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D E L T A

Articles

English and Portuguese consonant clusters: contrasts and challenges

Os grupos consonantais do inglês e do português: contrastes e desafios

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ABSTRACT

Consonant clusters occur both in Portuguese and English. However, clusters are more productive in English than in Portuguese and there are sequences which are only found in English.This study focuses on the contrasts between American English and Brazilian Portuguese consonant clusters and on three strategies Brazilian learners tend to apply when producing them: adding the high front vowel (epenthesis) between the consonants in the clusters, discarding consonants, or introducing phonetic changes. The relevance of introducing English clusters to Brazilian learners of English is pointed out and discussed under the framework of the Speech Learning Model (SLM).

Keywords: *English consonant clusters; Brazilian consonant clusters; English as L2; language input.*

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RESUMO

Os grupos consonantais ocorrem tanto em inglês quanto em português. Contudo, os grupos consonantais são mais produtivos em inglês do que em português e algumas das sequências de consoantes ocorrem apenas em inglês. Este estudo focaliza os contrastes entre os grupos consonantais em inglês americano e português brasileiro e as estratégias utilizadas por aprendizes brasileiros de língua inglesa ao pronunciá-los: adicionar a vogal anterior alta (epêntese) entre as consoantes dos grupos consonantais, descartar consoantes, ou introduzir alterações fonéticas. A relevância de introduzir os grupos consonantais a aprendizes brasileiros de língua inglesa é apontada e discutida com base no quadro teórico do Modelo de Aprendizagem de Fala (SLM).

Palavras-chave: *Grupos consonantais em inglês; Grupos consonantais em português como L2; inglês como L2; input linguístico.*

1. Introduction

This study focuses on the contrasts between American English and Brazilian Portuguese consonant clusters and on the strategies Brazilian learners tend to apply when producing them. The relevance of introducing English clusters to Brazilian learners of English is pointed out and discussed under the framework of the Speech Learning Model (SLM) developed by Flege (1995).

A consonant cluster is a sequence of consonants without any vowel between (Roach, 1992). As Gouskova and Stanton (2019) point out, the bigger the consonant clusters are, the less common they are in languages. As far as it is known, sequences of maximum 6 consonants are found in the world´s languages (Gordon, 2016).

There are more syllable patterns in English than in Portuguese. Collischonn (2005) and Souza CâmaraSilva and Barboza (2018) provide a list of the possible combinations between vowels (V) and consonants (C) in Portuguese. Nascimento (2016) provides a list of the English clusters based on Hammond (1999) and Pereyron (2008). Due to the greater productivity of clusters in English, more combinations are found. The following, Table 1, is an adaptation of the lists given in these works.

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Table 1 – List of Portuguese and English syllable patterns

Portuguese syllable patterns	English syllable patterns
V	V
CV	CV
VC	VC
CVV	CVV
VCC	VCC
CVC	CVC
CCV	CCV
CVCC	CVCC
CVVC	CVVC
CCVC	CCVC
CCVV	CCVV
CCVVC	CCVVC
CCVCC	CCVCC
	VCCC
	CCCVC
	CCVCC
	VCCCC
	CCVCCC
	CVCCCC
	CCCVCC
	CCVVCC
	CCCVCCC

Source: The author.

A cluster may occur at the beginning, middle and final positions in a word as in "spend", "inspire" and "clasp" or between words as in "more than". Not all sequences of consonants in the written language are pronounced as clusters. In words such as "bomb" and "iamb", orthography can be misleading, since only the bilabial nasal is pronounced.

Depending on the degree of coarticulation, articulatory changes concerning the place of articulation may occur. For instance, the word "headquarters" can be pronounced with a cluster formed by an alveolar plosive followed by a velar plosive or a voiced velar plosive followed by a voiced velar plosive. This latter way of pronouncing the compound word "headquarters" is more economical from the articulatory point of view since the dorsum of the tongue is at the same place of articulation in the production of the two consonants.

Producing and identifying English consonant clusters can be difficult in the acquisition of a L2 language. A study by Rungruang (2017) shows that after 4 year-study in the university, students have difficulties in identifying English consonant clusters.

Consonant clusters occur both in Portuguese and English. However, clusters are more productive in English than in Portuguese and there are sequences which are found only in English. Brazilians learning English have difficulties in pronouncing some sequences and either add vowels (epenthesis) between the consonants, discard consonants in pronouncing them or introduce some phonetic changes. Furthermore, processes of vowel reduction are very common in English and some resulting clusters can impose challenges to the Brazilian learner of English.

In the following wide band spectrograms of words containing clusters, the three mentioned pronunciation strategies usually implemented by Brazilians speaking English (adding vowels, discarding consonants or implementing phonetic changes) can be visualized.

The Figures 2, 4 and 6 refer to English native speakers´productions and the Figures 3, 5 and 7 to Brazilian Portuguese native speakers´ productions. The speech samples were taken from the accent archive recordings stored in the computer server at the Phonetics Laboratory (LIAAC) at PUCSP.

Wide band spectrograms are acoustic signal graphics showing time in the horizontal axis, frequency in the vertical axis and intensity in a gray scale (the darker, the more intense). The dark areas, which are seen in the spectrograms, correspond to the formants and these characterize the quality of the sounds we hear, that is to say, what we hear are the range of frequencies which are intensified in the vocal tract.

According to the Acoustic Theory of Speech Production as developed by Fant (1970) two kinds of source are intensified in the vocal tract: the voice source (generated by the vibration of the vocal folds) and noise sources (generated by obstructions in the vocal tract or in the glottis). All sonorant sounds (vowels, nasals, taps, approximants, trills and laterals) are characterized by voice source). Voiceless obstruent sounds (voiceless stops, fricatives and affricates)

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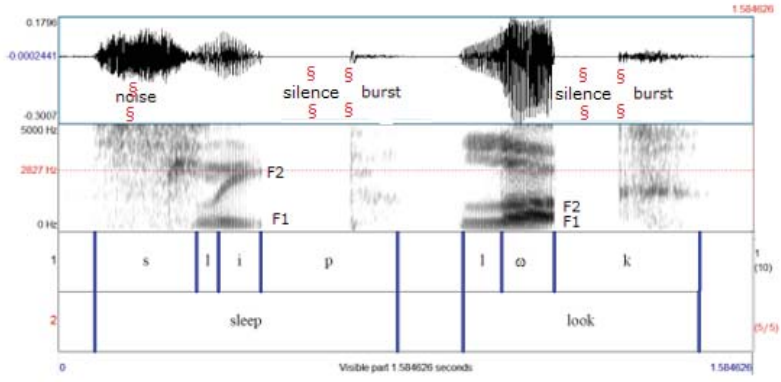
are characterized by noise sources and voice obstruednts by noise and voice source. Some voice qualities, such as whispery voice, are also characterized by noise and voice sources.

To guide the reader not used to read wideband spectrograms, the acoustic signals corresponding to an English native speaker`productions of the words “sleep” and “look” were concatenated, segmented and transcribed phonetically and ortographicaly in Figure 1. The alveolar voiceless fricative is characterized by continuous noise and no voice source, since there is not a dark band (voicing bar) at the bottom of the spectrogram. The voiceless bilabial and velar stops are characterized by by silence and burst noise. The lateral and the vowels are characterized by voice source. The first (F1) and the second (F2) formants in the vowel [i] of the word “sleep” are apart while in the vowel [ω] of the word "look" they are close together. That can be explained by the Acoustic Theory of Speech production by the different configurations of the vocal tract causing the resonances which characterize the quality of these sounds.

Figure 1 – Waveform, wideband spectrogram, phonetic transcription tier and word ortographic transcription of an American English native speaker´s pronunciation of the words “leave” and “look”.

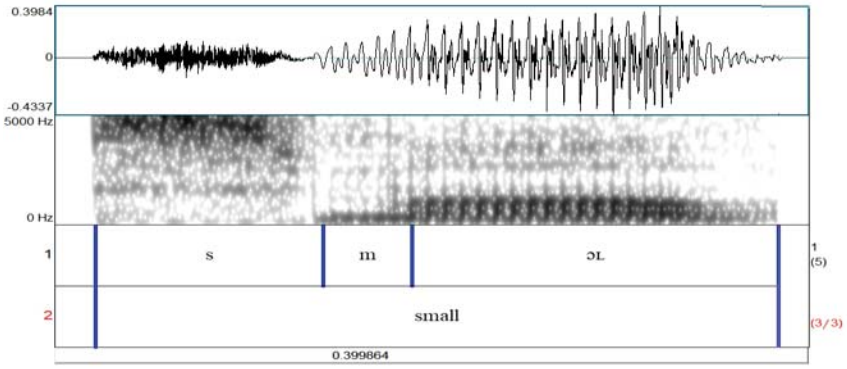


Source: The author.

Wideband spectrograms, contrasting English native and Brazilian speakers' productions of English words and phrases, are presented in Figures 2 to 7. From reading these spectrograms, one can infer production characteristics.

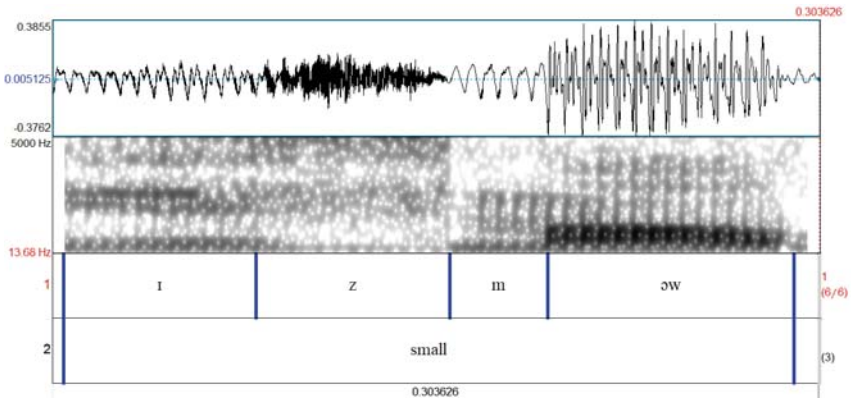
Comparing the wideband spectrograms of the following Figures 2 and 3, the adding strategy used by the Brazilian speaker is made evident.

Figure 2 – Waveform, wideband spectrogram, phonetic transcription tier and word ortographic transcription of the American English native speaker´s pronunciation of the word "small".



Source: The author

Figure 3 – Waveform, wideband spectrogram, phonetic transcription tier and word ortographic transcription of the Brazilian Portuguese native speaker´s pronunciation of the word "small".

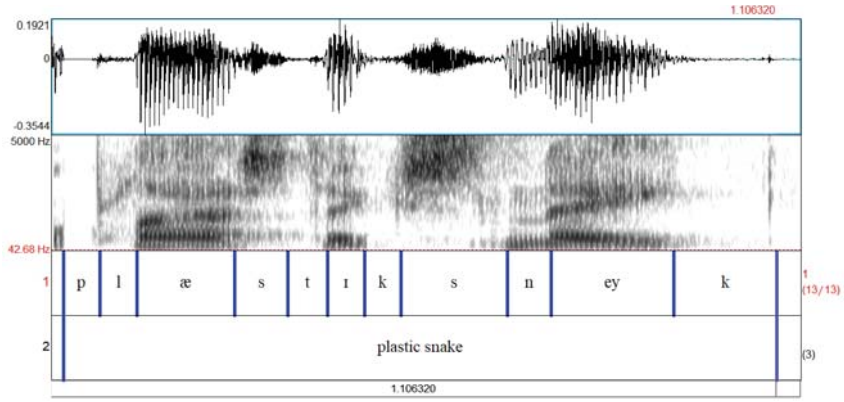


Source: The author

Contrasting the American speaker´speech production of the cluster in the word "small" with the one by the Brazilian Portuguese speaker, a change from [sm] to [ɪzm] can be noted. The adding strategy was employed by the Brazilian Portuguese speaker.

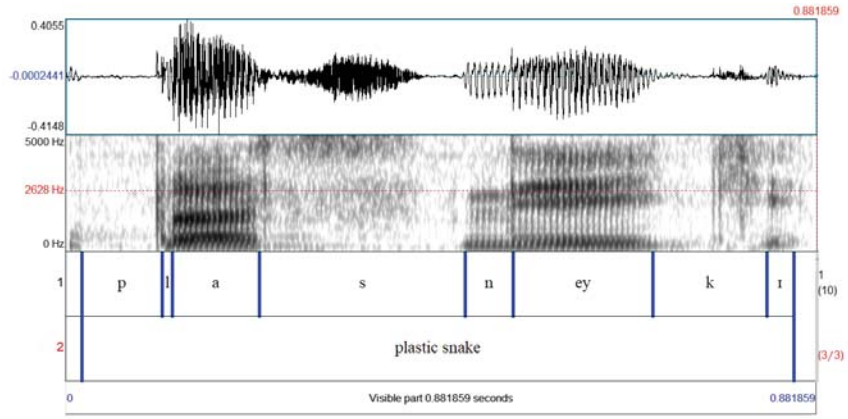
Comparing the wideband spectrograms of the following figures 4 and 5, the discarding strategy used by the Brazilian speaker is made evident.

Figure 4 – Waveform, wideband spectrogram, phonetic transcription tier and word ortographic transcription of the American English native speaker´s pronunciation of the phrase "plastic snake".



Source: The author

Figure 5 – Waveform, wideband spectrogram, phonetic transcription tier and word ortographic transcription of a Brazilian speaker´s pronunciation of the phrase "plastic snake".

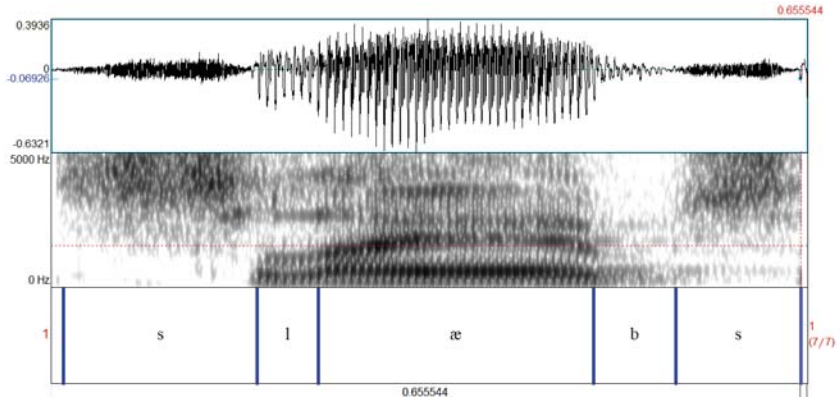


Source: The author

Contrasting the American speaker´speech production of the cluster formed by the last consonant of the word "plastic" and the two first consonants in the word "snake" with the one by the Brazilian Portuguese speaker, a change from [ksn] to [sn] can be noted. The discarding strategy was employed by the Brazilian Portuguese speaker.

Comparing the wideband spectrograms of figures 6 and 7, different phonetic realizations can be detected. The native speaker produces a voiced bilabial plosive followed by a voiceless alveolar fricative, while the native Brazilian Portuguese speaker produces a voiced alveolar fricative after the voiced bilabial plosive. These divergent phonetic realizations reflect the coarticulatory mechanisms which characterize the phonotactics of the two languages and point to divergent modes of syncronization between the phonatory and articulatory gestures.

Figure 6 – Waveform, wideband spectrogram, phonetic transcription tier and word ortographic transcription of the American English native speaker´s pronunciation of the word "slabs".



Source: The author

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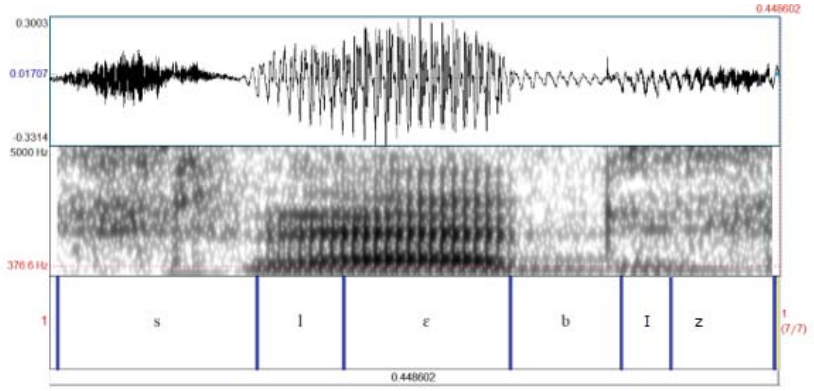
Figure 7 – Waveform, wideband spectrogram, phonetic transcription tier and word ortographic transcription of the Brazilian Portuguese native speaker´s pronunciation of the word "slabs".



Source: The author

Contrasting the American speaker´speech production of the cluster formed by the last consonants of the word "slabs" with the one by the Brazilian Portuguese speaker, a change from [s] to [z] can be noted. Two strategies were employed by the Brazilian Portuguese speaker: the adding and the phonetic change strategies.

Depending on the native language spoken, pronunciation strategies might differ. In relation to clusters beginning with the voiceless alveolar frictive /s/ followed by stops, for instance, Salem (2014), in his acoustic- based study, found differences between native and non-native English speech productions concerning the duration of the fricative (shorter in nonnative productions) and the stop closure interval (longer in nonnative speech productions).

Due to the great number of clusters which occur in English, their pronunciation should not be overlooked in teaching pronunciation to native speakers of languages such as Brazilian Portuguese. Bolella (2001) in her study on Brazilian Portuguese, European Portuguese and English clusters points out that distinct strategies must be applied in the teaching of English to European Portuguese and Brazilian learners since phonotactic processes in these two Portuguese varieties differ. In European Portuguese speech productions, vowels between consonants

are frequently dropped while in Brazilian Portuguese they are inserted (epenthesis).

Adding vowels at the onset of words with clusters such as in "scrape" can cause difficulty concerning accentedness, comprehensibility and intelligibility. According to Munro and Derwing (2015) accentedness refers to perceived differences in speech sound pronunciation, comprehensibility to perceived difficulty in understanding speakers´ pronunciation and intelligibility to the perceived matching between speakers´pronunciation and listeners´s perceptions.

Introducing clusters after the students have acquired knowledge of the articulation of individual consonant sounds and ability in pronouncing them is thought to be useful since speech productions must be understandable by listeners but not necessarily be native-like (Munro and Derwing, 2015).

Let's take, for instance, the word "snake". The cluster /sn/ tends to be pronounced as /izn/ by Brazilian learners of English since this cluster does not occur at initial word position in Brazilian Portuguese. The vowel followed by a voiced alveolar fricative in the pronunciation of the word "snake" by Brazilian speakers is often unintelligible to native speakers of English.

Speech intelligibility is an important goal to be achieved by the learner of a foreign language. According to Flege (2002) acquiring a L2 depends mainly on the quality and quantity of the language input.

In the next sections some of the principles posed by the SLM are discussed, a list of cluster correspondences in English and Portuguese are provided and the relevance of introducing English clusters to Brazilian learners of English is pointed out and discussed under the framework of the Speech Learning Model.

2. Theoretical background

Experimental research studies on second language/foreign language, in this paper referred as L2, have been developed by Jim Flege since 1977. An extensive amount of data from immigrants in the

United States, with varied linguistic backgrounds, Portuguese included, have been collected and analyzed.

These experimental research studies led eventually to the formulation of the phonetically oriented Speech Learning Model (SLM) by Flege in 1995. Its main claim is that the sound production in L2 depends on the development of perceptual goals by the learners and that failure in developing them may cause difficulties in speech sound production. However, the SLM does not claim that all production errors are related to perception difficulties.

The perceptual goals are thought to guide sound production in L2. This claim is based on a huge amount of data and acoustic, articulatory and perceptual phonetic analysis stemming from experimental Phonetics.

The SLM contains 4 Postulates and 7 hypotheses as showed in Table 2, extracted from Flege (1995:239).

Table 2 – Postulates and hypotheses as proposed by Flege (1995: 239)

	Postulates
P1	*The mechanisms and processes used in learning the L1 sound system, including category formation, remain intact over the life span, and can be applied to L2 learning.*
P2	*Language-specific aspects of speech sounds are specified in long-term memory representations called phonetic categories.*
P3	*Phonetic categories established in childhood for L 1 sounds evolve over the life span to reflect the properties of all L1 or L2 phones identified as a realization of each category.*
P4	*Bilinguals strive to maintain contrast between L 1 and L2 phonetic categories, which exist in a common phonological space.*
	Hypotheses
H1	*Sounds in the L1 and L 2 are related perceptually to one another at a position sensitive allophonic level, rather than at a more abstract phonemic level.*
H2	*A new phonetic category can he established for an L2 sound that differs phonetically from the closest L1 sound if bilinguals discern at least some of the phonetic differences between the L1 and L2 sounds.*
H3	*The greater the perceived phonetic dissimilarity between an L2 sounds and the closest L 1 sound, the more likely it is that phonetic differences between the sounds will be discerned.*
H4	*The likelihood of phonetic differences between L1 and L2 sounds, and between L2 sounds that are noncontrastive in the L1, being discerned decreases as AOL increases.*
H5	*Category formation for an L2 sound may be blocked by the mechanism of equivalence classification. When this happens, a single phonetic category will be used to process perceptually linked L 1 and L2 sounds (diaphones). Eventually the diaphones will resemble one another in production.*

H6 *The phonetic category established for L2 sounds by a bilingual may differ from a monolingual's if: (1) the bilingual's category is "deflected" away from an L 1 category to maintain phonetic contrast between categories in a common L1-L2 phonological space; or (2) the bilingual's representation is based on different features, or feature weights, than a monolingual's.*

H7 *The production of a sound eventually corresponds to the properties represented in its phonemic category representation.*

P = *Postulate* **H** = *Hypothesis* **AOL** = *Age of Leaning*

Source: Flege (1995)

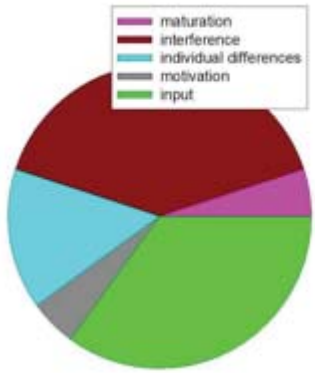
Highlighting the SLM postulates and hypotheses which bear relevance to this study, the following claims are made: sounds in L1 and L2 are related perceptually at the phonetic level rather than at the phonological level; perceived phonetic dissimilarity between L2 and L1 sounds avoids the assimilation of distinct phonemic categories in L2 to only one phonemic category in L1, since this kind of assimilation blocks the formation of a new phonemic category in L1; L1 learning mechanisms remain intact over the life span. Those claims mean that perceptual awareness and training attention to acoustic cues used in L2 with discriminant power can make a difference in learning a L2.

Perception, in the Speech Learning Model, is understood as the detection of acoustic properties which are specified as phonetic categories in long term memory representations. Perception is not considered as based on the equivalences among phonemic inventories, but on the phonetic realizations of the speech sounds in specific contexts. It varies as a ratio of the degree of linguistic experience.

The Speech Learning Model postulates that the L1 and the L2 phonetic categories coexist in the same phonological space. This means that bilingual speech productions differ from those of monolinguals.

Flege (2012) argues that the qualiy and the quantity of input is the most important factor affecting nativeness of L2 segmental production and perception. The graphic in Figure 8, extracted from Flege (2012) shows the relevance of the input in relation to other factors affecting the nativeness of L2 segmental production and perception.

Figure 8 – Share of influential factors on nativeness in L2



Source: Flege (2012)

Based on Flege theoretical claims about the quality and quantity of input and on the contrasts beween English and Brazilian Portuguese phonotactics, introducing activities to develop the perception and production of English consonant clusters in teaching English to Brazilians is here considered a way to promote intelligibility and comprehensibility. Knowing how sounds are produced and coarticulated is thought to be helpful.

In the next section examples of clusters in English and Portuguese are given and commented. The survey is based on Sanderson (1965), Fries (1967), Croft (1968), Francis (1968), Corder (1973); Hammond (1999), Roach (2002), Collischonn (2005), Gregová (2010) and Nascimento (2016).

Types of clusters in English and in Portuguese

The types of clusters are classified according to their distribution in the syllable (onset or coda) and in the words (word initial, word medial or word final). They are divided into groups according to one of the elements of the clusters. Specification about the other elements are given when there are some phonetic contrasts between Portuguese and English. In syllable initial positions, up to 3 consonants can occur

in English (Roach, 2002) and up 2 in Portuguese (Câmara Jr., 1986; Cristófaro Silva, 2002).

3. Word Initial Clusters

A lot of consonant sequences occurs in word and syllable initial position.

3.1. Clusters whose second element is an alveolar approximant/tap in English and a tap in Portuguese

{ stop / voiceless fricative } + alveolar approximant/tap consonant

English	Portuguese
/pr/ primitive	/pr/ primitivo
/tr/ translation	/tr/ tradução
/kr/ crater	/kr/ cratera
/br/ Brazil	/br/ Brasil
/dr/ drama	/dr/ drama
/gr/ graduation	/gr/ graduação
/θr/ three	_____
/fr/ fruit	/fr/ fruta
/ʃr/ shrimp	_____

Although just two of these clusters do not occur in Portuguese, they are usually produced with different allophones. In English, the voiceless plosive sounds are accompanied by aspiration in a stressed initial syllable. When /r/ follows one of these, it undergoes devoicing. This does not happen in Portuguese.

The voiced plosives are partially devoiced in initial position. When /r/ follows them, it is also partially devoiced. When /r/ follows the voiceless fricatives in accented syllables it is devoiced.

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Besides devoicing, there are also articulatory contrasts between English and Portuguese since /r/ is usually produced as an approximant consonant in English and a tap in Portuguese.

In English, the place of articulation for /t/ and /d/ is alveolar. In Portuguese, it is dentoalveolar. There is some variation from dialect to dialect.

Awareness of the articulatory and phonatory characteristics of the consonants forming the clusters above is found to be helpful in terms of accentedness and intelligibility.

3.2. Clusters whose second element is a lateral consonant

{ voiceless/voiced stop / voiceless fricative } + lateral consonant/ fricative

English	Portuguese
/pl/ plant	/pl/ planta
/kl/ classic	/kl/ clássico
/bl/ block	/bl/ bloco
/gl/ glory	/gl/ glória
/sl/ slav	_____
/fl/ flora	/fl/ flora
/ʃ l/ schlub	_____
/kv/ kvetcher	_____

The cluster /tl/ is not productive in English and in Portuguese. In English, there is devoicing of the lateral after voiceless consonants as /p/, /k/, /s/, /f/ and after lenis /b/ and /g/ there is partial devoicing. Conversely, in Portuguese a fully voiced consonant is produced.

3.3. Clusters whose second element is a palatal or velar approximant

{ stop / voiceless fricative / nasal } + { velar / palatal } approximant

English	Portuguese
/pj/ puberty	_____
/kj/ cuticle	_____
/bj/ beautiful	_____
/gj/ gewgaw	_____
/fj/ fume	_____
/vj/ view	_____
/θj/ thew	_____
/hj/ huge	_____
/mj/ municipal	_____
/pw/ Puerto Rican	
/tw/ twenty	
/kw/ quality	/kw/ qualidade
/bw/ bwana	_____
/dw/ dwell	_____
/gw/ guarani	/gw/ guarani
/sw/ swell	_____
/ʃw/ shwa	_____
/hw/ when	_____
/θw/ thwack	_____

The students must be aware of the existence of the glide. Otherwise, they will pronounce /u/ instead of /w/ and /i/ instead of /y/.

The following clusters are usually found is some British and American English dialects: /ty/ tuque, /dy/ duty, /ny/ new, /sy/ sue and /ly/ lute.

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3.4. Clusters beginning with the alveolar fricative in word and syllable onset position

English	Portuguese
/sp/ span	_____
/st/ state	_____
/sk/ sky	_____
/sf/ sphere	_____
/sm/ smart	_____
/sn/ snore	_____
/sl/ slav	_____
/sv/ svelt	_____
/ ʃm/ schmoo	_____
/spr/ sprout	_____
/str/ street	_____
/skr/ screen	_____
/spl/ splay	_____
/skl/ sclerotic	_____
/skw/ squat	_____
/spy/ spew	_____
/sky/ skew	_____

Although there are such combinations in Portuguese, they do not occur in initial position. Then, Brazilians tend to pronounce [ɪs] when the second elemento of the cluster is a voiceless sound and [ɪz] when the second element is a voiced sound.

4. Word medial clusters

Some syllable-initial, word-medial clusters occur both in English and in Portuguese as for example /gr/ in “photography – fotografia”. However, there are some which can be found only in English. Brazilians tend to use the adding strategy to pronounce words such as “objective”, “hatbox”, “absurd” and “blackmail”.

A partial list of medial clusters in Portuguese and English comprises the following groups (from 4.1 to 4.5).

4.1. Clusters whose first element is the voiceless alveolar consonant fricative

English	Portuguese
/sp/ dispute	disputa
/st/ destitute	destituir
/sk/ discourtesy	descortesia
/sb/ asbestos	_____
/sd/ disdain	_____
/sg/ disgrace	_____
/sp/ despair	disparate
/st/ constitute	constituinte
/sk/ ascorbic	ascórbico
/sm/ osmosis	_____
/sʒ/ disjoint	_____
/sl/ dislocate	_____
/sr/ disrespect	desrepeitar
/sj/ disunite	_____
/sw/ unswept	_____
/str/ distribute	distribuir
/spl/ resplendecent	resplandecente
/stl/ wrestler	_____
/skr/ description	descrição
/sfr/ disfranchise	esfregar

Brazilians tend to produce a voiced fricative instead of a voiceless fricative in English words whose first element is a voiceless alveolar fricative and this has a bad impact on their speech intelligibility.

4.2. Clusters with /j/ and /w/:

English	Portuguese
/bj/ abusive	_____
/gj/ legume	_____
/fj/ refuse	_____
/mj/ ammunition	_____
/pj/ amputate	_____
/kj/ osculate	_____
/kw/ unqualified	/kw/ inqualificável

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4.3. Clusters whose second element is the lateral consonant /l/

English	Portuguese
/pl/ diplomacy	/pl/ diplomacia
/bl/ oblique	/bl/ oblíquo
/kl/ aclimatize	/kl/ aclimatizar
/gl/ inglorius	/gl/ inglório
/fl/ reflexive	/fl/ reflexivo
/θl/ breathless	_____
/t ʃl/ matchless	_____

When sequences of sounds such as the inderdental fricative and the affricate are followed by lateral sounds in English words, Brazilians tend to add the vowel /i/ between the two consonant sounds.

4.4. Clusters whose second element is an alveolar approximant/tap

English	Portuguese
/pr/ oppress	/pr/ oprimir
/tr/ attract	/tr/ atrair
/kr/ across	/kr/ acreditar
/br/ abrupt	/br/ abrupto
/gr/ retrograde	/gr/ retrogrado
/dr/ adrenalin	/dr/ adrenalina
/θr/ thrilling	_____
/fr/ front	/fr/ afrontar
/sr/ enshrine	_____
/vr/ every	_____
/lrdw/ worldwide	_____

4.5. Clusters in which the first element is the alveolar approximant/tap

/rs/ marshals	marcha
/rk/ merchants	_____
/rm/ murmur	murmurar
/rn/ turning	tornar
/rl/ forlorn	_____
/rt/ portent	portento
/rsl/ fierceless	_____
/rh/ overhead	_____
/rs/ arsenal	arsenal
/rd/ sordid	sordido
/rps/ adsorption	_____
/ror/ arthritis	_____
/rv/ service	serviço
/rθ/ seaworthy	_____

The English consonant clusters listed from 4.6 to 4.8 do not have counterparts in Brazilian Portuguese.

4.6. Clusters whose first element is a stop.

/kspr/ express	/bg/ hobgloblin
/ksp/ expert	/bs/ absolete
/kspl/ explain	/dg/ mudguard
/ktf/ respectful	/tb/ hatbox
/kspl/ explore	/tp/ hotpot
/kskw/ exquisite	/bm/ submerge
/kstr/ extra	/ps/ shipshape
/kskr/ excrete	/pc/ scripture
/kskl/ exclaim	/bt/ obtain
/kt/ victorious	/df/ handfull
/kb/ blackboard	/tl/ cutlass
/kz/ exzema	/tn/ witness
/km/ blackmail	/bd/ subdued
/kn/ hackneyed	/kskl/ exclaim
/btr/ obtrude	/tkr/ outcry
/bstr/ abstract	/bs/ absorb

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According to the Portuguese spelling, there are some consonant sequences whose first element is a stop. However, the vowel [ɪ] follows the stop in their pronunciation.

4.7. Clusters whose first element is a lateral.

/lf/ engulfed
/lfr/ palfrey
/ld/ buildings
/lt/ alter
/lkr/ fulcrum
/lnh/ unhealthy

The English lateral sounds in sylable final position tend to be replaced by the velar approximant [w] by Brazilian Portuguese native speakers.

4.8. Clusters whose first element is a nasal consonant.

/mp/ impute
/mf/ triumphant
/mpt ʃ / sumptuous
/mpl/ complex
/mbld/ stumbled
/mpr/ impress
/mbr/ embrace
/mpstr/ semstress
/mb/ number
/ms/ themselves
/np/ unpleasant
/nt/ entangle
/nk/ unkind
/nb/ unbound
/nd/ tendency
/ng/ ungoverned

/nf/ unfair
/nv/ envious
/ns/ answer
/nz/ enzyme
/n θ/ unthankful
/nh/ unhealthy
/nt ʃ / uncharted
/n ʒ / enjoy
/ns/ unshape
/nkl/ conclude
/nl/ enliven
/nj/ union
/nw/ unwept
/ntr/ intrude
/ndr/ undrinkable
/npr/ unprocessed

/nbr/ unbruised
/ngr/ engrave
/nkr/ uncrowded
/nfr/ unframed
/nst/ instant
/n θr/ enthral
/nskr/ inscribe
/nstr/ instruct
/npl/ unpleasant
/ndzm/ groundsman
/ŋkw/ banquet
/ŋkj/ incubate
/ŋg/ finger
/ŋd/ kingdom
/ŋk/ monkey
/ŋkl/ conclude

In Brazilian Portuguese the nasal consonant is not articulated in syllable final position. The clusters whose first element is a nasal consonant pose difficulties to Brazilian learners of English which tend to produce a nasalized vowel instead of an oral vowel followed by a nasal consonant, causing not only problems related to accentedness but also interfering with intelligibility and comprehensibility.

In Portuguese, we do not find /s/ before a voiced consonant. In English, both /s/ and /z/ can occur before some voiced consonants as examples in 4.9 demonstrate.

4.9. Two-consonant clusters whose first element is an alveolar fricative

English	Portuguese
/sb/ asbestos	asbesto
/zd/ _____	desdém
/sd/ disdain	_____
/zm/ osmosis	osmose
/zn/	asneira
/zr/ Israel	israelita

5. Final Clusters

Clusters are very productive in syllable and word final position in English. Up to four consonants can occur in syllable coda position in English words. Roach (2002) mentions 55 two-consonant clusters, 40 three- consonant clusters and 7 four-consonant clusters in syllable final position in English.

Examples of word final clusters divided into four groups, according to the articulatory description of the first element, are given hereafter. Whenever a plosive consonant occurs in syllable coda position, it tends to be followed by /i/ in Brazilian students´ pronunciation. In clusters, the same thing happens: if the first element of a cluster is a stop or a fricative, the epenthetic vowel is often produced by Brazilians. Differences concerning the articulatory characteristics of

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the speech segments in clusters can also interfere with intelligibility and comprehensibility.

5.1. Clusters whose first element is a stop or a fricative.

/sp/ clasp	/pt/ adopt	/pθ/ depth
/sk/ risk	/ks/ tax	/ ŋ θ/ length
/sts/ chests	/ps/ lapse	/ksθ/ sixth
/fts/ lifts	/ts/ blitz	/fθ/ fifth
/kts/ facts	/ksts/ texts	/dθ/ width

5.2. Clusters whose first element is the alveolar approximant

Voiced alveolar approximant + { stop, affricate, fricative, nasal, lateral }

/rf/ dwarf	/rl/ snard
/rps/ warps	/rbd/ absorbed
/rt ʃt / arched	/rʒd/ charged
/rvd/ carved	/rsh/ harsh
/rnd/ warned	/rθ/ hearth
/rst/ forced	/rks/ marks
/rmd/ armed	/rgd/ morgued
/rts/ parts	/rdz/ cords

5.3. Clusters whose first element is a nasal consonant.

Nasal { plosive, fricative }

/ ŋ ks/ thanks	/nks/ jinx
/mpt/ stamped	/mps/ glimpse
/mft/ triumphed	/nθ/ hyacinth
/ŋkts/ instincts	/mpts/ tempts
/nts/ wants	/nd/ rand
/nt ʃ / lunch	/nst/ danced
/nz/ bronze	/nθ/ tenth
/zndθ/ thousandth	/nʒd/ changed

In Portuguese, nasal consonants are not articulated after vowels. Introducing clusters in which the first element is a nasal consonant to Brazilian learners of English is found to be relevant, since problems related to accentedness, intelligibility and comprehensibility can occur. Furthermore, velar nasal is often assimilated to a nasal vowel followed by the voiced velar sound, affecting speech inteligilibity.

5.4. Clusters whose first element is a lateral velar approximant or an alveolar approximant

approximant { stop, affricate, fricative, nasal }

/lz/ Charles
/rks/ Marx
/lks/ Wilkes
/rl ds/ worlds
/rts/ quartz
/lts/ waltz
/rmθ/ warmth
/rsts/ bursts
/rps/ corpse
/lkts/ mulct
/rnt/ aren't
/rpts/ excerpts
/lfθs/ twelfths

The array of examples presented in this paper shows that the occurrence of clustering in Brazilian Portuguese is considerably restricted as compared to English. In English, there are not only clusters with a great number of consonants but also a great deal of different kinds of speech segment combinations.

Summing up, Table 3 shows the types of clusters which have been described in this work.

Table 3 – Contrasts between English and Portuguese clusters. The letter "C" stands for consonants, the number indicates the maximum number of consonants in the cluster, "V" stands for vowel, "NV" for nasalized vowel and the line stands for the syllabic context.

	ENGLISH	PORTUGUESE
INITIAL CLUSTERS	C^2 + V_____ C^2 + velar/palatal approximant + V _____ C^3 + V_____	C^2 + V_____ C^1 + velar approximant + V_____ _____
MEDIAL CLUSTERS	____V + C^2 + velar/palatal approximants + V____ /y/ ____V + voiceless alveolar fricative + C^2_____ ____V + C^4 + V_____ ____V + nasal + C^4 + V___	____V + C^1 + /w/+V_____ ____V + voiceless alveolar fricative + C^2_____ ____V + C^2 + V_____ ____ NV + C^3_____
FINAL CLUSTERS	_____V + C^3	_____V + C^2

Source: The author

6. Conclusion

The speech production challenges English clusters pose to the Brazilian learner of English are multi-varied: linguistic productivity; distribution of the cluster in the syllable; phonetic features of the speech segments involved; language phonotactic features and orthographic misleading influences.

Some English clusters do not present difficulties to Brazilian speakers due to their clustering characteristics. Then, /sk/, /st/, for instance, can be mispronounced in word final position not because of the internal structuring of the cluster but due to the difficulty Brazilian learners have in pronouncing stop consonants in final position. Therefore, the word "risk" presents the same kind of difficulty as "rock".

However, there are sequences which Brazilian learners of English find hard to pronounce because of the articulatory nature of the sequence of consonants integrating the cluster and the distribution of the cluster in the syllable, such is the case of the word ”twelfths”.

Brazilian learners of English tend to have difficulties in pronouncing the following:

a) clusters beginning with /s/;

b) clusters consisting of { stop / fricative / nasal } + { velar approximant / palatal approximant }

c) three consonant clusters whose third element is an interdental fricative;

d) three consonant clusters whose second consonant is a velar lateral approximant;

e) clusters involving two stops;

f) clusters in final word positions.

Concerning the teaching of clusters, the ones which need special drills are the clusters which belong to the groups listed in the previous paragraph (from “a” to “f”).

In teaching English to Brazilian students, developing students´ awareness of the fact that some strategies implemented to avoid clusters can cause difficulties related to intelligibility and comprehensibility, and more importantly, providing means for them to increase their perceptual ability and to establish perceptual goals are thought to help their speech production and comprehension.

Tools freely available to be used in teaching pronunciation nowadays such as PRAAT (Boersma and Weenink, 2018), animations showing the articulation of sounds, among a lot of other tools, contribute to pronunciation teaching become effective and promote communicative effectiveness.

As Flege (2012) points out it is necessary for learners to develop perceptual goals. Pronunciation teaching is thought to provide means of facilitating the development of such goals. That is our argument in favor of promoting intelligibility and comprehensibility in speaking a second/foreign language.

And as a word of advice, listening and repeating activities, commonly used in teaching L2, are not enough to promote phonetic awareness and perceptual abilities. Activities especially designed to enhance attention to phonetic cues which are used in the L2 to cue phonemic distinctions are needed and they, nowadays, can be easily implemented with tools such as PRAAT. As Flege (2012) argues both the kind and the amount of input matter.

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