,0 71 <sup>a</sup>
Asy mp. Sig. (2- taile d)	,000	,000	,000	,16 4	,00 2	,00 0	,000	,000	,000	,00 8	,00 0	,00 0

a. Based on negative ranks.

b. Based on positive ranks.

c. Wilcoxon Signed Ranks Test

### Appendix VIII

Table showing the number of the non-target productions displayed by participant and by spelling / context

Partic.	Level	/s/#	/s/+V	/s/+vdC	/s/+vIC	/z/#	/z/+V	/z/+vdC	/z/+vIC	/se/#	/se/+V	/se/+vdC	/se/+vIC	/ze/#	/ze/+V	/ze/+vdC	/ze/+vIC	Total
SP01	1	0	2	2	0	2	3	1	2	0	1	3	3	3	0	0	2	24
SP02	1	0	2	1	0	3	1	0	3	2	3	3	1	3	0	0	1	23
SP03	1	0	2	0	0	3	0	0	3	1	3	3	0	1	0	0	2	18
SP04	1	0	1	1	0	3	2	1	3	1	2	2	3	3	0	2	3	27
SP05	1	0	2	1	0	3	2	2	3	0	2	3	2	2	0	0	2	24
SP06	1	0	0	1	0	3	0	0	3	0	3	2	0	3	1	0	2	18
SP07	1	0	1	1	0	3	2	2	3	0	0	2	2	3	1	0	0	20
SP08	1	0	0	0	0	3	2	0	3	0	2	1	1	3	1	1	2	19
SP09	1	0	1	1	0	3	1	0	2	0	3	3	3	2	0	0	2	21
SP10	1	0	0	1	0	3	2	0	3	0	3	2	2	3	0	0	1	20
SP11	1	0	2	2	0	3	1	0	3	0	3	3	3	3	1	0	2	26
SP12	1	0	1	1	0	3	1	1	3	0	3	3	2	3	0	1	3	25
SP13	2	0	0	2	0	3	2	0	3	0	2	2	1	3	0	0	1	19
SP14	2	0	2	2	0	3	3	1	3	0	3	3	2	3	1	1	0	27
SP15	2	0	0	1	0	3	0	0	3	0	1	3	0	3	0	0	0	14
SP16	2	0	0	2	0	3	0	0	2	0	1	3	3	3	0	0	1	18
SP17	2	0	2	1	0	3	1	0	3	2	3	3	3	3	0	0	1	25
SP18	2	0	0	1	0	3	3	2	3	0	0	1	0	3	2	1	3	22
SP19	2	0	2	2	0	3	0	0	3	1	3	3	1	2	0	0	0	20
SP20	2	0	1	0	0	3	1	1	3	0	3	2	2	3	1	0	1	21
SP21	2	0	0	0	0	3	3	0	3	0	3	3	3	2	2	1	1	24
SP22	2	0	0	2	0	3	2	2	2	1	3	3	3	2	0	0	0	23
SP23	2	0	1	1	0	3	1	2	2	0	1	0	0	2	0	1	1	15

a. Proficiency level: 1 = intermediate / 2 = advanced