

## VOICELESS STOP LENITION AND REDUCTION AS LINGUISTIC AND SOCIAL PHENOMENA IN CONCEPCIÓN, CHILE\*

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**ABSTRACT.** This study investigates voiceless stop lenition in Chilean Spanish. Recent studies (e.g. Pérez 2007, Figueroa & Evans 2014, among others) have documented high levels of lenition of /b d g/ in Chilean Spanish. As a result, the present study seeks to document the degree to which the voiceless stops /p t k/ undergo lenition in this variety of Spanish. Furthermore, the relationship between lenition and social factors (e.g., age, gender, and socioeconomic stratification) is examined. Data was taken from the sociolinguistic interviews of 32 speakers from the Province of Concepción, Chile. In all, 4,419 intervocalic tokens of /p t k/ were analyzed for lenition using three different measurement criteria: total voicing, articulatory reduction, and duration. Results confirm that according to all three criteria, elevated levels of lenition are observed in the production of /p t k/ in Concepción. Likewise, results indicate that as a social phenomenon, voiceless stop lenition in Concepción is primarily conditioned by age and gender.

**Keywords.** voiceless stops, Chilean Spanish, lenition, articulatory reduction, voicing, duration, sociophonetics

**RESUMEN.** Este estudio investiga la lenición de oclusivas sordas en el español chileno. Estudios recientes (e.g. Pérez 2007, Figueroa & Evans 2014, entre otros) han documentado altos niveles de lenición de /b d g/ en el español de Chile. Como resultado, el presente estudio trata de documentar en qué grado las oclusivas sordas /p t k/ sufren un proceso de lenición en esta variedad del español. Asimismo, se examina la relación entre la lenición y los factores sociales (e.g., edad, género y estratificación socioeconómica). Los datos proceden de entrevistas sociolingüísticas con 32 hablantes de Concepción, Chile. En total, se analizaron 4,419 casos de /p t k/ intervocálica, usando tres criterios de medida distintos: sonorización total, reducción articulatoria y duración. Los resultados confirman que, de acuerdo a estos tres criterios, se observan niveles elevados de lenición en la producción de /p t k/ en Concepción. Igualmente, los resultados indican que, en tanto que fenómeno social, la lenición de oclusivas sordas en esta zona está condicionada principalmente por la edad y el género.

**Palabras clave.** oclusivas sordas, español chileno, lenición, reducción articulatoria, sonorización, duración, sociofonética

### 1. Introduction.

Diachronically and synchronically, the voiceless stop consonants /p t k/ have been subject to weakening processes, especially in intervocalic position, in Spanish. These weakening processes have been shown to be the result of different types of voice

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assimilation and articulatory reduction (e.g. Penny 2002, Hualde, Nadeau, & Simonet 2011). In the evolution of Latin, intervocalic /p t k/ were weakened and voiced in Spanish and the other Western Romance languages spoken north and west of the isogloss known as the La Spezia-Rimini line, which runs across northern Italy (e.g. SAPĒRE > *saber* ‘to know’, AMATUS > *amado* ‘beloved’, AMICUS > *amigo* ‘friend’). In Spanish, these sounds further weakened, undergoing spirantization (e.g. [saβer], [aˈmaðo], [aˈmiyo]) (Alkire & Rosen 2010, Lloyd 1987, Penny 2002).

Synchronically, voicing of voiceless stops in Spanish is not a recent phenomenon. Citing Menéndez Pidal’s (1926) seminal work *Orígenes del español*, Salvador (1968) notes that voicing of word-initial /k/ was documented in Spain in the 10<sup>th</sup> and 11<sup>th</sup> centuries. Examples include [gaˈtoliga] for *católica* ‘Catholic’ in Sahagún in the province of León, [gaˈreras] for *carreras* ‘careers’/‘races’ in León, and [guˈʃara] for *cuchara* ‘spoon’ in Titaguas in the province of Valencia. Voicing of voiceless plosives subsequently spread to other phonetic contexts and to other parts of Spain (Almeida & Díaz-Alayón 1988, Alvar 1965, Alvar 1972, Herrera 1989, Hualde et al. 2011, Lewis 2000, Machuca-Ayuso 1997, Martínez Celdrán 2009, Oftedal 1985, Salvador 1968, Torreblanca 1976) and Latin America (Colantoni & Marinescu 2010, Dykstra 1955, Flórez 1963, Henríquez Ureña 1938, Isbășescu 1968, Lewis 2000, Toscano Mateus 1953), as documented by the studies reviewed in the following section. In addition, voicing of voiceless stops is not limited to Spanish, but also occurs in other languages, including Basque (Nadeu & Hualde 2014), Brazilian Portuguese (Lewis 2002), Quichua spoken in Ecuador (Toscano Mateus 1953, Toscano, 1963), Italian (Hualde & Nadeu 2011, Nadeu & Hualde 2015), and American English (Davidson 2016).

In the case of Spanish, many studies have reported voicing of intervocalic voiceless stops, or lenition, to varying degrees in various Peninsular and Latin American dialects. Weakening and voicing of intervocalic voiceless stops merits further investigation in Chilean Spanish in particular. While previous studies (Figuroa & Evans 2014, Pérez 2007, Rogers 2016) have found that intervocalic voiced stops are frequently lenited in this dialect, the degree to which this weakening phenomenon is also present in intervocalic voiceless stops in Chilean Spanish is not yet well-understood. Poblete (1992) and Cepeda (1994) both document voicing of /p t k/ in different phonetic contexts and socioeconomic groups in the Spanish of the southern city of Valdivia, Chile; however, the extent to which this phenomenon is present in the Spanish spoken in other areas of Chile is unknown. Likewise, because more than two decades have passed since the publication of both studies, a more current examination is warranted to provide more contemporary documentation and analyses. In addition, while studies on voiceless stop lenition in Spain have found that this process is affected by social factors, few studies on this phenomenon in Latin American varieties of Spanish have considered the role of such factors alongside linguistic factors. Therefore, the objectives of the present study are to document the degree to which intervocalic /p t k/ undergo lenition in Chilean Spanish and determine whether this weakening process is affected by social factors (e.g. age and gender) previously found to affect production of intervocalic voiced stops in this variety of Spanish (Rogers 2016).

The remainder of this paper is organized as follows: In the following section, the relevant literature is reviewed. Specifically, studies on voiceless stop lenition in Spain are reviewed in Section 2.1, studies on voiceless stop lenition in Latin America are reviewed in Section 2.2, and studies on lenition in Chilean Spanish are reviewed in Section 2.3. Section 3 explains the methodology used in the present study and Section 4 presents the results. Section 5 discusses the findings of this study in the context of the research questions. Finally, Section 6 summarizes the conclusions of this study and

presents directions for future research regarding weakening of intervocalic voiceless stops in Chilean Spanish.

## 2. Literature review.

Voiceless stop lenition, a weakening process whereby /p t k/ are frequently realized as their voiced counterparts in intervocalic position as well as in other phonetic contexts, has been reported rather systematically across Spanish dialects. Empirical studies have documented, to varying degrees, this process through acoustic or impressionistic analyses throughout Spanish territory. Voicing of voiceless plosives has similarly been found to occur in several varieties of Latin American Spanish, including those spoken in Mexico, Ecuador, Colombia, Venezuela, Cuba, and Argentina.

### 2.1. *Voiceless stop lenition in Spain.*

In northern Spain, Machuca-Ayuso (1997) investigated the phonetic implementation of intervocalic voiceless stops in spontaneous speech produced by four native speakers from Barcelona. Acoustic analysis on more than 2,000 tokens revealed that these speakers produced intervocalic voiceless stops and phonetically voiced stops with nearly the same frequency, as 43.63% of their productions were voiceless and 42.98% were voiced. In addition, intervocalic voiceless plosives showed further signs of weakening, as they were produced as voiced fricatives 3.39% of the time, voiced approximants 9.43% of the time, and complete elisions .56% of the time. Lewis (2000) found a similar degree of voicing in the spontaneous speech of two native speakers from Bilbao, who partially voiced intervocalic /p t k/ 18% of the time and fully voiced these sounds 33.3% of the time. Lewis also documented this weakening process in scripted speech, as the speakers from Bilbao partially voiced intervocalic /p t k/ 15.3% of the time and fully voiced these sounds 18.1% of the time on a passage reading, while they partially voiced these sounds 6.9% of the time and fully voiced these sounds 4.2% of the time on a word list reading. These are important findings because as Lewis (2000: 108) states, “the Spanish spoken in Northern Spain is considered extremely conservative” and is not generally associated with lenition processes. Although certain syllable-final lenition processes, such as /s/ aspiration and neutralization of /r/ and /l/, do not occur in the Spanish spoken in northern Spain, lenition processes affecting other sounds in other phonetic contexts do occur in this dialect.

In central Spain, in the province of Toledo, Torreblanca (1976) found that /p t k/ are partially or entirely voiced in different phonetic contexts in spontaneous speech. Full voicing of /p t k/ occurs the most in intervocalic position, especially when the two vowels are unstressed, while it occurs less when the voiceless stop is in contact with a liquid consonant (e.g. [la ˈblaθa] *la plaza* ‘the square’) and is sporadic after a nasal (e.g. [ˈaɲdes] *antes* ‘before’). In addition to voicing, /p t k/ weaken to the point of becoming what Torreblanca refers to as fricatives in Toledan Spanish, generally in intervocalic position (e.g. [ˈmaða] *mata* ‘plant’). He also found that voicing and fricativization of voiceless stops occur in different classes of words to varying degrees, occurring most frequently when /p t k/ are part of prepositions or conjunctions. In addition, both phenomena occur in both old and young speakers, even though the frequency varies with age, as younger speakers fully voice /p t k/ and produce fricatives the most. Torreblanca concludes that voicing of /p t k/ is a frequent phenomenon in Toledo but does not report the frequency with which voicing or fricativization occur, providing instead examples of participants’ productions of voiced and/or spirantized variants of /p t k/.

In southern Spain, Martínez Celdrán (2009) found that, in semi-spontaneous speech, in absolute-initial position and following /s/, /p t k/ are fully voiceless 100% of the time, while they undergo different degrees of voicing in intervocalic position in Murcian Spanish. Specifically, intervocalic voiceless stops were realized as voiced stops 58.54% of the time and as voiced approximants 15.85% of the time. Intervocalic voiceless stops were semi-voiced 21.35% of the time, while they were completely voiceless 4.26% of the time. This study is one of few empirical studies to find a high degree of voicing, as /p t k/ were at least partially voiced 95.74% of the time and fully voiced 74.39% of the time; however, it is important to note that his results are based on the speech of one speaker from Murcia.

In addition to varieties of Spanish spoken on the mainland, voicing of voiceless plosives has also been found to occur in Canary Island Spanish. Several studies have examined voicing of voiceless stops in Canary Island Spanish, with Alvar (1965) being one of the earliest to document voicing of the voiceless velar stop /k/ in Spain, carrying out a survey in La Caleta del Sebo, a town on the island of La Graciosa, which is part of the eastern Canary Islands. Based on impressionistic analysis, Alvar reports two cases of voicing of initial /k/ (e.g. [go meta] for *cometa* ‘comet’, ‘kite’), but does not report that the other voiceless stops are similarly voiced in this variety of Spanish. He does however note some examples in which /g/ becomes partially or fully voiceless (e.g. [ki tara] for *guitarra* ‘guitar’). Despite the small sample size ( $n = 2$ ) and the limited cases in which /k/ undergoes voicing, Alvar claims that this phenomenon, which appears to be wide-spread, coincides with the same tendencies in Andalusia documented by Salvador (1968). Alvar (1972) further documented voicing in his exhaustive study of the variety of Spanish spoken in the Canarian city of Las Palmas. Acoustic analysis revealed that in intervocalic position, all participants in Alvar’s study voiced /p/, even demonstrating full voicing in some cases. Intervocalic /t/ and /k/ were also partially or fully voiced by these speakers. Additionally, he found that speakers with the lowest level of education neutralized the velars /k/-/g/ in word-initial (e.g. [k/gafa] *gafas* ‘glasses’) and word-medial (e.g. [kara k/gol] *caracol* ‘seashell’) positions, a phenomenon previously documented in northern Spain by Salvador (1965).<sup>1</sup> In Gran Canaria, Oftedal (1985) found that speakers frequently or habitually voiced /p t k/ intervocalically and between a vowel and a liquid or semivowel in word-medial position and across word boundaries in semi-spontaneous speech. In addition, while old, middle-aged, and young speakers voiced /p t k/ to some degree, young speakers voiced these sounds the most. However, it is unknown how common voicing of /p t k/ is in Gran Canaria because Oftedal does not report the frequency with which this phenomenon occurs, but rather provides a list of examples of partially and fully voiced tokens of /p t k/ in different phonetic contexts, word-internally (e.g. [de borte] *deporte* ‘sport’) and word-initially (e.g. [una barma] *una palma* ‘a palm-tree’).

In a large-scale sociolinguistic study of Canary Island Spanish, Almeida & Díaz-Alayón (1988) investigated whether there were differences in the frequency of voicing according to the following extralinguistic factors: geographic location (rural vs. urban areas), sociocultural level (low, middle, or high), age (first, second, or third generation), and gender.<sup>2</sup> The researchers found that voicing occurs in both rural and urban speech

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<sup>1</sup> It is unknown how common voicing of intervocalic /p t k/ and neutralization of /k/-/g/ are in Las Palmas because Alvar (1972) does not report the frequency with which these phenomena occur. Although voicing of intervocalic voiceless stops is present in the speech of all participants, it is possible that it is only present in a limited number of tokens produced by each speaker.

<sup>2</sup> Almeida & Díaz-Alayón (1988) do not indicate whether their results are based on spontaneous or laboratory speech (i.e. passage or word list reading) data, which is important because voicing varies

in Canary Island Spanish, regardless of sociocultural level and age, although it is more common in urban speech. Of the more than 3,000 tokens of /p t k/ produced by rural speakers, 19.3% were voiced; while 31.2% of the more than 5,000 tokens produced by speakers in the city of Las Palmas were voiced and 23.2% of the more than 5,000 tokens produced by speakers in the city of Santa Cruz were voiced. According to Almeida & Díaz-Alayón, although voicing of /p t k/ can occur in any phonetic context in Canary Island Spanish, it is favored in intervocalic position and after a nasal. In addition, they found that /p/ is most frequently voiced (32.8% to 42.4% of the time), while /t/ is least frequently voiced (10.1% to 21% of the time) across the three dialectal areas studied. With respect to the effect of extralinguistic factors, Almeida & Díaz-Alayón found that voicing is led by the middle sociocultural level, as 28.3% of all tokens produced by these speakers were voiced, 25% of all tokens produced by speakers from the low sociocultural level were voiced, and 23.4% of all tokens produced by speakers from the high sociocultural level were voiced. Additionally, voicing in Canary Island Spanish is led by male speakers, as 27% of their tokens were voiced, while 23.5% of tokens produced by female speakers were voiced. Finally, Almeida & Díaz-Alayón did not find large differences in frequency of voicing between different generations of speakers, as 24.4% of all tokens produced by first-generation speakers, 25.6% of all tokens produced by second-generation speakers, and 25.9% of all tokens produced by third-generation speakers were voiced.

Herrera (1989) similarly examined the effects of gender, age (first, second, or third generation), and sociocultural level (low or middle) on /p t k/ voicing in Canary Island Spanish, focusing specifically on Tenerife. She found that in all six towns, 23.1% of all tokens of /p t k/ underwent some voicing, while 76.8% remained voiceless in spontaneous speech. Voicing was more common in certain towns, as it occurred the most in Arafo at 32.7% of the time, followed by Taganana at 27.3% of the time, and Guía de Isora at 25.9% of the time, while it occurred the least in Los Silos at 11.7% of the time. Similar to Almeida and Díaz-Alayón (1988), Herrera also found that voicing affected each individual voiceless stop differently, as /p/ and /k/ were voiced the most at 33.4% and 33.1% of the time, respectively, while /t/ was voiced the least at 7.2% of the time. In addition, word-initial position favored voicing, with 63.8% of all voiced tokens occurring in word-initial position and the remaining 36.1% of voicings occurring in word-medial position. Intervocalic context also favored voicing, as 63.9% of tokens of intervocalic /p t k/ were voiced, with intervocalic /k/ being voiced more often than intervocalic /p/ or /t/. Finally, with respect to the effect of social factors, Herrera did not find differences in frequency of voicing according to sociocultural level, but she did find that younger speakers and males favored voicing.

Finally, more recently, Hualde, Nadeau & Simonet (2011) documented voicing of intervocalic /p t k/ in the Balearic Islands, finding varying degrees of voicing in Majorcan Spanish in both unscripted and scripted speech. They found that intervocalic /p t k/ were partially voiced 13.6% of the time, fully voiced 22% of the time, and voiceless 64.2% of the time in spontaneous speech.<sup>3</sup> There was comparatively less voicing in read speech, as 0.1% of target sounds were partially voiced, 3.6% were fully voiced, and 96.3% were voiceless.<sup>4</sup> Moreover, voicing of intervocalic /p t k/ in

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according to speech style and has been found to occur more frequently in spontaneous than read speech (e.g. Hualde et al. 2011, Lewis 2000).

<sup>3</sup> These results are based on 476 tokens of intervocalic voiceless stops elicited from the spontaneous speech style.

<sup>4</sup> These results are based on 4,514 tokens of intervocalic voiceless stops elicited from the scripted speech style.

Majorcan Spanish occurs both within words and across word boundaries in both speech styles and in both high frequency and low frequency words. In addition to reporting the frequency with which intervocalic voiceless stops undergo voicing, the researchers investigated the degree of constriction of target sounds, finding that voiced tokens of /p t k/ are significantly more lenited than voiceless tokens of /p t k/ but more constricted than /b d g/. Although Hualde et al. (2011: 324) found less voicing of intervocalic voiceless stops in Majorcan Spanish than Martínez Celdrán (2009) in Murcian Spanish, they conclude that it is an incipient sound change but “given the great amount of variation among speakers in the frequency with which they implement this process, it is too early to tell whether the sound change will actually run its course. It may depend on social factors” (p. 324) -- which they did not examine.

In summary, the studies on Peninsular Spanish reviewed above found varying degrees of voiceless stop lenition. Voicing of voiceless plosives has been documented in different phonetic contexts and speech styles throughout Spain, both on the mainland and Canary and Balearic Islands, and has been found to occur with a rather high degree of frequency in northern and southern Spain as well as on the Canary Islands, suggesting that this phenomenon is not an idiosyncratic, but rather a systematic feature of varieties of Peninsular Spanish.

## 2.2. *Voiceless stop lenition in Latin America.*

Voiceless stop lenition is not unique to Peninsular Spanish. Just as voicing of voiceless stops has been documented throughout Spain, it has been documented in varieties of Spanish spoken throughout Latin America, including those spoken in Mexico (Henríquez Ureña 1938), Ecuador (Toscano Mateus 1953), Colombia (Flórez 1963, Lewis 2000), Venezuela (Lewis 2000), and Argentina (Colantoni & Marinescu 2010).

Henríquez Ureña (1938) reported voicing of voiceless stops in popular Mexican Spanish. However, the frequency of voicing in this variety of Spanish is unknown, as he only provides examples of the phenomenon in different phonetic contexts. For example, /k/ voices to /g/ in syllable-final position (e.g. [ˈdragma] ‘drachma’), word-initial position (e.g. [ˈgaraˈpaʃo] ‘shell’), and after a consonant (e.g. [ˈʧusgo] ‘funny’, ‘muffin’). The voiceless bilabial stop /p/ similarly voices in word-initial position and after a consonant (e.g. [ˈpompa] > [ˈbomba] ‘bubble’, ‘pomp’) and /t/ voices after a consonant (e.g. [falˈtriˈkera] > [falˈdriˈkera] ‘waist pouch’). According to Henríquez Ureña, voicing of a voiceless consonant (e.g. [atmˈosfera] > [admˈosfera] ‘atmosphere’) may be considered a type of assimilation, which is common throughout Mexico, both in educated and popular speech.

In his descriptive account of the Spanish spoken in Ecuador, Toscano Mateus (1953) notes cases of voicing of /p t k/. For example, many Quichua words that contain /p/ are commonly pronounced with a voiced stop /b/ in Ecuador as in [ˈpampa] > [ˈpamba] > [ˈbamba]. Voicing of /p/ is also common in the variety of Quichua spoken in Ecuador, especially in the northern and central parts of the mountainous region, as in the particle *pac*, which is frequently pronounced as [bak] or [bag]. The voiceless dental stop /t/ is not frequently voiced in the variety of Spanish spoken in Ecuador, but it is in the variety of Quichua spoken in the northern and central parts of the mountainous region. Finally, he notes that /k/ frequently voices in the variety of Quichua spoken in Ecuador (e.g. [rikuna] > [riguna]) and in the variety of Spanish spoken in Ecuador (e.g. [karasˈpera] > [garasˈpera] ‘hoarseness’). However, the extent to and frequency with which voicing of voiceless stops is present in both Quichua and Spanish in Ecuador is unknown.

In educated informal Colombian Spanish, Flórez (1963) found that some voiceless consonants, such as /p/, /f/, /t/, /s/, and /x/, occasionally voice. In Cuba, Isbăşescu (1968) reports that voicing of /p t k/ is limited to /k/, with only intervocalic /k/ in word-initial (e.g. [la ˈγasa] *la casa* ‘the house’) and word-medial (e.g. [βaγarˈði] *Bacardí*) positions voicing and spirantizing. More recently, Lewis (2000) documented voicing of intervocalic /p t k/ in the spontaneous and scripted speech of two native speakers from Medellín, Colombia. He found that they partially voiced the voiceless obstruents 9.7% of the time and fully voiced them 1.4% of the time in spontaneous speech. There was comparatively less voicing in scripted speech, as participants partially voiced /p t k/ 4.2% of the time and fully voiced them 2.7% of the time on a passage reading, while they partially voiced these sounds 2.8% of the time and fully voiced them 0% of the time on a word list reading. Lewis (2000) also investigated this phenomenon in the spontaneous and scripted speech of two native speakers from Caracas, Venezuela, finding a higher frequency of voicing than in the Colombian speakers’ productions. Specifically, the speakers from Caracas partially voiced intervocalic /p t k/ 19.4% of the time and fully voiced these sounds 30.5% of the time in spontaneous speech. On the passage reading, the speakers from Caracas partially voiced intervocalic /p t k/ 8.4% of the time and fully voiced these sounds 20.8% of the time. Finally, the speakers from Caracas partially voiced these sounds 11.1% of the time and fully voiced them 2.8% of the time on the word list reading.

Finally, Colantoni & Marinescu (2010) investigated weakening of intervocalic voiceless and voiced stops in the speech of six male speakers of Argentine Spanish. They found that /p t k/ did not undergo a high degree of voicing, as one speaker produced these sounds with variable voicing for 60% of their duration and the other five speakers’ productions were variably voiced from 10% to 30%. The researchers also found few signs of weakening in the voiceless stops, as less than 5% of target /p/ and /k/ were realized as approximants and no tokens of target /t/ were realized as approximants. Conversely, target voiced stops were consistently realized as approximants 75% to 95% of the time; and /d/ showed further signs of weakening, as 20% of tokens of target /d/ were deleted. The authors conclude that while intervocalic voiceless stops show few signs of voicing and weakening in Argentine Spanish, voiced stops are becoming weaker.

In summary, the studies on Latin American Spanish reviewed above found varying degrees of voiceless stop lenition, with only Lewis (2000) and Colantoni and Marinescu (2010) reporting its frequency in the varieties spoken in Colombia, Venezuela, and Argentina. Similar to the studies on Peninsular Spanish, voicing of voiceless plosives has been documented in different phonetic contexts and speech styles in Latin American Spanish; however, it appears that this phenomenon varies notably in Peninsular and Latin American varieties of Spanish.

### 2.3. *Stop Lenition in Chilean Spanish.*

Most studies that have documented lenition of stop consonants in Chilean Spanish have focused on voiced stops. Drawing on a speech corpus of Chilean news broadcasts, Pérez (2007) quantitatively analyzed the stylistic variation of intervocalic /b d g/ in Chilean Spanish. He found that all three target sounds undergo weakening to varying degrees, exhibiting slightly different tendencies in different speech styles. He concludes that voiced stop lenition is not a general tendency of all three voiced obstruents in Chilean Spanish, as only intervocalic /b/ and /d/ exhibited regular weakening. Figueroa & Evans (2014) also examined weakening of /b d g/ in Chilean Spanish, finding similar

results concluding that the allophones of /b d g/ in Chilean Spanish exist on a continuum of elision and oral occlusion, with /b d/ undergoing more elision than /g/.

Most recently, Rogers (2016) further investigated weakening of /b d g/ in Chilean Spanish, focusing on the variety spoken in the province of Concepción, examining the effect of linguistic factors on lenition and elision of intervocalic /b d g/. Similar to previous findings, he found that each individual segment exhibited slightly different degrees of spirantization, with /d/ being the most spirantized, followed by /b/, and then /g/. In addition, word-internal segments were significantly more weakened than word-initial segments. With respect to the effect of social factors, Rogers found that male speakers spirantized and deleted at a higher rate than female speakers and that younger speakers spirantized and deleted at higher levels than older speakers. Notably, he found that younger speakers, both male and female, reduced /g/ at significantly higher rates than older speakers. Based on these results, he concludes that spirantization of intervocalic /b d g/ in the Spanish of Concepción, Chile is the norm and that it is increasing, being primarily driven by males and younger speakers.

To date, to the best of our knowledge, only three studies have examined weakening of voiceless stops in Chilean Spanish, two of which focus exclusively on the southern city of Valdivia. Poblete (1992) examined the relationship between the lenition of /p t k/ and both linguistic and sociolinguistic factors. Linguistically, she states that /p t k/ were all more frequently voiced in intervocalic contexts, indicating that /p/ underwent voicing the most and /t/ was the most resistant to lenition. While /k/ reached levels of voicing that fell between the two extremes established by /p/ and /t/, Poblete indicates that /k/ was statistically more similar to /p/. With respect to social factors, she states that the voiceless stops were voiced by speakers from all three socioeconomic strata analyzed in her study. However, voicing was more frequent in the middle and lower strata. Age and gender were also shown to be factors, depending on the segment. Older male speakers tended to voice /p/ and /t/ more, while younger males voiced /k/ more than their older counterparts. Cepeda (1994) found that in Valdivian Spanish, /p/ and /k/ show a statistically significant tendency of voicing before sonorant segments, in intervocalic position, and in the case of /k/, before a coronal consonant and in coda position. Cepeda also found that /t/ voices in similar phonetic contexts as /p/, but its frequency was not significant.

Most recently, Sadowsky (2015) and Sadowsky & Aninao (forthcoming), analyze and document /p/ lenition in what they call “Mapuche Spanish”, a variety spoken in Chile that is a result of contact with the Amerindian language Mapudungun. Apart from traditional voicing, they also document a notably high number of cases of voiceless affricate pronunciations as well as complete elision in some cases. While male speakers in both the northern city of Santiago and the southern region of the Araucanía produced these “non-canonical” variants more than their female counterparts, both groups produced them at strikingly high frequencies. The authors assert that in Santiago, the increased use of these alternate allophones to /p/ is a form of covert prestige, especially among lower-class urban speakers looking to project an image of “toughness”.

While the high frequency of lenition of intervocalic voiced stops in Chilean Spanish has been more extensively documented, much less is known about how this weakening process affects intervocalic voiceless stops in this variety of Spanish. This is not only due to a lower number of studies, but also from a methodological standpoint, Poblete (1992) and Cepeda (1994) were restricted to a single city and used voicing as the sole indicator of lenition. Sadowsky and Aninao (forthcoming) looks at a wider range of allophones and used both spectrographic and waveform analyses, as well as auditory

cues, to identify these phonemes. However, they do not mention any use of voicing, intensity, or durational measurements. Studies on voiceless stop lenition, such as Colantoni and Marinescu (2010), have indicated that duration and articulatory reduction are processes of lenition that simultaneously occur along with voicing. To more accurately understand lenition as it relates to voiceless stops, voicing must be examined along with articulatory reduction and segmental duration.

Additionally, more than two decades have passed since Poblete (1992) and Cepeda (1994) carried out their respective studies, and with the very active role that lenition plays in the production of voiced stops in Chilean Spanish, a more contemporary study on /p t k/ is needed to determine to what extent lenition affects these segments. Likewise, in addition to quantifying the frequency with which lenition affects /p t k/ in Chilean Spanish and its relationship with linguistic factors, it is also of interest to consider whether social factors condition this process, as previous studies have found that to be the case in Chilean Spanish (Poblete 1992) as well as in other varieties, such as Peninsular Spanish (e.g. Almeida & Díaz-Alayón 1988, Herrera 1989, Torreblanca 1976). The present study investigates voiceless stop lenition in the variety of Spanish spoken in Concepción, Chile. Specifically, this study aims to answer the following research questions:

1. Given the high levels of lenition that the voiced stops /b d g/ undergo in Concepción, Chile, to what extent does lenition extend to the voiceless stops /p t k/ in the same region?
2. How does the degree of lenition of intervocalic /p t k/ vary by the linguistic factors of segment, word position, and stress in the Spanish of speakers from Concepción, Chile?
3. How does the degree of lenition of intervocalic /p t k/ vary according to the social factors of age, gender, or socioeconomic stratification in the Spanish of Concepción, Chile?

### 3. Methodology.

The data was taken from a corpus of spontaneous Chilean Spanish from several regions of Chile. A subset of 32 monolingual speakers from the southern-central city of Concepción was used for the current study. The interviews were carried out by the study's first author and were designed to be as spontaneous and natural as possible, and thus very minimally directed. To create the ideal environment for natural speech samples, the interviewer used his social networks to recruit participants. The interviews lasted 15 to 35 minutes and were designed to be as informal as possible. Some examples of topics of conversations were everyday routines, the 2010 earthquake and tsunami, local politics, crime, indigenous rights, family events, and childhood memories, among many others. Prior to the interviews, participants were asked to sign a consent form as well as complete a sociolinguistic survey which elicited basic information such as age, gender, and occupation. All interviews were recorded using a Marantz PMD660 digital field recorder and a head mounted microphone. Participants were from downtown Concepción, and the surrounding neighborhoods, referred to as poblaciones, of Candelaria, Michaihue, Boca Sur, Lomas Coloradas, Talcahuano, Villa San Pedro, and Hualpén.

Tokens of intervocalic /p t k/ in word-medial and word-initial positions were taken between the 350 and 800 second marks of each interview. While it is ideal to begin

extracting tokens from a later point of a sociolinguistic interview, due to the spontaneous nature of the interviews, not all interviews were the same length. Thus, by taking tokens from between the 350 and 800 second marks of each interview, it was possible to analyze the same amount of speech from each interview. In all, 4,419 tokens were extracted and analyzed using Praat (Boersma & Weenink 2015).

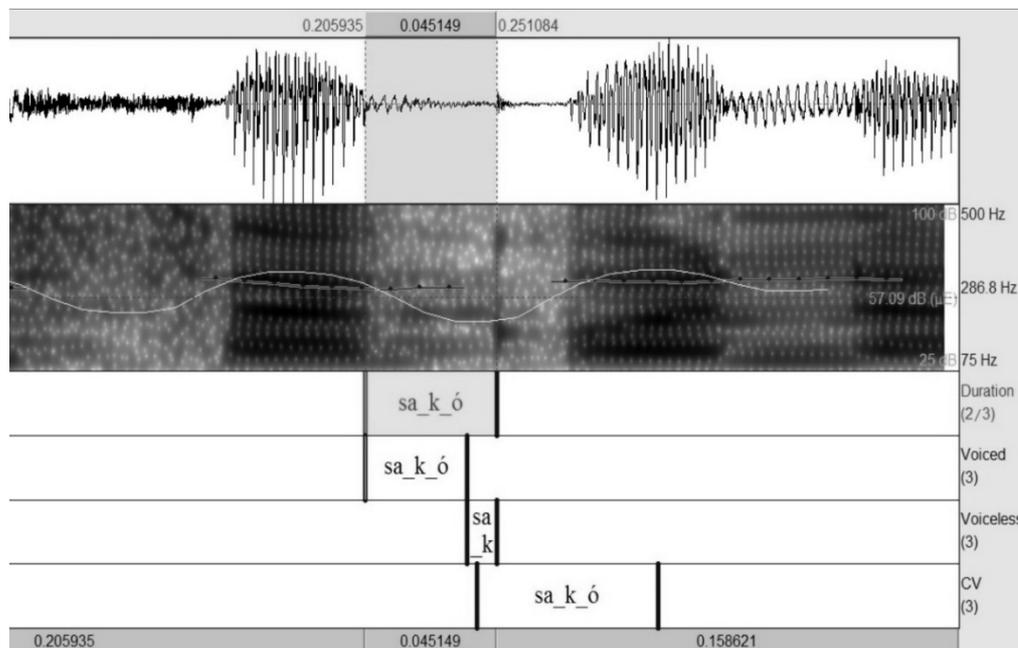
As mentioned, previous studies have shown that voiceless stop lenition does not manifest itself through a single medium (e.g. Colantoni & Marinescu 2010). In other words, voicing, which has been the measurement most associated with lenition of voiceless segments, does not take into account other processes of segmental reduction that can occur simultaneously. Therefore, in the current study, lenition was measured using three different criteria. First, the overall amount of voicing present in each token was measured from the point of closure to the release using the voice tracking function of Praat (Colantoni & Marinescu 2010). In a number of cases, tokens underwent high levels of lenition to the point where no clear closure or release was present. In these cases, the entire segmental duration was marked and coded as being completely voiced. It must be noted that Praat uses algorithms to perform various functions, including that of voice tracking using the fundamental frequency feature. These algorithms are not without their flaws, and at times, when scrolling through sound files, the program can indicate that a token has a different amount of voicing present based on several variables such as: the amount of a sound file that is visible, the number of frames that the researcher has scrolled forward or backward, and, from the experience of the authors, different operating systems (i.e. IOS and Windows), creating occasional discrepancies between what researchers code. While discrepancies were infrequent, they were still present, and to mitigate the effects of the software imperfections, all tokens were coded for voicing with a visible spectral time window of 1.875 seconds. Additionally, while the authors used different operating systems and computers to initially code the data, all files were quality checked, and corrected when needed, on the same computer running on the Windows 10 operating system before any further analysis was carried out.

Second, the amount of oral occlusion between the stop consonant and the following vowel was measured using the intensity curve in Praat to mark the valley of the consonant and the peak of the following vowel. After all corresponding points were marked, a script was run that subtracted all the valleys from their corresponding vocalic intensity peaks (Colantoni & Marinescu 2010, Ortega-Llebaria 2004). A consonant that undergoes a lower level of lenition releases into the following vowel at a faster rate. This is reflected by a steeper slope along the intensity curve between the consonantal valley and the following vocalic peak (Ortega-Llebaria 2004). Thus, greater intensity differences indicate more oral occlusion and less lenition of the stop consonant, while smaller intensity differences are indicative of a stop undergoing higher levels of lenition and articulatory reduction. Only cases of clear valleys followed by clear peaks were included in the study. In instances where no valley was present the intensity difference was 0 dB, and such cases were coded as complete deletions of the corresponding stops (Eddington 2011).

Finally, the entire duration from the closure to the release was measured using the same Praat script. Previous studies have indicated that more lenited productions tend to have shorter closure durations (e.g. Colantoni & Marinescu 2010). In the cases of segments that had no release, the duration of the entire segment was measured. Also, by taking into account duration, which does not use the algorithms that the F0 and intensity curve use, it was possible to further mitigate the effects of the previously mentioned sporadic variation seen in both the voicing and CV ratio measurements.

Figure 1 illustrates how all measurements were carried out in Praat. The first three tiers measure the overall duration of the consonant, the amount of voicing present in the segment, and the amount of voicelessness, respectively. The final tier was used to mark the valleys and peaks along the intensity curve. It must be noted that the temporal window in Figure 1 is less than 1.875 seconds in order to illustrate how each measurement was performed in more detail.

Figure 1. Example of how target tokens were labeled in Praat.



Several mixed effects analyses, with “speaker” as a random factor, were run to examine the relationship between lenition and several linguistic and social factors. The linguistic factors analyzed were segment, word position, and stress, while the social factors analyzed were age, gender, and socioeconomic stratum. It must be noted that socioeconomic stratum was only analyzed within each gender and not overall because of the lack of female speakers from the lowest of the four economic strata used. Therefore, the overall analyses were only run for age and gender. All factors were analyzed with three separate dependent variables: total amount of voicing, CV ratio, and the total duration of the closure period. Based on Rogers’ (2016) study of spirantization of /b d g/ in the same province of Chile, speakers were placed into three age groups: 18-24, 25-44, and 45-49. Socioeconomic strata were determined using a modified version of Esomar (Adimark 2000) that Sadowsky (2012) used in his study of vowels in Concepción, which determines socioeconomic stratification based primarily on the level of education and the occupation of an individual. The social strata examined were working class, lower-middle class, middle class, and upper-middle class.

## 4. Results.

### 4.1. Overall results.

Contrary to several previous studies on Spanish voiceless stop lenition (e.g. Colantoni & Marinescu 2010, Hualde et al. 2011, Machuca-Ayuso 1997, among others), the current data showed high levels of voicing and articulatory reduction. Overall, 98% of all tokens were at least partially voiced. On average, tokens were

voiced for 72.3% of their overall durations and 54.36% of the tokens analyzed were completely voiced. In numerous cases, tokens were not only fully voiced, but they also underwent spirantization and were produced as the voiced approximants [β, ð ɣ] with varying levels of articulatory reduction. In a smaller number of instances, 4%, tokens were elided. Table 1 shows the total number of instances of each of the three stops, along with the average amount of voicing, intensity differences, and deletions of each segment.

*Table 1. Average amount of voicing, intensity differences, and deletions per voiceless stop phoneme.*

Phoneme	Number of tokens	Average amount of voicing	Overall CV intensity difference	Deleted tokens (percentage)
/p/	1163	79.3%	16.929 dB	91 (7.8%)
/t/	1201	67.8%	22.353 dB	13 (1.1%)
/k/	2055	70.9%	19.726 dB	69 (3.4%)

#### 4.2. Linguistic factors.

As previously stated, the relationships of all the independent linguistic variables with three different dependent variables: total amount of voicing ( $F(1, 31.388) = 367.993, p < .0001$ ), CV ratio ( $F(1, 31.350) = 343.166, p < .0001$ ), and the total duration of the closure period ( $F(1, 32.070) = 820.104, p < .0001$ ) were examined in three separate mixed model analyses.

##### 4.2.1 Total amount of voicing.

With regards to the total amount of voicing, there was a significant interaction between stress and segment ( $F(2, 4382.755) = 7.684, p < .0001$ ) as well as a significant main effect for segment ( $F(2, 4382.266) = 33.253, p < .0001$ ). Table 2 shows that overall, /p/ was the most voiced of all three stop consonants with productions of /p/ being 76% voiced on average, followed by /k/ (67%), and /t/ (66.8%). Overall, unstressed tokens were, on average, more voiced (73.4%) than stressed tokens (66.4%), as illustrated in Table 3. There was no significant main effect for word position ( $F(1, 4385.473) = 1.579, p = .209$ ).

*Table 2. Overall voicing (%) by segment.*

Segment	Overall voicing (%)	Standard error
/p/	.759	.037
/t/	.668	.037
/k/	.670	.037

*Table 3. Overall voicing (%) by stress.*

	Overall voicing (%)	Standard error
Stressed	.664	.037
Unstressed	.734	.037

Table 4 shows the significant interaction between stress and segment, demonstrating that for all three segments, unstressed tokens were overall more voiced than stressed tokens. As there was an overall significant main effect for segment, post-hoc Bonferroni pairwise tests were run for segment pairings to examine which, if any, of the observed differences between individual segments were significant. The results indicated that

there were significant voicing differences between /p/ and /t/ ( $p < .0001$ ) and between /p/ and /k/ ( $p = .0001$ ), but no significant difference between /t/ and /k/, as indicated in Table 5.

Table 4. Significant interaction between stress and segment.

Segment	Stress/Unstressed	Mean (%)	Standard error
/p/	Stressed	.717	.040
	Unstressed	.801	.037
/t/	Stressed	.657	.038
	Unstressed	.679	.038
/k/	Stressed	.618	.038
	Unstressed	.722	.037

Table 5. Post-hoc Bonferroni pairwise tests on segment pairings with significant voicing differences.

Pairing	Mean difference (%)	Standard error	Significance	Post-hoc
/p/ and /t/	.091	.013	$p < .0001$	/p/ > /t/
/p/ and /k/	.089	.012	$p < .0001$	/p/ > /k/
/t/ and /k/	-.001	.011	$p = 1.000$	n.s.

#### 4.2.2 CV ratio.

Similar to the results for total voicing, the CV ratio analysis indicated that there was a significant interaction between segment and stress ( $F(2, 4382.561) = 11.287, p < .0001$ ). For all three stops, overall, stressed tokens had higher CV ratios than unstressed productions, indicating that unstressed tokens underwent a greater amount of overall articulatory reduction than their stressed counterparts. The results of the significant interaction are illustrated in Table 6. It must be noted that while previous studies on Chilean Spanish (e.g. Rogers 2016) and other dialects of Spanish (e.g. Eddington 2011) found that word position was a significant factor in determining the degree to which /b d g/ were lenited/spirantized, there was no significant main effect for word position in the CV ratio analysis of the present analysis of the voiceless obstruents ( $F(1, 4385.197) = .031, p = .861$ ).

Table 6. Significant interaction between segment and stress.

Segment	Stress/Unstressed	Mean (dB)	Standard error
/p/	Stressed	22.050	1.221
	Unstressed	15.845	1.151
/t/	Stressed	23.962	1.167
	Unstressed	21.242	1.159
/k/	Stressed	23.060	1.166
	Unstressed	18.895	1.138

There was also a significant main effect for segment ( $F(2, 4382.126) = 49.435, p < .0001$ ). As reported in Table 7, the results mirrored those of total voicing in that /p/ had the lowest overall CV ratio, thus undergoing a greater amount of articulatory reduction. The velar stop /k/ followed /p/ in overall CV ratio, while /t/ had the highest CV ratio and thus lowest overall levels of articulatory reduction.

Table 7. Overall mean CV ratio by segment.

Segment	Overall CV ratio mean (dB)	Standard error
/p/	18.947	1.153
/t/	22.602	1.140
/k/	20.978	1.134

Post-hoc Bonferroni pairwise tests indicated that there were significant voicing differences between all three voiceless stops and between stressed and unstressed tokens. The post-hoc results for segment are shown in Table 8.

Table 8. Post-hoc Bonferroni pairwise tests on segment pairings with significant voicing differences.

Pairing	Mean difference (dB)	Standard error	Significance	Post-hoc
/p/ and /t/	-3.654	.368	$p < .0001$	/p/</t/
/p/ and /k/	-2.030	.344	$p < .0001$	/p/</k/
/t/ and /k/	1.624	.306	$p < .0001$	/t/>/k/

#### 4.2.3. Duration.

The duration results also mirrored those of the other two dependent variables. The mixed model analysis for duration also indicated a significant interaction between segment and stress ( $F(2, 4384.776) = 5.830, p = .003$ ). Unstressed productions for all three segments had overall shorter durations than stressed productions, as illustrated in Table 9.

Table 9. Mean duration of each segment according to stress.

Segment	Stress/Unstressed	Mean (sec.)	Standard error
/p/	Stressed	.057	.002
	Unstressed	.047	.002
/t/	Stressed	.057	.002
	Unstressed	.052	.002
/k/	Stressed	.050	.002
	Unstressed	.046	.002

There was also a significant main effect for segment ( $F(2, 4383.711) = 34.493, p < .0001$ ). With respect to segment, /k/ had the overall shortest duration, followed by /p/ and then /t/. These results differ slightly from the segment results for CV ratio and overall voicing, which indicated that /p/ underwent more voicing and articulatory reduction. However, they are similar in the sense that they indicate that both /p/ and /k/ show evidence of more lenition than /t/. Table 10 illustrates these durational means.

Table 10. Overall mean duration by segment.

Segment	Overall duration mean (ms.)	Standard error
/p/	.052	.002
/t/	.055	.002
/k/	.048	.002

Post-hoc Bonferroni pairwise tests indicated that there were significant durational differences between all three voiceless stops and between stressed and unstressed tokens. The post-hoc results for segment are shown in Table 11, while the means by

stress are shown in Table 12. There were no significant main effects for word position ( $F(1, 4388.317) = 1.866, p = .172$ ).

Table 11. Post-hoc results for segment.

Pairing	Mean duration difference (ms.)	Standard error	Significance	Post-hoc
/p/ and /t/	-.004	.001	$p = .004$	/p/</t/
/p/ and /k/	.003	.001	$p < .0001$	/p/>/k/
/t/ and /k/	.006	.001	$p < .0001$	/t/>/k/

Table 12. Means by stress.

	Mean (ms)	Standard error
Unstressed	.048	.002
Stressed	.054	.002

#### 4.3. Social factors.

As was the case with the linguistic variables, separate mixed model analyses were run for each of the relationships of the social variables, as well as the variable of segment, with the dependent variables being total amount of voicing ( $F(1, 25.941) = 715.295, p < .0001$ ), CV ratio ( $F(1, 24.667) = 614.779, p < .0001$ ), and total duration of the closure period ( $F(1, 24.954) = 710.265, p < .0001$ ). All three models were statistically significant.

##### 4.3.1 Total amount of voicing.

While there were no significant main effects for age ( $F(2, 24.822) = 2.692, p = .087$ ), the overall results for the analysis of total voicing indicated that there was a significant interaction between age and phoneme ( $F(4, 4384.954) = 19.874, p < .0001$ ), as illustrated in Table 13. The 18-24-year-old speakers voiced all three stops more than the subsequent age groups, while the 25-44 age group voiced /p/ and /t/ more than the 45-49 age group. The 45-49-year-old speakers voiced /k/ slightly more than the 25-44-year-old speakers. Thus, the general pattern, except for /k/ between the second and third age groups, was for total voicing of /p t k/ to decrease as age increased.

Table 13. Significant interaction between age and phoneme.

Age group	Segment	Mean (%)	Standard error
18-24	/p/	.797	.061
	/t/	.765	.060
	/k/	.818	.058
25-44	/p/	.784	.025
	/t/	.654	.025
	/k/	.663	.025
45-49	/p/	.721	.048
	/t/	.611	.048
	/k/	.670	.047

There were significant main effects for segment ( $F(2, 4384.973) = 19.874, p < .0001$ ) and gender ( $F(1, 27.764) = 66.899, p < .0001$ ). Regarding segment, the results were identical to the linguistic analysis, with /p/ being the most voiced followed by /t/ and /k/. With respect to gender, tokens produced by males underwent more voicing

overall (88.5%) than tokens produced by female speakers (55.6%). No significant interactions were found. A post-hoc analysis also indicated that the difference between male and female speaker productions was significant ( $p < .0001$ ). Table 14 illustrates the gender means, while Table 15 shows the results of the post-hoc analysis.

*Table 14. Overall voicing means by gender.*

Gender	Overall voicing mean (%)	Standard error
Female	.556	.030
Male	.885	.035

*Table 15. Post-hoc analysis on mean duration difference between female and male speakers.*

Pairing	Mean duration difference (ms.)	Standard error	Significance	Post-hoc
Female and Male	-.329	.040	$p < .0001$	Female < Male

When the male and female productions were analyzed separately, there was a significant interaction between age and segment (Male: ( $F(4, 2435.972) = 4.435, p = .001$ ) Female: ( $F(4, 1941.376) = 3.833, p = .004$ )) and there were significant main effects for segment (Male: ( $F(2, 2436.083) = 5.471, p = .004$ ) Female: ( $F(2, 1941.121) = 15.892, p < .0001$ )). The productions of each segment were broken down in both the female and male data, and no significant voicing differences between the different age groups in the male data were found. However, in the data for the female productions of /k/, post-hoc comparisons ( $F(2, 11.356) = 4.213, p = .043$ ) showed that there was a significant difference between the 18-24-year-old group and the 45-49-year-old speakers ( $p = .044$ ). Productions of /k/ from the 18-24-year-old group were overall 80.5% voiced, while those of the 45-49-year-old group were 42.8% voiced on average.

#### 4.3.2 CV ratios.

The overall results for the CV ratios indicated that there was a significant interaction between age and segment ( $F(4, 4385.831) = 8.693, p < .0001$ ), as shown in Table 16. As was the general case for voicing and age group, all three segments had lower CV ratios, or were more reduced overall, with each subsequent younger age group. For the 18-24 group, /k/ was the most reduced segment followed by /p/ and /t/. Notably, in the 18-24 group, /k/ had a markedly lower CV ratio than the overall productions for the older two age groups. The most reduced segment for the oldest two groups was /p/, followed by /k/ and /t/.

Table 16. Significant interaction between age and segment.

Age group	Segment	Overall CV Ratio Mean (dB)	Standard error
18-24	/p/	15.106	1.645
	/t/	20.252	1.638
	/k/	13.982	1.577
25-44	/p/	17.660	0.691
	/t/	22.987	0.688
	/k/	21.067	0.662
45-49	/p/	19.314	1.293
	/t/	23.973	1.299
	/k/	22.253	1.259

There were also significant main effects for gender ( $F(1, 27.787) = 89.697, p < .0001$ ), segment ( $F(2, 4385.853) = 73.323, p < .0001$ ), and age ( $F(2, 27.862) = 4.040, p = .029$ ). Overall, the results for segment mirrored the overall voicing results, with /p/ showing the highest levels of oral occlusion, followed by /k/ and /t/. Consistent with the voicing results for gender, male productions had a lower overall CV ratio mean (14.502 dB) than that of the female productions (24.741 dB), consequently further supporting the trend reported in the voicing data of male productions undergoing overall higher levels of lenition. With respect to age group, there was a gradual decrease in CV ratio means from the oldest to the youngest age groups, potentially indicating a trend toward greater articulatory reduction in this younger demographic. Post-hoc comparisons further confirmed this overall trend with significant differences between the youngest speakers, who reduced their productions more, and both subsequent older age groupings. Table 17 shows the overall CV ratio means by gender and Table 18 by age.

Table 17. Overall CV ratio means by gender.

Gender	Overall CV ratio mean (dB)	Standard error
Female	24.741	0.817
Male	14.502	0.931

Table 18. Overall CV ratio means by age.

Age group	Overall CV ratio mean (dB)	Standard error
18-24	16.446	1.535
25-44	20.572	0.643
45-49	21.847	1.225

Male and female productions were analyzed separately, and there were significant interactions between age and segment (Male: ( $F(2, 2438.217) = 5.280, p < .0001$ ) Female: ( $F(4, 1941.379) = 3.583, p = .006$ )) and both analyses indicated that there were significant main effects for segment (Male: ( $F(2, 2438.452) = 64.144, p < .0001$ ) Female: ( $F(1, 1941.168) = 13.366, p < .0001$ )). When the productions of each segment were analyzed separately by gender, the only significant main effect was for age and the male productions of /k/ ( $F(2, 14.040) = 5.509, p = .017$ ). Post-hoc comparisons indicated that there were significant differences for /k/ between 18-24-year-old male productions and those of both the 25-44 and 45-49-year-old productions, with the 18-

24-year-old speakers reducing /k/ more than their older counterparts, as illustrated in Table 19.

*Table 19. Post-hoc comparisons on mean duration difference between different age groups.*

Pairing	Mean duration difference (ms.)	Standard error	Significance	Post-hoc
18-24 and 25-44	-6.033	1.983	$p = .026$	18-24<25-44
18-24 and 45-49	-7.301	2.477	$p = .032$	18-24<45-49
25-44 and 45-49	-1.267	1.983	$p = 1.000$	n.s.

#### 4.3.3 Duration.

The overall analysis for duration found no significant interactions but significant main effects for segment ( $F(2, 4388.006) = 29.588, p < .0001$ ), gender ( $F(1, 28.176) = 33.017, p < .0001$ ), and age ( $F(2, 28.283) = 5.611, p = .009$ ). Regarding segment, similar to the linguistic analysis, /k/ had the overall shortest duration, followed by /p/ and /t/. A post-hoc analysis indicated that the overall durational difference between all three segments was significant. With regards to age group, shorter duration has been shown to be indicative of higher levels of lenition (Colantoni & Marinescu 2010), and thus the overall durational results mirrored those of the voicing and CV ratio data in that males and younger speakers produced overall shorter voiceless stops. Male speakers produced tokens with overall shorter durations (.043 ms.) than those produced by female speakers (.056 ms.). A post-hoc test indicated that the overall durational difference between genders was significant ( $p < .0001$ ). Post-hoc tests indicated that the differences between the 18-24-year-old speakers and the 25-44-year-old speakers ( $p = .030$ ) as well as the 45-49-year-old age group ( $p = .008$ ) were significant. This serves as further evidence that males and younger speakers lenite /p t k/ the most. The only significant main effect when the data were broken down by segment and gender, and analyzed for duration was for segment (Male: ( $F(2, 2437.482) = 17.153, p < .0001$ ) Female: ( $F(2, 1941.208) = 18.174, p < .0001$ )). In both cases, the durational results mirrored those of the overall analysis of segmental duration, with /k/ having the shortest overall duration followed by /p/ and /t/. Table 20 shows the gender means for duration and Table 21 shows the age means.

*Table 20. Overall duration means by gender.*

Gender	Overall duration means (ms.)	Standard error
Female	.056	.002
Male	.043	.002

*Table 21. Overall duration means by age.*

Age group	Overall duration means (ms.)	Standard error
18-24	.042	.003
25-44	.051	.001
45-49	.055	.003

## 5. Discussion.

The motivation for the current study was to examine and better understand the process of lenition in Chilean Spanish in relation to intervocalic voiceless stops /p t k/, and various linguistic and social factors. As has been shown, a number of the variables analyzed turned out statistically significant results, and given that lenition was measured using three different criteria (voicing, CV ratio, and duration), it is clear that lenition is a complex process related to both linguistic and extralinguistic factors. The results and their implications with respect to the research questions that guided the current investigation are discussed below.

*RQ1: Given the high levels of lenition that the voiced stops /bdg/ undergo in Concepción, Chile, to what extent does lenition extend to the voiceless stops /ptk/ in the same region?*

Given that the data from the current study come from the same region and neighborhoods as the speakers used in Rogers' (2016) study on /b d g/ in Concepción, it is possible to make some comparisons. Rogers only measured lenition, specifically spirantization and articulatory reduction, using CV ratios. Table 22 shows the overall CV ratios for /b d g/ from Rogers (2016) and for /p t k/ from the current study.

*Table 22. Overall CV ratios for /b d g/ from Rogers (2016) and for /p t k/ from the current study.*

	<b>Current study-CV ratio (dB)</b>		<b>Rogers (2016)-CV ratio (dB)</b>
/p/	18.947	/b/	3.702
/t/	22.602	/d/	2.853
/k/	20.978	/g/	5.324

In addition to having much lower CV ratios, Rogers (2016) also indicated that just over 40% of all tokens of /b d g/ were deleted, while the current data only report an overall deletion rate of 4% for all productions of /p t k/. Thus, as would be expected, the voiced stops regularly undergo much higher levels of articulatory reduction. However, the fact that a portion of the productions of intervocalic /p t k/ was deleted, indicates that even though lenition is much more present and advanced with the voiced stops, it clearly affects the voiceless stops as well. In fact, the other two measurements of lenition, voicing and duration, confirm that when compared to previous studies on other varieties of Spanish (e.g. Almeida & Díaz-Alayón 1988, Colantoni & Marinescu 2010, Hualde et al. 2011, Lewis 2000, among others), lenition of /p t k/ is more advanced and present in the Spanish of Concepción, Chile.

Finally, the use of three different measurements to examine lenition of voiceless stops supports previous studies that have shown that no one single measurement is sufficient on its own when examining this phenomenon. A segment can undergo an extensive amount of voicing, but can still be produced with notable articulatory precision, which consequently can result in a longer duration. Likewise, some segments can undergo both voicing and extensive articulatory reduction and still be produced with the typical burst that follows stop closures. Other segments can be produced as the voiced approximants [β, ð, ɣ], and others are deleted. A single measurement cannot account for all the different processes of voicing, reduction, and durational variation that occur simultaneously to varying degrees. Figure 2 gives a case of a single stop, /k/, while Figure 3 illustrates how this variation occurs often within the same utterance.

Figure 2. An example of a fully voiced token of /k/ with a stop burst.

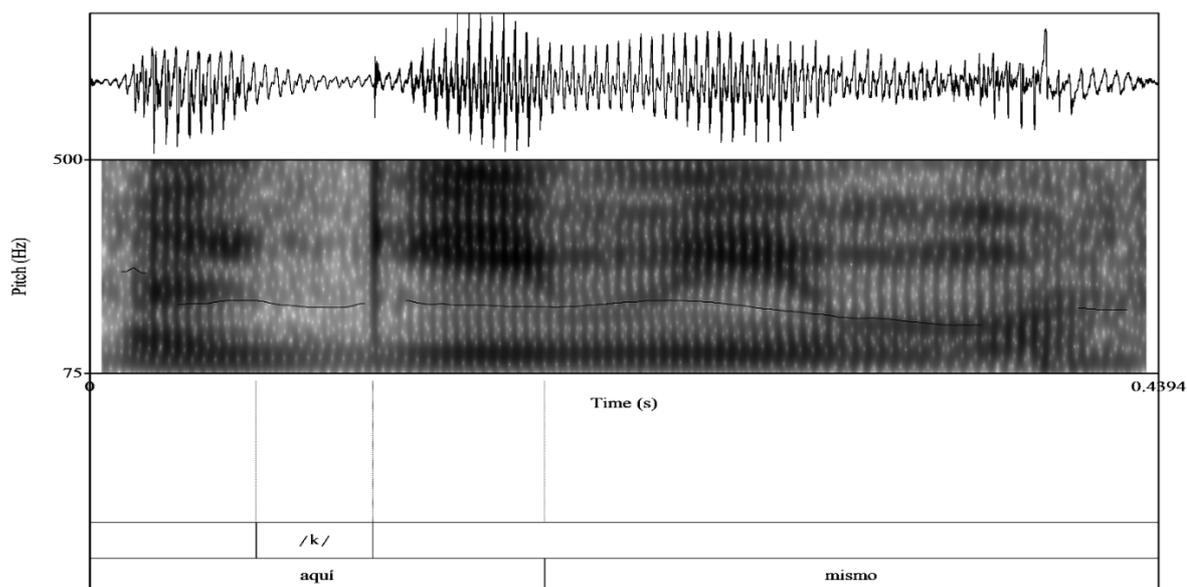
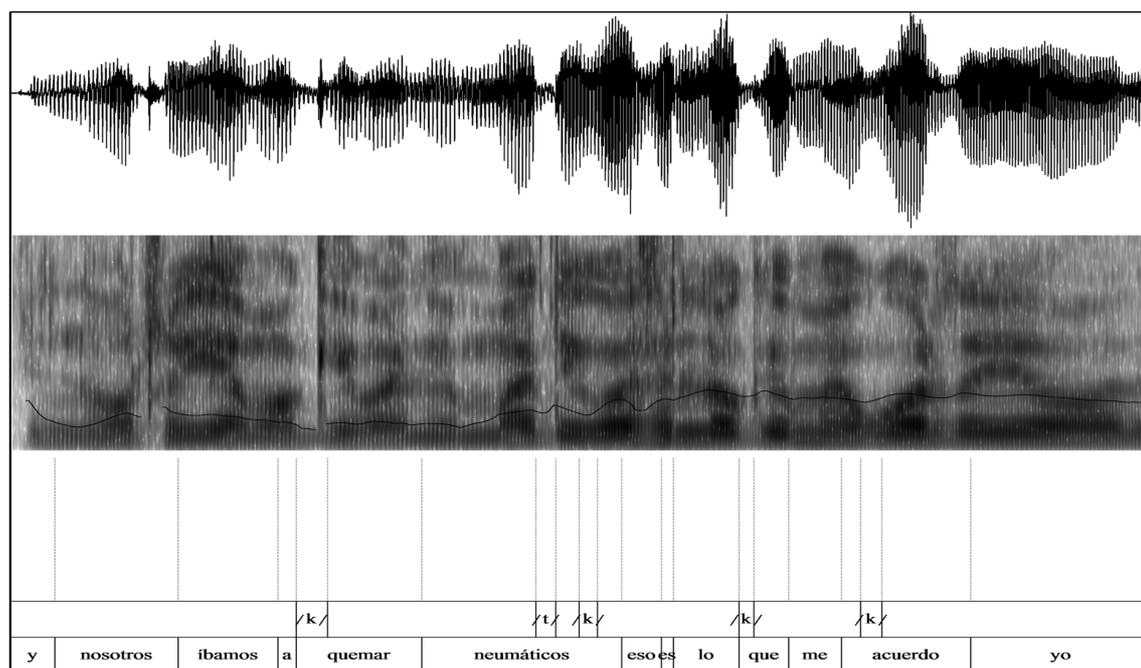


Figure 3. Example of stop production variation within the same utterance.



In Figure 2, /k/ is produced with complete voicing in the closure, yet there is still a clear burst, indicating that while voiced, the speaker produced this particular token of /k/ with a higher level of articulatory precision than cases where /p t k/ were realized as voiced approximants with uninterrupted airflow throughout the duration of the segment. In Figure 3, the speaker produced the /t/ in *neumáticos* ‘tires’ and the /k/ in *quemar* ‘to burn’ and *que* ‘that’ as fully voiced stops with a burst, while producing the /k/ in *neumáticos* and *acuerdo* ‘I remember’ as the voiced approximant [ɣ]. Thus, using only a single measurement criterion limits the ability of the researcher to account for the various manners in which lenition affects voiceless stops and can yield results that do not fully represent the data.

*RQ2: How does the degree of lenition of intervocalic /p t k/ vary by the linguistic factors of stress, segment, and word position, in the Spanish of speakers from Concepción, Chile?*

Two of the three linguistic factors analyzed, stress and segment, produced statistically significant results. Interestingly, while several studies on the voiced stops /b d g/ (e.g. Long & Baldwin 2013, Michnowicz 2011, Pérez 2007, Rogers 2016, among others) found that word-initial voiced stops underwent less lenition than word-internal voiced stops, the current study found that there were no significant differences between word-internal and word-initial /p t k/ for any of the three measures used. This might also be an indication that while lenition affects the voiceless stops, it has not advanced as much as with the voiced stops, and speakers treat intervocalic /p t k/ the same regardless of word position, while /b d g/ are treated differently. As lenition continues and begins to affect intervocalic /p t k/, it is possible that the voiceless stops will eventually mirror the voiced stops and show higher levels of lenition in word-internal position.

While speakers appeared to not treat intervocalic stops differently based on word position, they did treat productions of /p t k/ differently based on stress. Productions in unstressed syllables were consistently more voiced, less orally occluded, and shorter than those in stressed syllables. These results mirror previous studies on Spanish vowels (Delattre 1969, Harmegnies & Poch-Olivé 1992, Skelton 1969, among others), Spanish voiced stops (Carrasco et al. 2012, Cole et al. 1999, Eddington 2011), and Spanish and English voiced stops (Ortega-Llebaria 2004), which have shown stress to be an inhibitor of articulatory reduction and lenition. Most likely, this is due in part to the prosodic salience that stress creates in the mind of a speaker, inherently engendering a higher level of articulatory precision, which would be a natural inhibitor of lenition.

With respect to segment, as previously reported, overall, 98% of all tokens were at least partially voiced and on average, tokens were voiced for 72.3% of the overall durations with 54.36% of the tokens being completely voiced. Similar to previous studies on voiceless stop lenition in Canary Island Spanish (Almeida & Díaz-Alayón 1988, Herrera 1989) and in Valdivia, Chile (Poblete 1992), /p/ exhibited the most voicing and /t/ the least in the Spanish of Concepción, Chile examined in the current study. The voicing means match the CV ratio means, with /p/ appearing to undergo the most lenition, followed by /k/ and finally /t/. This is further supported by the deletion rates reported in Table 1, which indicate that productions of /p/ were elided at the highest rate, followed by /k/ and then /t/. The durational differences tell a slightly different story, with /k/ appearing to undergo higher levels of lenition, followed by /p/ and then /t/. This could be due to the increase of /k/ lenition among the younger generation, which Poblete (1992) also reports for her younger speakers. Based on the overall results of intervocalic /b d g/ from Rogers (2016) and those of the current study on intervocalic /p t k/, it appears that in the population examined in both studies, overall lenition of intervocalic stops occurs along the following continuum, increasing from left to right:

/t/ → /k/ → /p/ → /g/ → /b/ → /d/

While the possible implications of the results of intervocalic /k/ among the 18-24-year-old speakers will be discussed in greater detail later in this section, it is possible that with the higher levels of /k/ lenition among these speakers, the continuum of

intervocalic stop lenition may differ slightly and manifest itself with /k/ switching places with /p/:

/t/ → /p/ → /k/ → /g/ → /b/ → /d/

The reasons behind this ostensible continuum of lenition are ultimately beyond the scope of the current investigation. However, the frequency with which each stop occurs in intervocalic contexts could possibly play a role. Bybee (2001: 67) asserts that frequent phonetic sequences in a given language lead to what she describes as “increased automation of the neuromotor sequences of articulation”. As a phonetic sequence becomes more frequent in a language, its articulation becomes more “practiced”, and thus subject to varying levels of articulatory reduction due to the articulatory automatization of sequence. Bybee (2001) demonstrates this in her study on the past participle suffixes *-ido* and *-ado* in New Mexican Spanish, showing that while /d/ was deleted in both phonetic sequences, it was deleted at much higher rates in the much more frequent *-ado* sequence. Eddington (2011) reports similar results for *-ado*, while Long and Baldwin report higher levels of reduction and deletion of intervocalic /b/ in the *-aba* sequences of the imperfect tense in Venezuelan Spanish. In the current study, /k/ was the most frequent token reported, followed by /t/ and /p/. At first glance, this does not seem to support the notion that the much lower rates of lenition for /t/ are the result of some type of frequency effect. However, it is possible that /p/ and /k/ appear in more frequent phonetic sequences than /t/ due to their presence in generally high frequency function words such as *por*, *para* (often reduced to *pa'* in the data) and *que*, as well as the very common, utterance-final tag word *poh*, unique to Chilean Spanish. Future studies should look at the additional variable of word frequency to determine if /p/ and /k/ do in fact occur in more frequently used phonetic environments than /t/.

*RQ3: Does the degree of lenition of intervocalic /p t k/ vary according to the social factors of age, gender, or socioeconomic stratification in the Spanish of Concepción, Chile?*

The results for all three measurement criteria indicate strongly that like what Rogers (2016) found for lenition and spirantization of intervocalic /b d g/ in Concepción, Chile, lenition of the intervocalic voiceless stops is primarily driven by gender and age. Cheshire (2002) asserts that due to the large amount of social capital generally afforded to the female-male dichotomy in human societies, in a given linguistic community, it is probable that there are notable differences in female and male language use and production. Previous literature on gender and language (e.g. Cheshire 2002, Labov 1990, Trudgill 1972) has asserted that, in general terms, one of these tendencies exhibited by female speakers is greater conservatism than male speakers with respect to the use of reduced, or culturally substandard segments that carry social capital. It would be incorrect to assert based on solely the evidence presented in the current study that heavy lenition of /p t k/ in Chilean Spanish is substandard. What can be concluded through an analysis of the current data, as well as that of Rogers' (2016) findings on /b d g/ from the same population, is that higher levels of lenition of both voiced and voiceless stops are generally a definitive feature of male speech in Concepción, Chile. This is consistent with previous studies on lenition in Spanish (e.g. Cepeda 1991, Long & Baldwin 2013, Michnowicz 2011) and with Poblete's (1992) findings on gender and /p t k/ voicing in Valdivia, Chile. Thus, superficially, with respect to gender, lenition,

as a process of segmental weakening and articulatory reduction in Chile follows previously established notions of gender and language, as female speakers produced less lenited intervocalic voiceless stops than their male counterparts. When considered with previous results on Chilean /p t k/ (Poblete 1992) and /b d g/ (Rogers 2016), heavy stop lenition is more a marker of male speech than female speech. Perceptual studies are needed to determine if speakers are indeed aware of these phonetic differences and if they assign them any social value.

Despite the female speakers leniting less, it must be noted that this phonetic conservatism should be considered a relative phenomenon, due to the fact that the female speakers in the current study lenited intervocalic /p t k/ much more than female participants in similar studies of different Spanish varieties (e.g. Colantoni & Marinescu 2010, Hualde et al. 2011, Machuca-Ayuso 1997). In fact, the female speakers in the present study lenited intervocalic /p t k/ more than what has been reported for male speakers of other Spanish varieties. Thus, while more conservative for Chilean Spanish, the behavior of the current study's female participants would be considered more extreme in other previously documented dialects, indicating that diachronically, the process of stop lenition is more advanced in Chilean Spanish than in other reported dialects.

While there were definitive differences between gender, the data indicate more strongly that /p t k/ lenition is primarily being led in Chile by younger speakers. For both the measurements of total voicing and the CV ratios, there were significant interactions between segment and age, with the 18-24-year-old speakers exhibiting higher levels of voicing and articulatory reduction for all three segments. While there was no significant interaction for any of the independent variables in relation to duration, there was a significant main effect for age that showed that the younger speakers' productions of /p t k/ also exhibited overall shorter durations than those of the speakers in the older age groups. Further supporting the notion that lenition strengthens among younger speakers, is the fact that in proportion to the overall number of tokens taken from each age group, the 18-24-year-old speakers deleted /p t k/ more than three times the rate of the 25-44-year-old speakers and over 5.5 times the rate at which the 45-49-year-old speakers deleted, as seen in Table 23. This mirrors the same trend with respect to elision that Rogers (2016) reports for /b d g/ in Concepción.

*Table 23. Number and percentage of deleted tokens by age group.*

<b>Age group</b>	<b>Total tokens</b>	<b>Number of deleted tokens</b>	<b>Percentage deleted</b>
18-24	537	60	11.17%
25-44	2941	94	3.2%
45-49	941	19	2%

Labov (2006) states that there are two types of linguistic change that can occur as a result of cultural and social perceptions and value attached to different aspects of a language within a given language community. The first type he labels “change from above”, which occurs when speakers are aware of differences, be they phonetic, syntactic, or morphological. This awareness causes those speakers to adopt and proliferate certain changes in order to enhance their social standing in some form. Labov refers to the second type of change as “change from below” wherein speakers are not aware of a given change that is occurring in their language, and thus that change runs its course with little or no social value assigned to it. What is apparent from the current data is that when combined with the previous results on the voiced stops in Concepción by Rogers (2016), stop lenition is clearly accelerating among younger

speakers. If younger speakers are in fact aware of these phonetic differences, they possibly view heavy stop lenition not so much as a marker of male speech, but rather as a form of differentiating themselves from older speakers. It is possible that this attitude could persist and the 18-24 age group could continue to look at it as a marker of generational identity. If this were to happen, then it could eventually be considered a change from above. However, in order for this to happen, it would have to remain unique to the specific generation, with lenition weakening its influence in the younger upcoming generations. Based on the data in the current study and that of Rogers (2016), this is unlikely, as the clear trend from one subsequent generation to the next is an increase in lenition. What is more likely is that this increase in lenition is a change from below that increases from one generation to the next as speakers are generally unaware of the phonetic differences that acoustically differentiate one generation's intervocalic stop productions from another's. Perceptual data is needed to confirm this hypothesis.

Likewise, lenition and segmental reduction are not processes that are limited to strictly oral stop consonants, as they can affect other segments such as /s/ and vowels. During the coding of the current study, lenition of stops that preceded liquids and /s/ voicing, was also seen in the data, as well as what can preliminarily be described as "nasal lenition" (e.g. Shosted & Willgoos, 2006). Thus, future studies should examine the effect of lenition on other segments to determine if these processes have a significant presence in Chilean Spanish, and if so, if they are being driven by younger speakers as well. In fact, a recent study, Sadowsky (2012), suggests that this may be the case, as he documents vowel shifts in Concepción that he postulates are being led by teenage working-class female speakers.

Finally, one of the more salient results borne out in the data was the notable increase in lenition of the voiceless velar stop /k/ in the younger generation. For both the measures of overall voicing and CV ratio, the 18-24-year-old speakers voiced and reduced /k/ more than the speakers of the two older age groups. Likewise, while the two older age groups voiced and reduced /p/ more than /t/ and /k/, the youngest age group voiced and reduced /k/ more than the other two stops. Interestingly, Rogers (2016) also documented notably accelerated rates of articulatory reduction of /g/ among the same 18-24-year-old age group. He postulates that higher levels of intervocalic /g/ reduction could be an identity marker for younger speakers. The current investigation expands on this and posits that reduction of both velar stops in intervocalic contexts could be a marker of generational identity. As previously stated, perceptual data is needed to confirm whether these phonetic differences are above or below the consciousness of speakers. If speakers cannot perceive these differences, then increased lenition of intervocalic /k/ and /g/ in Chile might be a change from below with little or no social bearing.

## 6. Conclusions.

The results further bolster the notion that lenition, especially of intervocalic stops, is a very active and complex process in the Spanish of Concepción, Chile. While intervocalic /p t k/ were not lenited as much as /b d g/, as reported in previous studies, when compared to the levels of lenition reported for intervocalic /p t k/ in other varieties of Spanish, the voiceless stops undergo much greater levels of lenition. While there are gender differences, when compared to other dialects, the female speakers of the present study lenited /p t k/ at higher levels than what has been reported for males in other dialects. Thus, while females lenite /p t k/ less than males in Concepción, they still do so at high levels for what has been previously reported for Spanish. The data also show a clear trend that stop lenition, for voiceless and voiced stops, in Concepción is

primarily driven by age, as younger speakers consistently lenite and elide at notably higher levels than their older counterparts. It has yet to be determined if these are sound changes that will persist and prove to be permanent. Likewise, it is not clear if speakers are conscious of these generational phonetic differences and future perceptual studies are needed to determine what, if any, social value is attached to the phenomenon of voiceless stop lenition in Chile.

With respect to methodological approaches to measuring lenition, one of the strengths and contributions of the current study, is that it demonstrates, as in previous studies (e.g. Colantoni & Marinescu 2010), that when examining lenition and how it affects voiceless segments, a simple measurement of voicing is not enough. In fact, the data indicate that at least three different processes occur when voiceless stops undergo lenition: voicing, articulatory reduction, and durational reduction. These three processes do not always show a definitive correlation with each other, as previously shown. In other words, fully voiced segments are not necessarily produced with a lower level of articulatory precision or in a shorter time span than more voiceless segments. In order to more accurately report how lenition affects voiceless consonants, it is necessary to use all three measurement criteria.

Finally, when the present data is taken into account with other studies on intervocalic stops, both voiced and voiceless (e.g. Cepeda 1994, Figueroa & Evans 2014, Pérez 2007, Poblete 1992), it is likely that heavy stop lenition is a trend that applies to most native speakers of Chilean Spanish. In more general terms, based on studies on other segments in Chilean Spanish, such as /s/ (Cepeda 1990a, Cepeda 1990b, Cid 2003, Soto-Barba 2011, Tassara 1991, Valdivieso & Magaña 1988, Valdivieso & Magaña 1991, Valencia 1993) and vowels (Sadowsky 2012, Soto-Barba 2007a), as well as some of the phenomena reported from the current data (e.g. /s/ voicing and nasal “lenition”), segmental reduction extends well beyond a limited subset of phonemes. Future studies on Chilean Spanish should investigate how lenition and segmental reduction manifest themselves in different phonetic contexts as well as how they affect different segments that have not traditionally been considered susceptible to these phenomena. The implications of a more widespread tendency toward segmental reduction would not be limited to strictly the phonetic realm, as they could also affect prosodic phenomena such as speech rhythm and timing. Likewise, as is the case with stops, it is probable that any process of segmental reduction or lenition in Chilean Spanish has some type of connection with social variables, which should thoroughly be examined by any future studies on the issue.

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