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Sonority effects in the production of the triconsonantal sequences Ct/d]$_\sigma$C by Brazilian learners of L2 English

Efeitos da sonoridade na produção de sequências triconsonantais Ct/d]$_\sigma$C por aprendizes brasileiros de inglês como L2

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ABSTRACT: This study investigates the production of a variable pattern in English by Brazilian L2 learners, i.e. triconsonantal sequences containing coronal plosives flanked by heterosyllabic consonants. Thus, the interlanguage of 24 learners from the city of Campina Grande in the state of Paraíba, Brazil, is analyzed to achieve the following objectives: (1) verify the phonological processes whereby the sequences Ct/d]$_\sigma$C are simplified in the participants' interlanguage; and (2) examine the role of sonority in the surface phonetic representations of these sequences. 1,071 tokens were audio-recorded, coded and subjected to multivariate analysis using Rbrul (JOHNSON, 2015). The results indicate that sonority-based principles play an important role in the application of repair strategies on the surface forms of these complex structures.

KEYWORDS: variationist linguistics; triconsonantal sequences; repair strategies; L2 English.

RESUMO: Este estudo investiga a produção de um padrão variável em inglês por aprendizes brasileiros(as) de L2, qual seja, sequências triconsonantais com oclusivas coronais flanqueadas por consoantes heterossilábicas. Assim, a interlíngua de 24 aprendizes da cidade de Campina Grande (PB) é analisada para alcançar os seguintes objetivos: (1) verificar os processos fonológicos pelos quais as sequências Ct/d]$_\sigma$C são simplificadas na interlíngua dos(as) participantes; e (2) examinar o papel da sonoridade nas representações fonéticas dessas estruturas. Um total de 1.071 ocorrências foi gravado em áudio, codificado e submetido à análise multivariada, usando o pacote Rbrul (JOHNSON, 2015). Os resultados indicam que os princípios baseados na sonoridade desempenham um papel importante na aplicação de estratégias de reparo nas formas superficiais dessas estruturas complexas.

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PALAVRAS-CHAVE: sociolinguística variacionista; sequências triconsonantais; estratégias de reparo; inglês como L2.

1 Introduction

Both theory and common sense suggest that there is distinction between first and second language (cf. STERN, 1983). In fact, theoretical, empirical and anecdotal evidence highlight this difference by focusing on the difficulties and limitations that L2[102] learners usually present in the process of acquiring an additional language after their L1. Consequently, learning an L2 entails certain limitations and failures, especially after puberty, which is widely claimed as the endpoint of the critical period (cf. LENNEBERG, 1967). In other words, exposure to robust input up to a certain age is crucial for a language to be acquired normally by a speaker (FINGER, 2008).

Ever since Selinker (1972) proposed the concept of *interlanguage* (IL) as a transitional linguistic system which is independent of both the learner's native language and the target language, the study of Second Language Acquisition (SLA) has been interested in describing such a phenomenon, which "[...] might better be understood if it is regarded as a continuum between the native language and the target language" (SONG, 2012, p. 778). Although the notion of *interlanguage* comprises features of both the learners' L1 and L2, it is seen as a unique and individual language that differs from either (NOYAU, 1990 apud BAYLEY, 2007).

Considering the dynamic and inseparable relations between speaker, language and society – in addition to the interplay of internal linguistic factors which systematically constrain SLA –, variability has been mainly investigated through two different perspectives: (1) the Dynamic Paradigm (BICKERTON, 1973 apud BOUDAOUD; CARDOSO, 2009), which draws on the systematic but

102 According to Stern (1991, p. 11), "[t]he concept of L2 ('non-native language', 'second language', 'foreign language') implies the prior availability to the individual of an L1, in other words some form of bilingualism".

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unstable nature of variation and focuses on the gradual development of interlanguage grammar in a continuous and constant, rather than orderly, manner; or (2) the variable rules approach, which seeks to identify the factors that influence the application of a given variable rule (BOUDAOUD; CARDOSO, 2009).

Undoubtedly, a process as complex as that of learning an L2 needs to be investigated through an integrative approach, and the present study adopts one whereby the theoretical-methodological assumptions of variationist linguistics are in line with the most recent theoretical developments in phonology. More specifically, we aim to investigate the acquisition of triconsonantal sequences[103] in which the coronal plosives are flanked by heterosyllabic consonants, as represented in Figure 1:

Figure 1 – Triconsonantal sequences of interest

$$C \quad C]_{\sigma} \quad C$$

$$\begin{bmatrix} \text{-son} \\ \text{-cont} \\ \text{+cor} \\ \text{+ant} \\ \text{-del rel} \end{bmatrix}$$

Source: Elaborated by the authors.

Most of the words containing these triconsonantal sequences are bimorphemic, and they can be formed by adding suffixes (*-ness*, *-ly*, *-ment*, *-ful*, etc.) or by compounding (*text+book*, *soft+cover*, *hand+ball*, etc.). The coronal plosives occupy the last slot of the complex medial codas that make up the syllable structure of the roots (in the case of words formed by suffixes) or the modifiers (in the case of modifier-head compounds). The suffixes and heads, in turn, have

[103] We adopt the terminology proposed by Pulgram (1965), who distinguished the terms *cluster* and *sequence* with respect to the possible combinations of consonant sounds within words. According to the author, consonant clusters involve the co-occurrence of consonants within the same syllable. Consonant sequences, on the other hand, refer to the contact between consonants across syllable boundaries, i.e. word-internal coda-onset sequences.

their respective onset slots filled, resulting in the triconsonantal sequences Ct]$_{\sigma}$C or Cd]$_{\sigma}$C. Our interest in such a pattern is motivated by the following observation:

> The occurrence of a final cluster before another consonant creates a triconsonantal sequence, and triconsonantal sequences tend to undergo simplification by various phonological devices in every language which has them (and many, like Japanese and Dakota, do not allow them at all). (CHAMBERS; TRUDGILL, 2004, p. 135)

Different theoretical perspectives and approaches have been used in SLA research, such as psychology, anthropology, sociology, neurolinguistics, psycholinguistics, cognitive linguistics, etc. However, this study adopts the theoretical-methodological assumptions of variationist sociolinguistics (LABOV, 1963, 1966, 1972/2008) to investigate the IL variation in the speech of Brazilian learners of L2 English with respect to the production of triconsonantal sequences of the type Ct/d]$_{\sigma}$C. Thus, the approach that seeks to shed light on the systematicity of learners' IL variability (TARONE, 2006; BAYLEY, 2007; SONG, 2012) is applied here to answer the following research questions:

(a) How do Brazilian learners of English produce the triconsonantal sequences of the type Ct/d]$_{\sigma}$C in words such as *postman*?; and
(b) What role, if any, does sonority play in the interlanguage of Brazilian learners of English regarding the surface forms of these syllable contacts, which are marked and unlicensed in Brazilian Portuguese phonology?

Since stops are not allowed to occur syllable-finally in Brazilian Portuguese (BP), as maintained by Alves (2004) and Collischonn (2004), the surface forms of Ct/d]$_{\sigma}$C Ct/d]$_{\sigma}$C may vary according to universal sonority principles and language-specific phonotactic constraints. Therefore, the following hypotheses are proposed:

H1: Brazilian learners of English are likely to insert an additional high front vowel (either [i] or [ɪ]) after coronal stops in coda position; and

H2: The use of repair strategies may be triggered by violations of universal and language-specific syllable well-formedness conditions.

This paper is organized as follows: Section 2 describes the notion of sonority cycle, as proposed by Clements (1990); Section 3 presents the methodological procedures adopted to conduct this study; Section 4 is dedicated to data analysis, interpretation of results, and discussions; finally, Section 5 brings the final remarks of this work.

2 The role of sonority in syllabification

Clements (1990) argues that there are significant regularities with respect to the syllable structures found in languages worldwide, and the sequential organization of phonemes in this phonological unit can be explained on the basis of the notion of *sonority cycle*, a principle formulated by the author. Clements (1990) proposes the sonority cycle as a formal model for a theory of syllable representation, which is implemented by two guiding principles, namely *core syllabification* and *feature dispersion*.

According to Clements (1990, p. 302), "[t]he Core Syllabification Principle (CSP) expresses a generalization about the way sequences of segments are commonly organized into syllables." This principle is based on a relatively simple sonority scale, formulated in terms of the sum of positive specifications of four binary major class features, as illustrated in Figure 2, where the segment types are divided into the major sound classes of O = Obstruents, N = Nasals, L = Liquids, G = Glides, and V = Vowels:

Figure 2 – Sonority scale

O	<	N	<	L	<	G	<	V	
–		–		–		–		+	syllabic

–	–	–	+	+	vocoid
–	–	+	+	+	approximant
–	+	+	+	+	sonorant
0	1	2	3	4	sonority rank

Source: Adapted from Clements (1990, p. 292-299).

As shown in the sonority scale proposed by Clements (1990), the characterization of the sonority of the sounds of a given language is determined by a ranking scale, whose values are derived from the sum that the groups of sounds have in the specifications of the presence (or absence) of the major class features, i.e. [syllabic], [vocoid], [approximant], and [sonorant]. Despite using the traditional distinctive features theory, the scale does not follow the standard phonological classification, which operates in terms of binary values. Thus, the obstruents, for example, are classified as presenting a zero value of sonority, in that they are characterized by the absence (-) of the four major class features, that is, [-syllabic], [-vocoid], [-approximant], and [-sonorant]. The segments considered as *syllabic*, on the other hand, have the sonority value of 4 because they attract the syllabic nucleus in a given language (CLEMENTS, 1990, p. 293), a property commonly associated with vowels and, in the case of some languages, with sonorants as well.

In general, there are two basic types of syllables: those that conform to the CSP, classified as *simple* or *unmarked*, which are taken to be present in the world's languages, and those that violate it, which are syllabified by language-specific rules at a later stage, or deleted, and are referred to as *complex* or *marked*. As a language universal algorithm that builds unmarked syllables, the CPS is stated as in (1):

(1) The Core Syllabification Principle (CSP):

a. Associate each [+syllabic] element with a syllable node.

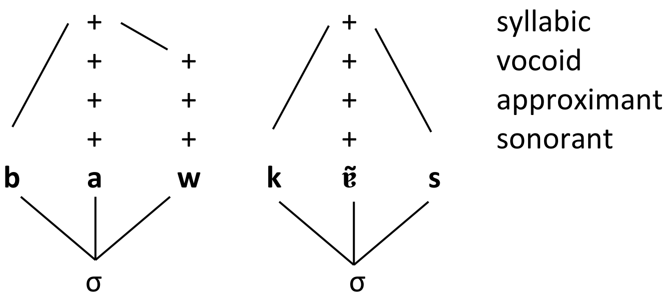
b. Given P (an unsyllabified segment) preceding Q (a syllabified segment), adjoin P to the syllable containing Q if P has a lower sonority rank than Q. (iterative).

c. Given Q (a syllabified segment) followed by R (an unsyllabified segment), adjoin R to the syllable containing Q if R has a lower sonority rank than Q. (iterative).

Source: Clements (1990, p. 299).

As can be seen, syllabification occurs in three stages: first, there is the association of a [+syllabic] segment with a syllable node; then, there is the formation of the onset with a segment that precedes the syllable node and has a lower degree of sonority than the nucleus; finally, there is the formation of the coda with a segment that follows the nucleus and that also presents a lower degree of sonority than the node. Based on the CPS, Figure 3 shows the syllabication of the word *bálcãs*, which means *balkans* in BP:

Figure 3 – Syllabification of the word *bálcãs* according to the CPS



Source: Adapted from Silva (2010, p. 42).

Following the CPS rules, the [+syllabic] segments [a, ɐ☐] are associated with the syllable nodes in the first stage and, since they get syllabified, these vowels correspond to the Q of the rules. Then, considering that the obstruents [b] and [k] are attributed 0 sonority according to the scale in Figure 2, they can be adjoined to the syllables containing [a] and [ɐ☐] in the first iteration, as in (1b), since these plosives have a lower sonority index than that of the central vowels. After the formation of [ba] and [kɐ☐], the step in (1c) takes place, that is, the second iteration, which forms the coda: the segments [w] and [s] have sonority values of 3 and 0, respectively, which are, in turn, lower than those of [a, ɐ□]. The order of these three steps in core syllabification reveals the *left-precedence* principle, which is a universal tendency that serves as the basis for the formulation of the maximal onset principle, according to which intervocalic consonants are generally divided in order to maximize the onset instead of the coda.

Finally, as regards the dispersion principle, Clements (1990) takes the view that the syllable is divided into two overlapping parts, referred to as *demisyllables*, in which the nucleus belongs to both – instead of having a hierarchical structure of onset and rime, further divided into nucleus and coda. The author states that the reason for using such a notion lies in the fact that the sonority profile of the initial demisyllable has no dependency on that of the final demisyllable, which better supports this dispersion of sonority (CLEMENTS, 1990, p. 303). Therefore, the sonority profile of the preferred syllable type in the world's languages has a sharp sonority rise from the onset towards the nucleus, but a minimal sonority drop from the nucleus to the coda. Thus, natural languages generally seem to prefer consonants with relatively higher sonority levels in their post-nuclear positions. Another implication that such a principle entails is the less restricted occurrence of consonants in the onset, compared to the coda, which exhibits a more limited spectrum of licensed consonants.

Having discussed the role of sonority within the syllable structure, the debate shall focus on its margins in more detail, since the consonant sequences of interest occur across syllable boundaries, so that the relationship between the heterosyllabic consonants will be analyzed in terms of the Syllable Contact Law (henceforth SCL), understood as an epiphenomenon of these sonority cycles (COLLISCHONN, 2005).

2.1 The role of sonority across syllable boundaries

Concerning the contact between consonants across syllable boundaries, the SCL was proposed by Murray and Vennemann (1983) to explain a tendency in languages worldwide to maximize sonority contrasts between heterosyllabic segments: the higher the sonority of the segment in coda and the lower the sonority of the consonant in the following onset, the more the syllable contact is preferred. According to the authors, a range of linguistic changes have been induced as a way to avoid a sonority rise across syllable boundaries, so that the relation between the coda and the following onset is considered more harmonic the more sonority falls between its respective segments, as demonstrated in (2):

(2) Preferred syllable contact according to the SCL:

$$C1]_{\sigma} > {}_{\sigma}[C2$$

Source: Albert (2014, p. 36).

According to (2), the falling sonority slope in /al.ta/ is preferred to the contact in /at.la/, for example (SEO, 2011), since the SCL, in its version based on the notion of sonority rather than the original consonantal strength, establishes that: “[a] syllable contact A$B is the more preferred, the greater the sonority of offset A and the less the sonority of onset B” (DAVIS; SHIN, 1999, p. 286). As regards the notion of sonority, it should be pointed out that a rather comprehensive study carried out by Parker (2002) investigated the sounds of English and Spanish based on five acoustic and aerodynamic measurements, namely intensity, peak intraoral air pressure, F1 frequency, peak air flow, and total segmental duration, and the values obtained by the author, complemented by phonological considerations, allowed him to formulate a sonority scale that can be universally applied to determine the sonority of the segments in a given language.

Unlike the simpler scale proposed by Clements (1990), shown in Figure 2, where there is no difference between voiced and voiceless segments or between the three types of obstruents, namely plosives, fricatives and affricates, the ordering proposed by Parker (2002) can be potentially generalized to account for sonority universally, even though it was based only on the sounds produced by eight native English speakers and eight native Spanish speakers. According to the author:

> My claim is that the phonological sonority scale [...] is universal: it forms part of UG, and the constraints in CON can and do access its rankings, and perhaps its indices as well. Probably no language invokes the distinction between all 16 of these sonority classes, but they are always potentially available. Furthermore, there are no other natural class divisions in the sonority hierarchy, with the possible exception of more exotic types of segments such as ejectives, clicks, etc., about which I have nothing else to say (PARKER, 2002, p. 240).

In order to discuss the syllable contacts in the sequences Ct/d]$_\sigma$C, the sonority scale proposed by Parker (2002, 2011) will be adopted here, as outlined in Table 1:

Table 1 – Universal hierarchy of relative sonority

Natural classes	Sonority index
low vowels	17
mid peripheral vowels (not [ə])	16
high peripheral vowels (not [ɨ])	15
mid interior vowels ([ə])	14
high interior vowels ([ɨ])	13
glides	12
rhotic approximants ([ɹ])	11
flaps ([ɾ])	10

laterals	9
trills ([r])	8
nasals	7
voiced fricatives	6
voiced affricates	5
voiced stops	4
voiceless fricatives (including [h])	3
voiceless affricates	2
voiceless stops (including [ʔ])	1

Source: Parker (2011, p. 1177).

Based on the sonority indices attributed to the natural sound classes in Table 1, some distinctions can be made regarding the Sonority Distance (SD) of the members composing the consonant sequences where (t,d) are flanked by heterosyllabic consonants. Considering the contacts composed of C1 and C2, in which C1 belongs to the coda and C2, to the onset, the SD of these consonants is calculated by the difference between the sonority indices of C1 and C2. Thus, these sequences, which contain a complex coda closed by /t/ or /d/, are considered less marked when there is a decreasing sonority towards the onset of the following syllable, according to the LCS.

Since the voiceless stops have the lowest sonority index in the universal hierarchy proposed by Parker (2002, 2011), there is clearly no sequence in which /t/ has a lower index than that of the following heterosyllabic consonant. Thus, the sequences with /t/ are restricted to plateaux (where this segment is followed by another voiceless plosive, as in *postpone*, *postcard*, and *waistcoat*, for instance) or sonority reversals (when sonority rises from /t/ to the following heterosyllabic consonant, in words like *trustful*, *postman*, *softness*, etc.).

As for the voiced coronal stop, in turn, there are three possible sonority patterns. When /d/ is followed by voiceless stops in the onset of the subsequent syllable (in words such as *grandkid*, *hardcover*, *handkerchief*, *handcuff*), the sequences conform to the LCS – although with a less sharp fall in sonority.

However, syllables starting with sonorants or voiced obstruents after complex codas closed by /d/ have margins consisting of sonority reversals (as in *blindness*, *amendment* and *grandmother*) and plateaux (e.g., *handbags*), respectively.

3 Methodology

Considering the dearth of investigations focusing on north-eastern varieties of BP (CARDOSO, 2005; LUCENA, 2012), this sociolinguistic study aims to examine the phonological acquisition of a variable pattern in English by Brazilian L2 speakers from the city of Campina Grande in the north-eastern state of Paraíba. Regarding the choice of a dialect used in the Northeast region of Brazil, in addition to the aforementioned scarcity of studies, it is also important to point out that, since its emergence as a research paradigm in the late 1960s and early 1970s, the variationist sociolinguistic approach has demonstrated a special interest in the scientific study of stigmatized, non-standard varieties as a way of refuting linguistic stereotypes (cf. BAYLEY, 2005, p. 1).

3.1 Data collection

Data were collected with 24 L2 English learners who were born in the city of Campina Grande, the second largest city in the state of Paraíba, by means of two instruments in English: (1) the reading of 43 target words embedded in carrier sentences; and (2) word and phrase elicitation through pictures. These instruments were exhibited to the participants on the screen of a laptop computer through Microsoft PowerPoint presentation files (.ppt). Participants' productions were audio-recorded using the open-source software Audacity v. 2.0.6 (MAZZONI; DANNENBERG et al., 2014). Table 2 shows the gender and L2 proficiency level of the population:

Table 2 – Informants' stratification according to their gender and L2 proficiency

Coded name	Gender	Proficiency level	Age	Instruments	
				1	2
F1	Cis women	Basic	21	✓	✓
F2			31	✓	
F3			33	✓	
F4			55	✓	✓
F5		Intermediate	24	✓	✓
F6			24	✓	✓
F7			31	✓	
F8			34	✓	✓
F9		Advanced	18	✓	✓
F10			31	✓	✓
F11			32	✓	
F12			33	✓	
M1	Cis men	Basic	28	✓	
M2			33	✓	✓
M3			58	✓	
M4			60	✓	
M5		Intermediate	25	✓	✓
M6			32	✓	
M7			37	✓	
M8			42	✓	✓
M9		Advanced	31	✓	✓
M10			32	✓	
M11			36	✓	
M12			39	✓	✓

Source: Elaborated by the authors.

All the informants read the 160 carrier sentences in the first data collection instrument, and answered the questionnaire, applied in both printed and online versions[104]. Although they all demonstrated interest in participating in the second round of data collection, only half of them were available to proceed to the next phase, as can be seen in the last column of Table 2.

As for the application of the instruments, more specifically, firstly, they were asked to read a list of 160 words in English, embedded in the following carrier sentence: *The word is* [...]. However, only 43 of the sentences contained words with the triconsonantal sequences of interest, while the remaining 117 phrases were used as distractors, to prevent informants from becoming aware of the structure in advance. The 43 lexical items are listed in Table 3:

Table 3 – Target words used in the data collection instruments

Stray consonant (C')	**Bimorphemic words**
/t/	*postpone, trustful, textbook, Christchurch, nextdoor, postcard, waistcoat, respectful, neglectful, softshell, giftshop, softcover, softcore, Christmas, postman, vastness, restless, exactly, correctly, perfectly, swiftness, softness, liftman, leftmost, countdown, saintdom, shortcut, shortcake, heartbreak, dirtbag, partly, courtroom.*
/d/	*grandkid, hardcover, handkerchief, handcuff, handbag, sandpiper, kindness, blindness, bandwidth, grandmother, amendment.*

Source: Elaborated by the authors.

[104] Available online, the questionnaire applied in its digital version can be accessed through the site: https://docs.google.com/forms/d/e/1FAIpQLSekqcVAN5hbxOk3ZCv4W2L3awodbQlTPKZIE5XinFhD-vMn6w/viewform.

Regarding the organization of such phrases, each slide shows four carrier sentences, with at least one of them containing a crucial word, while the other three phrases are closed with words within the same semantic field of the target word, such as food, holidays, sports, computer science, politics, professions, feelings, family, etc.[105] They were divided into 32 bimorphemic words (in italics) and 11 anglicisms commonly used in BP.

The second data collection instrument consisted of displaying a set of three images per slide, as demonstrated in Figure 4:

Figure 4 – Set of images displayed on the second data collection instrument

Source: Elaborated by the authors.

4 Data Analysis

A total of 1,071 tokens were obtained from the application of the two instruments to the population who accepted the invitation to voluntarily participate in this study and, then, codified in order to be subjected to multivariate analysis using Rbrul (JOHNSON, 2015). Here, the analysis will focus on the internal factors with statistically significant effects on the dependent variable (response) of interest, whose application value is the simplification of

[105] Three of the 40 slides contain two target words, instead of one.

the medial complex coda closed by coronal stops. In general, three variants were identified in the corpus, as detailed in (2):

(2) variants of the dependent variable (DV):

a) with no phonological rules:

– $C\,t/d]_{\sigma}\,C$;

b) with the application of epenthesis:

– $\emptyset \longrightarrow [i] / \begin{Bmatrix} [t] \\ [d] \end{Bmatrix} \_\_]_{\sigma}$;

c) with the application of coronal stop deletion:

– $\begin{Bmatrix} /t/ \\ /d/ \end{Bmatrix} \longrightarrow \emptyset / C\_\_ \begin{Bmatrix}]_{\sigma} \\ + \end{Bmatrix} C$.

Considering the surface phonetic forms of $Ct/d]_{\sigma}C$ produced by the 24 informants, a word such as *liftman*, for example, was pronounced in three different ways: (1) [ˈlɪftmən], without any phonological rules, as in (2a); (2) [ˈlɪftimən], as a result of the epenthesis rule, that is, Ø → i / [−son, −cont, +cor] ___]$_{\sigma}$, as in (2b); and, finally, (3) [ˈlɪfmən], with the application of coronal stop deletion (CSD), i.e. [−son, −cont, +cor] → Ø / [+cons] ___]$_{\sigma}$, in line with (2c).

Since the logistic regression analysis deals with binary responses, the deletion of [t] or [d] and the epenthesis were amalgamated as *application of repair strategies to (t) or (d) between heterosyllabic consonants*, as opposed to *non-application*. The mixed-effects model discussed here was obtained using R (R CORE TEAM 2018), version 3.5.2, and the statistical package Rbrul (JOHNSON, 2015). Unlike the programs that preceded it, Rbrul can conduct mixed-effects models (TAGLIAMONTE, 2012), in that it performs logistic regression taking into account different types of factor groups (both fixed and random effects). Table 4 provides a summary of our independent variables:

Table 4 – Factors controlled in the study

Independent variables	Values	Types
Informant	F1-F12 and M1-M12	random
Word	*postpone, trustful,* etc.	random
Age	log	continuous
Gender	cis women and cis men	categorical
L2 proficiency level	basic, intermediate, advanced	categorical
Preceding context	coronal, dorsal and labial	categorical
Sonority index of the previous consonant	11 (approximants), 7 (nasals), 3 (voiceless fricatives), and 1 (voiceless plosives)	categorical
Stray consonants	/t/ and /d/	categorical
Following context	obstruents and sonorants	categorical
Sonority pattern of the following consonant	sonority equivalent to, higher or lower than that of (t,d)	categorical

Source: Elaborated by the authors.

It is worth emphasizing that variation is a phenomenon conditioned not only by internal factors, such as phonological contexts, stress, morphological or syntactic classes, etc., but also by external factors, such as gender, social class, age groups, etc. All these examples of factors are designed to be independent of each other. As regards fixed-effect variables, more specifically, Johnson (2009, p. 364-365) points out that:

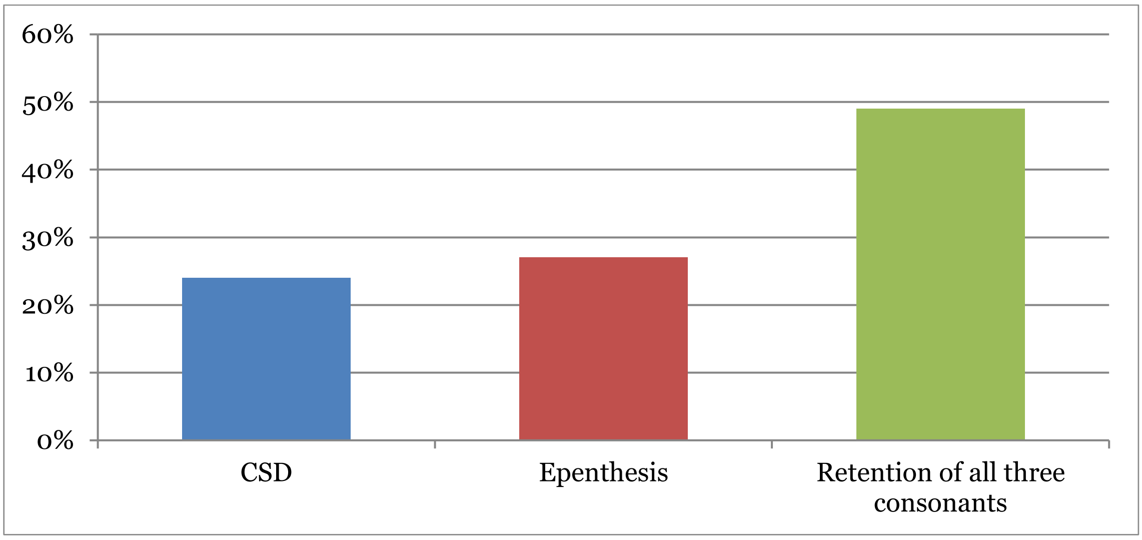
> Fixed effects are factors with a fairly small number of possible levels, for example, male/female, stressed/unstressed, or following vowel/consonant/pause. These factors are usually the direct object of interest, and their levels would be replicable in a further study.

There are factors, however, that are drawn from truly larger populations that cannot easily be replicated in other studies, such as individual speakers or specific words (JOHNSON, 2009). Thus, the mixed-effects model implemented in the Rbrul statistical package (JOHNSON, 2015) estimates a single parameter representing the amount of variation within a random factor (cf. JOHNSON, 2009), while the specific values of individual effects within the group are hidden by default. Because they are not formal parameters in the model, the significance of factor groups composed of a tiny fraction of a larger universe is not tested.

4.1 Overall frequency of the three variants

In general, the population investigated here produced a slightly larger number of outputs with application of repair strategies, with 542 tokens yielded by the application of phonological rules, compared to 529 outputs in which the three members of the sequences Ct/d]$_\sigma$C surfaced without the application of any repair strategy to readjust them, as shown in Chart 1:

Chart 1 – Overall frequency of the three variants in 1,071 tokens of Ct/d]$_\sigma$C



Source: Elaborated by the authors.

The descriptive analysis shows that 49% of the 1,071 tokens of Ct/d]$_\sigma$C were produced with the retention of all their three members, as in the word *swiftness* produced by M12 as [ˈswɪftnes], whereas the remaining 51%, in turn, were yielded by repair strategies, either epenthesis or coronal stop deletion, as in the words *postman* and *postpone*, respectively produced by M12 as [ˈp⁼owʃtɪme□n] and [ˈp⁼owspo□w□n]. Chart 1 further indicates that epenthesis after the coronal plosives was used to break up the triconsonantal sequences with a frequency slightly higher than that of the deletion rule. In absolute terms, this means that there are 288 tokens with epenthesis after [t,d] (equivalent to 27% of the total data) and 254 surface forms with the CSD (corresponding to 24%). These initial results are interesting for two reasons: firstly, the use of repair strategies as a way to simplify the L2 syllable structure or to transform it into native structures was quite similar to the retention of the marked structure; secondly, the application rate of the epenthetic vowel strategy was slightly higher than that of CSD.

According to the multivariate analysis performed by Rbrul (Johnson 2015), the trigger for the application of repair strategies in complex codas closed by a coronal obstruent involves the sonority of the consonants preceding and following (t,d). More specifically, three predictors, one external and two internal factor groups, were returned as significant, that is, they have an effect on the application of repair strategies in (t) or (d) between heterosyllabic consonants: sonority pattern of the following consonants > sonority index of the preceding consonants > L2 proficiency level. All three predictors have a *p*-value of less than 0.001 ($p < 0.001$). Each relevant factor group will be discussed separately in the following sections, in the order of significance made explicit by the greater-than signs previously used.

4.2 The effect of the SCL on the application of repair strategies in Ct/d]$_\sigma$C

The SCL played a decisive role in the production of the triconsonantal sequences Ct/d]$_\sigma$C: the sonority pattern of the following consonants has the most statistically significant effect on the use of repair strategies in coronal stops flanked by heterosyllabic segments.

As previously discussed, the law formulated by Murray and Vennemann (1983) captures a preference observed in the languages of the world for syllable contacts with a maximum sonority contrast. According to the authors, a wide range of linguistic changes were induced as a way to avoid rising sonority over a syllable boundary, so that the relation between the heterosyllabic coda and the onset segment is considered more harmonic the greater the sonority drop between these adjacent consonants.

The data set demonstrates the tendency expressed by the SCL, considering the fact that the following (heterosyllabic) consonants with higher sonority values than those of (t,d) favored the use of repair strategies in the interlanguage of Brazilian L2 learners, as indicated by the positive log-odds value (0.639). However, segments with sonority values equivalent to or lower than those of (t,d) disfavors syllable structure adjustments, as Table 5 shows:

Table 5 – Effect of SCL violations on the use of repairs in (t,d)

Factors	**Log-odds**	**Cases/total**	**%**	**Factor weight**
Higher sonority	0.639	429/758	57	.65
Equal sonority	–0.179	85/197	43	.45
Lower sonority	–0.46	27/116	23	.39
Deviance: 1207.685; $p < 0.001$; df: 8; Intercept: –0.863; Input probability: 0.297; Grand mean: 0.506				

Source: Elaborated by the authors.

Table 5 shows that 758 tokens of Ct/d]$_\sigma$C have a sonority reversal, since sonority rises from /t,d/ to the heterosyllabic consonant. Considering the fact that the voiceless plosives have the lowest sonority index in the scale elaborated by Parker (2011), there are, consequently, no sequences in which [t] can be followed by a segment with lower sonority – which leads the possible contacts between [t] and the following consonant to violate the SCL. Therefore, the sequences with such a segment are restricted to plateaux (with a total of 173 tokens in which [t] is followed by another voiceless plosive, such as [tp] and [tk] in words like *postpone* and *waistcoat*, respectively) or to sonority reversals (when sonority rises from [t] to the following syllable, usually starting with liquids, nasals, voiced plosives, and voiceless fricatives and affricates, in words like *exactly*, *softness*, *nextdoor*, *giftshop*, and *Christchurch*, respectively).

A total of 30 words out of the 43 presented in the first instrument do not conform to the SCL, as they have a sonority rise from coda to onset and, therefore, favor the application of repairs, presenting a relative weight of 0.65. Consequently, 57% of the total of 758 tokens with syllables violating the SCL were adjusted in the interlanguage of the population, with these repairs taking place in the form of epenthesis in 229 tokens and deletion in the remaining 200.

Table 6 shows the 30 words used in the carrier sentences which contain consonant sequences belonging to the first factor group in Table 5, that is, the group containing intersyllabic contacts that violate the SCL (MURRAY; VENNEMANN, 1983):

Table 6 – Target words with sonority reversals across syllable boundaries

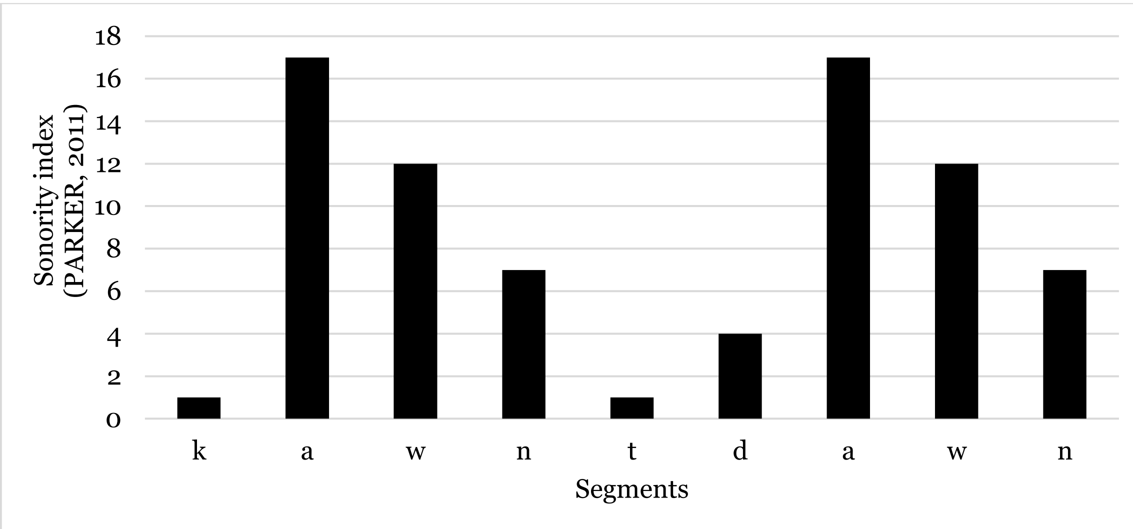
Following consonants	**Sonority index**	**Target words**	
		Ct]$_\sigma$C	**Cd]$_\sigma$C**
Glide /w/	12	–	*bandwidth*
Approximant /r/	11	*courtroom*	–
Lateral /l/	9	*restless, exactly, partly, correctly, perfectly*	–
Nasals /m,n/	7	*Christmas, postman, liftman, leftmost, softness, vastness, swiftness*	*kindness, blindness amendment, grandmother*
Voiced plosives	4	*textbook, nextdoor,*	–

/b,d/		*countdown, saintdom, heartbreak, dirtbag*	
Voiceless fricatives /ʃ,f/	3	*trustful, respectful, neglectful, giftshop, softshell*	–
Voiceless Affricates /ʧ/	2	*Christchurch*	–

Source: Elaborated by the authors.

As shown in Table 6, all the following syllables starting with consonants whose sonority values are higher than 1 promote SCL violations in the Ct]$_{\sigma}$C sequences. The word *countdown* is used in Chart 2 to illustrate the universal tendencies that model the syllables in the world's languages:

Chart 2 – Sonority profiles of *countdown*



Source: Elaborated by the authors.

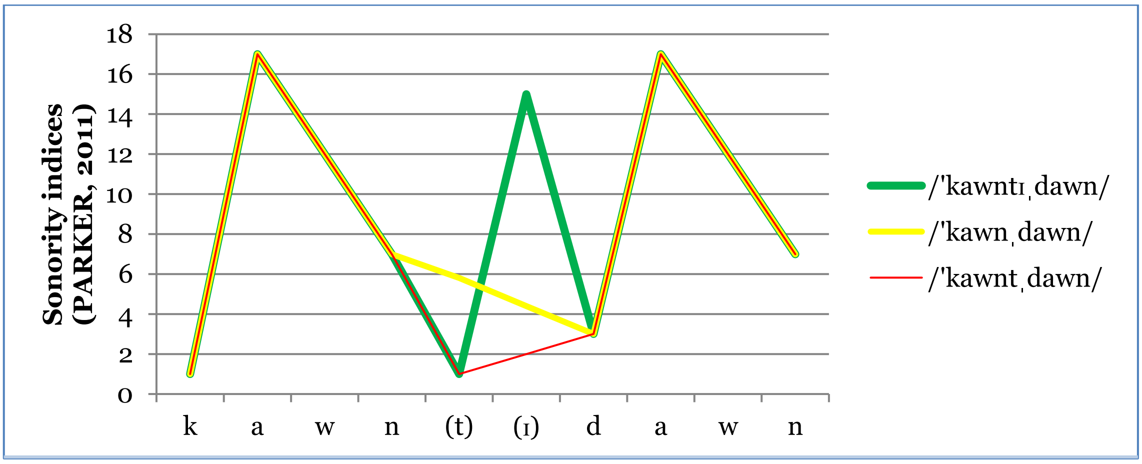
Chart 2 illustrates intra- and inter-syllabic relationships that conform to and violate some of the sonority-based principles that explain the organization of segments within the syllable and across syllables. The word *countdown* is composed of two syllables whose sonority profiles are quite representative of the Sonority Sequencing Principle (SSP), a universal tendency whereby sonority is highest in the peak of the syllable and declines towards its margins. The SPP, as postulated by Selkirk (1984, p. 116), states that "[i]n any syllable, there is a segment constituting a sonority peak that is preceded and/or followed by a sequence of segments with progressively decreasing sonority values".

As Chart 2 shows, the diphthong [aw] corresponds precisely to the sonority peak in the two syllables, which start with the plosives [k] and [d], and are followed by the sequence [nt], in the case of the first syllable, and by the nasal [n], in the second. The sonority indices of these segments in the syllable margins are progressively lower than that of the first element of the diphthong, which, in addition to being longer and more prominent, is produced with the tongue in the position of the low vowel [a], undergoing transition towards the glide [w]. Then, sonority decreases gradually from the nucleus towards the margins in the syllables [kawnt] and [dawn], in line with the SSP.

Both simple onsets in *countdown* are filled by consonants with low sonority values, which enable a sharp rise of +16 (17-1) from [k] to [aw], in the case of the first syllable, and of +13 (17-4) from [d] to [aw], in the second one. The onset-nucleus relationship of the two syllables, therefore, conforms to the sonority cycle, the model of syllable structure proposed by Clements (1990) which states that the sonority profile of the optimal syllable rises *sharply* towards the peak and falls minimally towards the end. As regards their rimes, however, a difference can be noticed: the coda of the second syllable is simple and filled by a sonorant segment with a relatively high sonority index, as maintained by the principle of the sonority cycle, given the more gradual sonority decline towards the nasal (whose sonority index is 7). Yet, such a minimal drop in sonority does not take place in the first syllable.

The second member of the complex coda has the lowest sonority level in the scale, leading to a sharp sonority drop in the nucleus-coda relationship, and thereby reaching index 1, associated with the voiceless stops. Thus, in addition to violating the sonority cycle, this steep sonority fall also prevents the contact between the two heterosyllabic consonants to be in line with the SCL, since the sonority would rise from [t] to [d]. Although (language-particular) collocational restrictions require [–son, +cor] consonants in the second position of the coda in English (cf. SELKIRK, 1982, p. 349), which allows for the occurrence of /t/, its presence in the second slot of the coda seems to cause problems in the population's interlanguage. Thus, the repair strategies used by the informants modify the syllable structures in order to guarantee their conformity with both the sonority cycle and the SCL, as can be seen in Chart 3:

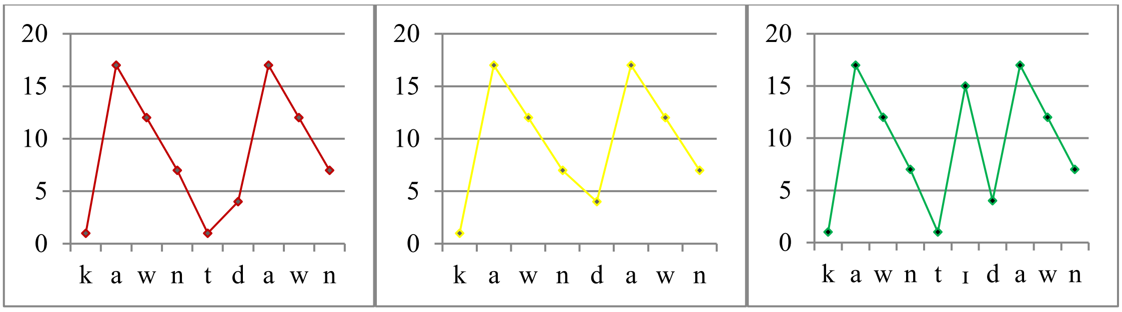
Chart 3 – Possible sonority profiles of *countdown*



Source: Elaborated by the authors.

The chart shows how sonority behaves in the word *countdown* when the output remains faithful to the entry in English, represented by the red line, in addition to the sonority profiles yielded by the application of deletion and epenthesis rules, represented by the yellow and green lines, respectively. These different sonority profiles are displayed separately in Figure 5:

Figure 5 – Sonority profiles of *countdown* observed in L2 outputs



Source: Elaborated by the authors.

It can be seen in Figure 5 that the CSD (yellow line) leads to a less sharp fall in sonority at the coda position, when compared to the steep drop observed with the maintenance of [t] (red line). In addition, the deletion also guarantees the decrease of sonority between the heterosyllabic consonants, as specified by the LCS, whereby $C1]_\sigma > {}_\sigma[C2$. The vowel epenthesis leads to the creation of the canonical CV structure, considered a linguistic universal (cf. JAKOBSON, 1962; CARDOSO, 2008), assigning the additional syllable the status of unmarked.

The other two factor groups presented in Table 6 are composed of heterosyllabic consonants with sonority values equivalent to those of (t,d) or lower than that of (d), with factor weights of 0.45 and 0.39, respectively. Table 7 shows the remaining 13 words of the corpus that present plateaux or drops in sonority across syllable boundaries:

Table 7 – Target words with plateaux and drops in sonority across syllable boundaries

Following consonants	**Sonority index**	**Target words**	
		$Ct]_\sigma C$	**$Cd]_\sigma C$**
Voiced plosive /b/	4	–	*handbag* (plateau)
Voiceless Plosives /p,k/	1	*postpone, postcard, waistcoat, softcover,*	*sandpiper, grandkid, hardcover, handcuff*

		softcore, *shortcake*, *shortcut* (plateaux)	(sonority drop) *handkerchief.*

Source: Elaborated by the authors.

Subtle but important differences should also be noted regarding the values attributed to factor groups containing following consonants with sonority values equivalent to or lower than those of (t,d): 43% of the 197 tokens of the 8 words listed in Table 7 with plateaux were repaired, with 20 percentage points higher than the lower sonority onsets. Although both groups disfavour the application of repair strategies in (t,d) between heterosyllabic consonants, flat sonority sequences led to a higher rate of readjustments than lower (falling) sonority sequences.

Our analysis demonstrates that syllable structures violating the SCL in the form of plateaux are not as problematic for the population as reversal violations, in conformity with Clements (1990). Finally, it may be concluded that the ordering of the factor groups indicates that onsets with higher sonority values than those of the coronal stops promote more repairs in the complex codas that precede them.

4.3 The effect of coda sonority on the use of repair strategies in Ct/d]$_{\sigma}$C

It is well known that most consonants in the phoneme inventory of English can be singleton codas, except /h, j, w/. Brazilian Portuguese, however, allows a limited set of segments in codas: they must be [–voc, +son] or [–son, +cont, +cor]. As opposed to syllable onset, which allows the full realization of the BP consonantal system (MONARETTO; QUEDNAU; HORA, 2014), the postvocalic position reduces the system to:

> [...] the continuant coronal, underspecified for voicing, [+ant] in some dialects, [-ant] in others; the nasal, underspecified with respect to its place-of-articulation feature; the vibrant, with the variation that is

peculiar to it; and the lateral, which tends to be replaced by the posterior glide. (MONARETTO; QUEDNAU; HORA, 2014, p. 207[106])

As maintained by the authors, the coda position can only be filled by fricatives, nasals, or liquids, represented by the archiphonemes /S/, /N/, and /R/ and /L/, respectively. However, several words in BP reflect an old grammar (BISOL, 1999) and thereby contain coda obstruents, since voiceless stops were allowed in both Classical Latin and Vulgar Latin (VL) codas (CSER, 2016), as in VL *raptāre*, *pactum* and *signum* > BP *raptar*, *pacto* and *signo* (*to kidnap*, *pact*, and *sign*, respectively).

Although epenthesis is a distinctive rule generally applied to break up the contact between these heterosyllabic consonants, which leads to the pronunciation of the aforementioned Latin-derived words as *rap*[i]*tar*, *pac*[ɪ]*to*, and *sig*[ɪ]*no*, the incorporation of the unlicensed consonants into the coda is also a possibility in BP. Indeed, the epenthetic element seems to be specially avoided by educated speakers in more formal contexts (CAMARA JR., 1970/2013). The fact that coda obstruents may variably surface in some BP dialects is explained by Bisol (1999, p. 731) as a "[...] remnant of an old grammar."

Moreover, considering the increasing influx of words borrowed directly from English into BP, it is common to hear Brazilians using anglicisms like *internet*, *hot dog*, *iPad* and *top*, for example, whose codas do not trigger the repair strategies of epenthesis or deletion in English, but are more likely to be produced in Portuguese with additional phonetic substance, given that coda stops violate syllable structure constraints in this Romance language.

Thus, when coda plosives occur in the phonological representation, these segments are assumed to be *stray* (Cˈ) and are therefore unassociated to any syllable node, which happens to segments that are not able to fill a given syllable position, either the onset or the coda (COLLISCHONN, 2004). Unlike English, stops are not licensed to occur syllable-finally in Portuguese. However, as previously discussed, when these illicit segments occupy the postvocalic slot,

[106] "[...] a contínua coronal, subespecificada quanto à sonoridade, [+ant] em alguns dialetos, [−ant] em outros; a nasal subespecificada quanto ao ponto de articulação; a vibrante, com a variação que lhe é peculiar; e a lateral, que tende a ser substituída pelo glide posterior."

some variable processes are triggered to avoid unacceptable codas: (1) the word may undergo epenthesis and resyllabification (*ad.vo.ga.do* → *a.d*[i]*.vo.ga.do*, meaning *lawyer*); (2) the stray consonant may surface in the original position by means of Coda Condition [107] Weakening (CCW), a phenomenon acting on obstruents (with the exception of /S/) in syllable-final position; or (3) the underlying plosive consonant may be deleted by stray erasure (*ha.bi.tat* → *ha.bi.ta*[ø]).

CCW is possibly active in the dialect from the state of Paraíba, especially in medial codas, so that words like *fac.ção* (*faction*), *pac.to* (*pact*), *op.ção* (*option*), and *rép.til* (*reptile*), for example, may be heard without the addition of phonetic substance, since the dorsal and labial plosives can be incorporated into the coda by means of this variable process: *fac.ção* [fakˈsɐ□ʊ□] ~ [fakiˈsɐ□ʊ□]; *op.ção* [ɔpˈsɐ□ʊ□] ~ [ɔpiˈsɐ□ʊ□]; *pac.to* [ˈpaktʊ] ~ [ˈpakɪtʊ]; and *rép.til* [ˈhɛptɪʊ̯] ~ [ˈhɛpɪtɪʊ̯]. Word-final plosives, nevertheless, tend to be mostly heard with a vowel insertion [108], as occurs in several loanwords, such as *pop*[ɪ], *internet*[ɪ], *rock*[ɪ], *web*[ɪ], *download*[ɪ], and *blog*[ɪ].

As regards the vowel insertion rule, the descriptive analysis shows that the high vowels /i,u/ (which usually surfaces as [i] or [u] in the context of pretonic and tonic syllables, and as [ɪ] or [ʊ] in posttonic syllables) were inserted after [t,d] in 27% of the 1,071 tokens. These stray consonants, therefore, were resyllabified as the onset of the new syllable, thereby simplifying the complex codas closed by the two obstruents and adjusting their production to the syllable template of BP. Similar to the epenthesis process, the deletion of [t,d] also promotes a change in the syllable structure, since the complex coda of the input also becomes simple on the surface with the elision of its second member, a phenomenon which occurred in 24% of the data. According to the multivariate analysis carried out by Rbrul, the sonority of the consonants preceding the coronal plosives is also

[107] Coda condition is also referred to as *coda filter*.
[108] The term *vowel insertion* is used with respect to the addition of phonetic substance in any word position, but *epenthesis*, however, refers specifically to segments inserted in word-medial positions.

statistically significant for the application of repair strategies in (t) or (d) flanked by heterosyllabic consonants.

In general, the data set demonstrates that the application of repair strategies in the syllable structures of the L2 is favored when the coronal plosives are preceded by the voiceless fricatives /s,f/, whose sonority index is 3, with a factor weight of 0.81 and log-odds of 1.456. The coronal nasal, which has a higher sonority value (i.e. 7), also promotes the simplification of the complex codas, with a factor weight of 0.58 and log-odds of 0.343, as can be seen in Table 8:

Table 8 – Effect of the sonority of the preceding consonants for the application of repair strategies in Ct/d]$_\sigma$C

Factors	Log-odds	Cases/total	%	Factor weight
Voiceless fricatives /s,f/ = 3	1.456	344/484	71.1	.81
Nasal /n/ = 7	0.343	133/306	43.5	.58
Voiceless plosive /k/ = 1	–0.401	43/120	35.8	.40
Approximant /r/ = 11	–1.398	22/161	13.7	.19
Deviance: 1207.685; $p < 0.001$; df: 8; Intercept: –0.863; Input probability: 0.297; Grand mean: 0.506				

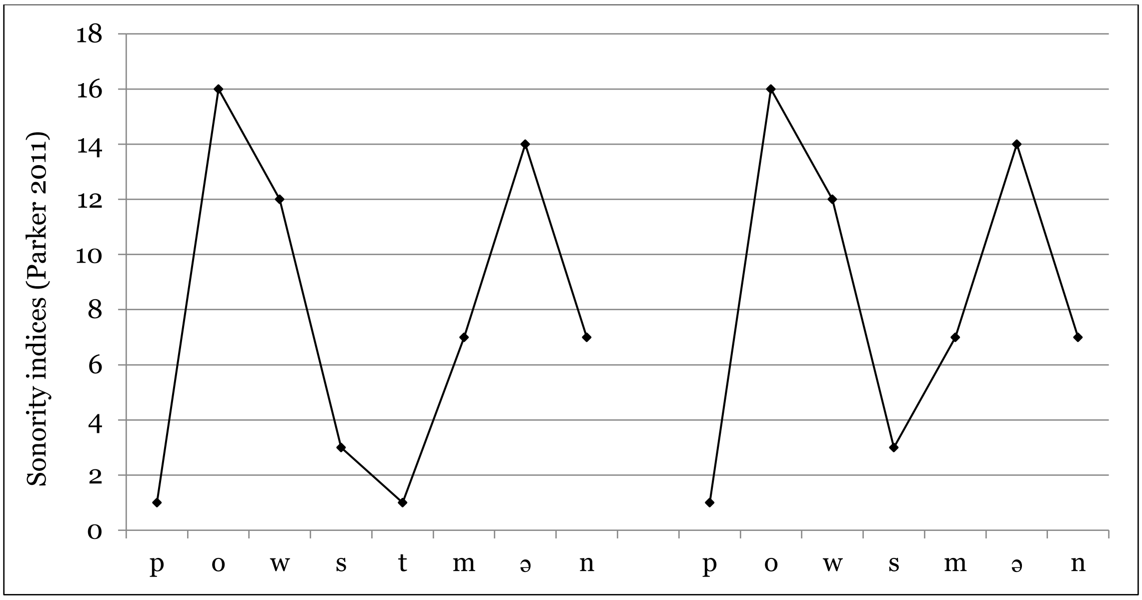
Source: Elaborated by the authors.

The voiceless fricatives /s,f/ show a relatively low sonority index, only higher than those of the voiceless plosives and affricates, respectively. Thus, the sequences /ft.n/, /ft.ʃ/, /ft.k/, /ft.m/, /st.m/, /st.n/, /st.l/, /st.p /, /st.b/, /st.d/, /st.k/, /st.f/, /st.ʧ/, which contain postvocalic consonants with a low sonority distance between them, equivalent to 2 in all these examples, were more susceptible to the use of repair strategies.

Table 8 shows that out of the 484 tokens of codas closed by /t/ and preceded by the voiceless fricatives /s,f/, 71.1% of them underwent simplification, either through CSD or vowel insertion after [t]. Overall, in absolute terms, this means that out of 344 codas containing the voiceless fricatives /s/ or /f/ before /t/, the vowel insertion rule was applied in 164 of them, while the other 180 were yielded by deletion. In fact, the word *vastness* was produced only by informants M2, F3, and F8, with epenthesis after [t]; in all the other 21 word tokens, the coronal stop was elided. Thus, several words, such as *swiftness*, *liftman*, *postman* and *restless*, for example, suffered more repairs in the form of deletion (*sof*[ø]*ness*) or epenthesis (*lift*[ɪ]*man*) than those words containing the rhotic approximant [ɹ] before /t,d/, as in the case of *heartbreak*, *shortcut* and *hardcover*, whose complex codas display higher sonority distances between their segments (SD = 10 in the case of [ɹt], and SD = 7 in [ɹd]).

Thus, the deletion of [t] after the voiceless fricatives seems to be in conformity with Clements' principle of sonority cycle (1990), according to which the preferred syllable type shows a sonority profile that rises maximally from the onset to the peak and falls *minimally* from the nucleus to the coda. Thus, instead of falling to the lowest index of the scale, the drop in sonority becomes less sharp with the application of CSD, as can be seen in Chart 4, which brings the sonority profiles of the word *pos(t)man*, with and without the production of the voiceless coronal stop, respectively:

Chart 4 – Sonority profiles of *pos(t)man*



Source: Elaborated by the authors.

The sonority profiles exhibited in Chart 4 indicates that the deletion of [t] in the surface form of the word *postman* reduces, albeit subtly, the valley that represents the sonority drop at the end of the first syllable. Thus, the sonority begins to fall from the peak, filled by the mid vowel [o] whose sonority index is 16, and it stops at the sonority value of 3, attributed to the sibilant fricative [s], thereby not reaching the bottom of the hierarchy.

It should be emphasized, therefore, that sequences containing consonants with a greater sonority distance between coda members, which are less marked, tend to present less pronunciation difficulties for L2 learners in general. Nevertheless, consonant clusters in codas with smaller sonority distances and plateaux are more marked and thereby more susceptible to repairs in the interlanguage of 24 Brazilians speakers of L2 English.

Overall, the results obtained here indicate the effects of sonority on the application of repair strategies in the triconsonantal sequences Ct/d]$_{\sigma}$C. First, codas with a high sonority distance values, like /rt/ and /rd/, do not favor the application of repair strategies, having occurred in only 22 of the 161 tokens, which corresponds to 13.7%, with a factor weight of 0.19 and log-odds of –1.398. This rate is consistent with observations widely disseminated in the literature that the liquid /r/ does not promote the deletion of the coronal stops in English (GUY; BOBERG, 1997). Secondly, consonant clusters with low sonority distance values, on the other hand, elicited the application of repair strategies for the simplification of the coda, as observed in 344 of the 484 tokens with /s,f/ before /t/ (SD = 2), representing 71.1% of this total, with a factor weight of 0.81 and log-odds of 1.456. However, consonant clusters containing plateaux in codas, like /kt/, were not the ones that promoted the most repairs, as would be expected. The fact that /kt/ remained unchanged in 77 of the 120 occurrences (64.2%), compared to 30 cases of epenthesis and 13 of CSD, albeit corresponding to a more marked structure, can be interpreted, in our view, by the phenomenon of Coda Condition Weakening (CCW).

Although they never occur in the same syllable constituent in BP, the consonants /k/ and /t/ may occur together without an intercalated epenthetic vowel, especially in word-medial position, as in *as.pec.to* (*aspect*), *co.nec.tar* (*to connect*), *in.tac.to* (*intact*), *in.vic.to* (*undefeated*), *pac.to* (*pact*), and *in.tros.pec.ti.vo* (*introspective*), for instance. Despite the possibility of (or even tendency to) hearing a vowel after /k/, there is also a movement, especially in more formal contexts of communication, that seeks to silence the manifestation of such a vowel, by weakening the coda condition. Thus, this phenomenon is active not only in the informants' native dialect, but also in their interphonology. The transfer in L2 speech caused by the phonological rules of the L1 was attested by Reis and Lucena (2019, 2020).

5 Final remarks

The sociolinguistic research described here aimed to investigate the behavior of Brazilian speakers of L2 English with respect to the acquisition of the triconsonantal sequences $Ct/d]_{\sigma}C$, in order to identify the factors which are statistically significant for the application of repair strategies in coronal stops between heterosyllabic consonants, since this type of sequence does not occur in BP and is considered a marked structure, tending, therefore, to cause more difficulties than the simple codas or the consonant sequences with only two members, for example. This means that the acquisition of the sequence /st.f/ in *trustful*, for example, would entail greater difficulties than /sf/, as in *crossfire*, considering the ill-formed syllable contact between the voiceless coronal stop and the voiceless labial fricative, with a sonority rise. The multivariate analysis using Rbrul selected three factors that have a significant impact on the DV: the sonority of the following consonants; the sonority of the preceding consonants; and the L2 proficiency level. This article focused only on the sonority effects[109].

Assuming that language structures are not conditioned only by elements internal to the system, but also by external factors (including social, cognitive, contextual, and individual ones), in an intricate and multifaceted relationship between language and society, it should be noted that the discussion on the effects of sonority only partially explains the variation in focus. However, these results may shed light on the acquisition process of a group of speakers whose variable grammar still lacks description in the literature.

Overall, the low sonority of the coronal plosives explains the strategies used in 51% of the total tokens to readjust a syllable structure that, in addition to being marked, does not occur in BP phonology. Codas with a high sonority distance between their consonants, such as /rt/ and /rd/, did not favor the application of repair strategies, which were used in only 22 of the 161 tokens of sequences containing the coronal plosives preceded by the rhotic approximant, corresponding to 13.7% with a factor weight of 0.19 and log-odds of –1.398. On the other hand, consonant clusters with a low sonority distance value, such as those formed by voiceless fricatives before /t/ (SD = 2), led to the application of rules to simplify the coda, as shown by 344 of the 484 tokens (71.1%). Clusters

[109] Cf. Reis and Lucena (2019) for the description of the role that L2 proficiency level plays in the application of repair strategies on the surface forms of Ct/d]$_\sigma$C.

with plateaux in the codas, as /kt/, were not the ones that promoted the most repairs, as expected.

As regards the sonority of the following consonants, our analysis shows that there is a tendency to readjust (t,d) when these sounds are followed by consonants with higher sonority values. This means that there was a greater incidence of repairs in words whose suffixes and heads start with nasals or laterals, than in words whose second morpheme contains onsets filled by consonants with a lower or equal sonority index, as in [dk] and [tk] or [db], respectively. This means that words like *exactly*, *partly*, *correctly*, *perfectly*, and *leftmost*, for example, suffered more alterations than *hardcover*, *handcuff*, *shortcake*, and *handbag*, which were generally produced by the informants with the three members of their respective sequences.

Finally, the L2 tokens of $Ct/d]_{\sigma}C$ produced by 24 Brazilian speakers show that adjustments are conditioned by sonority, following universal principles of syllable structure, such as the SSP, and by the apparent lack of familiarity with the L2 phonological system, as in the case of speakers with more elementary performance, whose effects were not reported here, although we acknowledge that all the factors selected as significant by Rbrul act together in the process of L2 acquisition.

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