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Los Angeles

Plural Production and Perception in Santiago Spanish

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy
in Hispanic Languages and Literatures

by

Mariska Aldora Bolyanatz

2017

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ABSTRACT OF THE DISSERTATION

Plural Production and Perception in Santiago Spanish

by

Mariska Aldora Bolyanatz

Doctor of Philosophy in Hispanic Languages and Literatures

University of California, Los Angeles, 2017

Professor Ji Young Kim, Co-Chair

Professor Norma Mendoza-Denton, Co-Chair

Coda /s/ weakening is among the most studied phonological phenomena in Spanish, and variationists have shown that /s/ weakening and complete deletion are conditioned by many factors. Though complete deletion of a plural /s/ may occasion homophony with singular items in Spanish, few studies have examined the acoustic and prosodic cues that speakers may use to signal plurality when a final /s/ is deleted. In this dissertation, I explore cues used by speakers and listeners of Chilean Spanish, an /s/ weakening variety, to distinguish plural from singular Noun Phrase (NP) constituents in both speech production and perception. I analyze acoustic cues of duration, vowel quality, and breathiness from the sociolinguistic interviews of 60 Santiago residents grouped by age and gender, comparing singular word-final vowels to plural word-final vowels with the final /s/ completely deleted. These 60 participants also took part in a two-alternative forced-choice perception task, asked to identify plurality on isolated natural stimuli extracted from sociolinguistic interviews. I determined that utterance-medial vowel shortening is

a cue for plurality, produced and perceived by only members of the middle age groups across genders and SES groups demonstrating age grading and overall community stability. Additionally, breathiness is produced and perceived on plural vowels by high SES speaker-listeners, and produced by younger members of the lower SES as well, though these low SES speakers do not perceive breathier vowels as plural. I posit that these younger speakers are adopting the use of breathy plural vowels in a change from above, and that the mismatch between production and perception signals the instability of the nascent change. Utterance-final lengthening is produced but not perceived by young females in the low SES, while middle- and older age group females in this neighborhood perceive breathier vowels as plural but do not produce them as such. Again, I posit that this mismatch signals instability of this cue as it is begun as a change from below by these low SES female speakers. Finally, plural vowel lowering is produced only by young males in the high SES group, but is perceived by all males and young females in both SES groups. It is therefore a perceptually robust but seemingly unreliable cue, signaling some type of instability. Plural vowel raising, on the other hand, is produced by middle- and older age group speakers in the lower SES, but not perceived by any groups. I therefore posit that plural raising is moving toward loss, as younger speakers in the low SES do not produce their singular and plural vowels with any F1 differences.

In sum, this dissertation contributes findings from both production and perception, offering evidence for shifts in multiple directions of the several cues that mark the singular~plural distinction in this /s/ weakening dialect of Spanish.

The dissertation of Mariska Aldora Bolyanatz is approved.

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2017

This dissertation is dedicated to the many Chileans who participated in my experiments, shared thoughts, experiences, and intuitions, opened their homes, networks, and cell phone contacts in order to help me find more participants, and welcomed me into their communities. Special thanks to Denisse Hurtado, Elisa Montero, and Carolina Muñoz for all of the above!

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Chapter 1. Introduction

In many dialects of Spanish, coda /s/ frequently weakens and variably deletes.

Variationist sociolinguists have demonstrated that weakening and complete deletion are conditioned by many factors, from following phonological segment and syllable stress to speaker age and speaker social class (Cedergren 1973; Terrell 1977; Lafford 1982; Poplack 1986; Alba 1990; Ruiz-Sánchez 2004; Carvalho 2006 and others). This /s/ at the end of a word serves as both a plural as well as a verbal marker. For instance, when /s/ at the end of plural noun phrase (NP) constituents is completely deleted, the plural NP may become near-homophonous with its singular counterpart as in Example 1.

Example 1. Near-minimal pair example; /s/ deleted from plural NP	
/las kasa s bonitas/	/la kasa bonita/
the- <i>fem</i> house- <i>fem pl.</i> pretty- <i>fem pl.</i>	the- <i>fem</i> house- <i>fem sg.</i> pretty- <i>fem sg.</i>
‘the pretty houses’	‘the pretty house’
[la ‘ka s a βo ‘ni t a]	[la ‘ka s a βo ‘ni t a]

As Spanish is an inflectional language, in many cases plurality is recovered via verbal inflection. However, scholars have also claimed that /s/ deletion occasions a compensatory alternation mechanism on the vowel preceding deleted /s/. For instance, Navarro Tomás (1918) and Alvar (1991) posit a 7-vowel system /i e ε a o u/ in Puerto Rican and Eastern Andalusian dialects of Spanish, claiming that /s/ weakening causes the preceding vowel to lower. Oroz (1966) claimed that when /s/ is deleted in Chile, its preceding final vowel is lowered and/or lengthened. Cepeda (1990b) reported that /s/ deletion is associated with lengthening of the preceding vowel, lowering or raising of the vowel, and what she calls *aspiración vocálica*

‘vocalic aspiration,’ which I interpret as *breathiness* on the preceding vowel. Additionally, as variationists have shown, variation in production is often aligned with the social identity of the speaker. Therefore, my first research questions ask whether Chilean Spanish speakers residing in Santiago use acoustic strategies to differentiate singular and plural NP components in their speech production, and whether use of these strategies varies according to the age, gender, and social status of the speaker.

Additionally, previous studies have examined the potential outcomes of /s/ reduction in other dialects of Spanish, and explored whether listeners can recover plurality on synthesized or laboratory-produced utterances, and found that listeners are not very accurate at this task (Resnick & Hammond 1975; Poplack 1980a; Figueroa 2000). However, most of these studies only examine accuracy, not the specific, naturally-produced cues that make listeners more or less likely to identify a stimulus as plural. Studies have shown that phonological dimensions are cued by many continuous acoustic characteristics (Lisker 1972, Repp 1982), and that speech processing consists of mapping these continuous measures onto functionally equivalent classes or categories (Holt & Lotto 2010). Stevens (2005) and other authors also claim that listeners determine the boundaries of phoneme categories based on their language-specific experience. For instance, Esposito (2006; 2010) showed that Mexican Spanish listeners are marginally sensitive to voice quality measures of H1-H2 and H1-A1 when listening to phonemically distinctive breathy and modal Mazatec vowels. Phonation type is contrastive in Mazatec via a three-way contrast between breathy, modal, and creaky voice, but voice quality is not contrastive in Spanish. That is, Mexican Spanish listeners were sensitive to these measures of breathiness when they were asked to categorize unfamiliar, Mazatec stimuli as more or less similar. The present study, on the other hand, asks Chilean Spanish listeners to make judgments about a

meaningful contrast in their own language. That is, the present study examines what acoustic cues listeners attend to when asked to identify plurality on isolated words. In addition to continuous acoustic measures as cues for identification of plurality, many recent studies in an exemplar theoretic framework have shown that stimulus identification depends not only on the stimulus itself, but also on the identity of the person listening. That is, speech perception has been shown to vary based on qualities like the listeners' socioeconomic status (Warren et al. 2007), the region of origin of the listener (Ladefoged and Broadbent 1957; Willis 1972; Fridland and Okamoto 2009) and the sex of the listener (Drager 2011). Additionally, perception of auditory stimuli has also been shown to vary according to the perceived identity of the speaker. For instance, perceived dialect area of the speaker (Niedzielski 1999; Hay and Drager 2010); perceived gender of the speaker (Strand 1999); perceived age of the speaker (Drager 2005; Hay, Warren, and Drager 2006); and perceived social class of the speaker (Hay, Warren, and Drager 2006) have all been found to condition listeners' perceptions of auditory stimuli. In light of these findings, this study also examines how a listener's social characteristics and the demographics of who they perceive to be speaking may influence identification of plurality.

I find that production and perception of the singular~plural contrast is conditioned by socio-demographic factors. For instance, only middle-age group speakers across genders and neighborhoods produce and perceive utterance-medial shortening on plural items, leading me to posit that this is a feature associated with age-grading. Additionally, plural vowel breathiness is produced and perceived reliably by high SES speaker-listeners, causing me to posit that this is a prestigious characteristic. However, several members of the lower SES also produce their plural vowels as breathier, but do not perceive breathier vowels as plural. This mismatch signals the instability of the nascent change, leading me to posit that this is a change from above, in which

speakers begin to use a phonetic cue indexed with high prestige or status. Utterance-final lengthening is produced by not perceived by young females in the low SES, while middle- and older age group females in this neighborhood perceive breathier vowels as plural but do not produce them as such. Again, I posit that this mismatch signals instability of this cue as it is begun as a change from below by these low SES female speakers.

Finally, plural vowel lowering is produced only by young males in the high SES group, but is perceived by all males and young females in both SES groups. It is therefore a perceptually robust but seemingly unreliable cue, signaling some type of instability. Plural vowel raising, on the other hand, is produced by middle- and older age group speakers in the lower SES, but not perceived by any groups. I therefore posit that plural raising is moving toward loss, as younger speakers in the low SES do not produce their singular and plural vowels with any F1 differences.

This dissertation is organized as follows. In the next chapter, Chapter 2, I review the main phonological characteristics of the Chilean dialect of Spanish, and present a review of the pertinent literature regarding production and perception of /s/ weakening. In Chapter 3, I detail the methodology of the experiments carried out during fieldwork in 2015. Chapter 4 includes the analysis and results of the production data, while Chapter 5 presents analyses and results of the perception experiment. In Chapter 6, I consider the production and perception results together, and address some concerns as well as future directions.

Chapter 2. Review of the Relevant Literature

In this chapter, I provide a summary of key phonetic, phonological, and morphological characteristics of Chilean Spanish. I use the term Chilean Spanish here to denote the Spanish spoken within the national borders of Chile. Chilean Spanish in contact with English and other languages, commonly spoken by persons of Chilean descent outside of Chile, will not figure in to this current definition since that could form the basis of another complete dissertation. First, I will briefly discuss the history of the settlement of the nation of Chile as well as some current Chilean demographic characteristics, followed by perspectives of Latin American dialectologists regarding the Spanish of Chile as opposed to other Latin American Spanish varieties. Both of these will point to the uniqueness of Chilean Spanish, a component of the importance of the proposed dissertation. In section 1, I provide a description of particular characteristics of Chilean Spanish, as found in dialectological, lexical geographical, and sociolinguistic studies, highlighting the importance of the subject of the current project, or word-final /s/ (further discussed in section 2). In section 3, I highlight important experimental studies of final /s/ in Spanish, and emphasize several areas ripe for further exploration. Finally, in section 4, I discuss briefly the relevance and importance of this project.

2.1. Characteristics of Chilean Spanish

The history of the Spanish language in Chile is entirely unique, as demonstrated by Cartagena (2002). He states that part of the Chilean territory as we now conceive of it used to be part of the Incan empire, from Arica in the north to the Maule River (approximately 250 km south of Santiago). The Spanish conquest of Chile began in 1540 with the arrival of Pedro de Valdivia across the Atacama Desert, establishing Santiago del Nuevo Extremo in 1541. This

capital was destroyed several months later, beginning, as Cartagena states, a long war of resistance between the Spanish and the indigenous Mapuche population, the only one of its kind in America, which lasted approximately 300 years (17). This conflict situation led to high population concentrations in the central region of Chile, where many *haciendas* were established, slowly wiping out the indigenous population and establishing a *mestiza* population (18). Chile officially declared its independence from Spain in 1818, later obtaining the northerly regions previously belonging to Peru and Bolivia through the *Guerra del Pacífico* (1879-1881), and finally dominating the Mapuches (or *araucanos*) toward the end of the 19th century. According to Cartagena, the 20th century in Chile has consisted of attempted cultural and political unification, yet the Mapuche minority has not been included in the economic and educational development of the nation (19)¹. Currently, Chile is described as “one of South America’s most stable and prosperous nations” (BBC News 2014). However, according to the Organisation for Economic Co-operation and Development (2011), Chile also has one of the highest rates of income inequality in the world. Santiago is both the capital of Chile as well as the largest city in the nation (with a population of just over 7.3 million people; more than a third of Chile’s population of 18 million; Instituto Nacional de Estadísticas Chile 2013). Acuña and Schuster (2012)

¹ In fact, since the early 1990s following the return to democratic government in Chile, the Mapuche have begun to organize and protest government development of ancestral lands, governmental renegeing on previous treaties, deforestation, and other instances of privation of indigenous rights by coming together to participate in marches, hunger strikes, road blocks, destruction of property, and other acts of criticism against the government (Aylwin 2000). Some Mapuche demand political and territorial autonomy from the Chilean government, while others aim to work within the confines of politics to improve the dire economic situation in which many Mapuche find themselves. This situation has been denoted *el conflicto mapuche* (the Mapuche conflict) or *la cuestión mapuche* (the Mapuche matter).

describe a well-known phrase among Chileans: “Santiago is Chile,” reflecting that within the city of Santiago is concentrated everything from jobs, healthcare, education, culture, sports, business and politics.

Among Spanish dialectologists, Chile has traditionally been categorized as its own dialectal group. For instance, Henríquez Ureña (1921), utilizing historical, geographical and political criteria, assigns Chile its own dialect zone, while he combines, for instance, Mexico, Central America, and the southern United States into a unified dialect area. Rosenblat (1933, 1962) characterizes Chile as a member of the *tierras bajas*, coastal and/or tropical areas, which are associated with consonantal weakening and loss. Rona (1964) created a dialectal division of all of Latin America, basing his work on four variables: *Zeísmo*, *yeísmo*, the presence or absence of *voseo*, and in regions where the *voseo* is used, whether the verbal morphology is used together with *vos*. The region of interest, or central Chile, Rona defines as *+yeísmo*, *-zeísmo*, *+voseo* type B, or a *voseo* paradigm in which the Spanish infinitival -ar verbs terminate in *-áis*, and the -er/-ir in *-ís*. While he characterizes northern and southern parts of Chile as belonging with neighboring countries’ dialect zones, central Chile is unlike any other dialect zone (according to these 4 characteristics he uses). Zamora Munné and Guitart (1982) divide the Americas into 9 dialect zones, according to the manifestation of coda /s/ (as [s], [h] or [Ø]); whether /x/ is velar [x] or glottal [h], and whether the *voseo* is used. Again, Chile forms its own dialectal group within this distinction, as a variety that weakens final /s/, uses a velar /x/, and has a unique *voseo* form. Moreno Fernández (1993), utilizing the lexical geography methodology, compares and contrasts the lexical items used by speakers in Latin American capital cities, but eventually leaves Santiago out of the classification (assumedly because he determines that it doesn’t fit well with any other capital city’s lexicon).

Cartagena (2002) uses a historical, diachronic approach to describe the phonetic characteristics of Chilean Spanish. As he states, his monograph is an attempt to combine traditional elements of American dialectology (those that describe a dialect's features in comparison with other dialects') with the need to also accentuate the particular historical development of the Spanish spoken in Chile (20). He describes several important features of Chilean Spanish, such as the instability of unstressed vowels; the use of the *seseo*; confusion between /b/ and [v]; *yeísmo*; weakening of syllable-final /s/; weakening of intervocalic /d/; confusion of /r/ and /l/; assibilation of /r/, especially in /tr/ clusters; and the use of the fricative [ʃ] for the affricate [tʃ]. Regarding syllable-final /s/ weakening, Cartagena cites Matus (1998-1999) who claims that /s/ variation is present in Chilean writings from the 16th century, and Cartagena states that /s/ is weakened among both the educated as well as the popular classes (30). Cartagena goes on to mention other grammatical features of Chilean Spanish, as well, including features such as *arcaísmos* such as *agora* for *ahora* or *muncho* for *mucho*, *estove* for *estuve*, and *ayga* for *haya*. A particularly unique feature of Chilean Spanish is the type of *voseo* used, or that of a combination of a *tuteo* pronoun (such as *tú*) with a *voseo* verbal inflection, such as *tú querís* (~*tú quieres*), *tú estáis* (~*tú estás*), and *tú escribís* (~*tú escribes*). Cartagena affirms that this is a phenomenon decidedly correlated with the lower classes and younger speakers, though he also posits that its use is on the rise.

Lenz, upon his arrival to Chile in 1890, was struck by the 'curious' dialect of lower-class Santiaguinos, "que presentaba una infinidad de sonidos variables del lenguaje en evolución, de formales verbales anticuadas y otras recién creadas por el «voseo» corriente" ('which presented an infinity of variable sounds of an evolving language, with antiquated verb forms and others recently created by the ordinary *voseo*,' 16). As the "first scientific description of the Spanish

spoken in Chile” (Figuroa Candia 2011: 12), Lenz’s *Chilenische Studien*, translated and republished as *Estudios Chilenos* (1940a), is the first large-scale description of Chilean Spanish, including phonetic, phonological, and morphological features.

Lenz divides Chile itself into 5 dialectal zones: North (including the cities of Tacna, Antofagasta, and provinces of Atacama and Coquimbo); Central (including Aconcagua, Santiago and Valparaíso; its dividing line is the Maule river); South-Central (including Maule, Ñuble, and Concepción); South (Arauco, Valdivia, and Llanquihue); and finally, the Chilote region (containing the islands of Chiloé).

Lenz (1940) claims that “el español ha evolucionado probablemente en Chile más que en ninguna otra región de la tierra y es de un extraordinario interés fonético debido a sus originales peculiaridades de pronunciación” (‘The Spanish language has evolved in Chile probably more than in any other region on earth and it is of extraordinary phonetic interest due to its peculiar innovations of pronunciation’, 87). Lenz proposes three reasons for the “innovative characteristics” of Chilean Spanish: the Spanish colonizers mainly settled in the Santiago area (and were primarily located there for approximately 300 years); there was a slow process of *mestizaje*, or Spanish colonizers becoming involved with local women; and finally, Lenz points to a lack of schooling, an institution known to promote linguistic standardization. There were, however, modernization movements in the mid-19th century, promoting and centralizing schooling and other infrastructure, a movement in which Andrés Bello figured prominently.

Bello (1940) attempted to draw attention to the ‘improprieties and defects’ (51) of speakers of Chilean Spanish, based on lexicon, pronunciation, and sentence construction. He mentions the common ‘archaism’ of *haiga* for *haya*, and draws attention to the use of the *voseo* verbal paradigm as well as the personal pronoun *vos*. Additionally, he mentions the ‘bad habit’

of weakening and deleting consonants such as /d/ (in words such as *virtud*, *vanidad*, and *estao* for *estado*) and final /s/ (such as in *do* for *dos*; 52). He also mentions the commonly added final [s] in the 2nd person verbal paradigm, such as *comistes* and *vinistes* (72-76). He mentions other phonic characteristics that should be avoided, such as the alternation of /r/ and /l/ in words such as *cárculo* for *cálcu*lo. Bello mentions distinction of /b/ and /v/, “para los que se aspiran a una pronunciación más esmerada” (p.66). Hanssen (1966) proposes that until the end of the 16th century, [b] and [v] in Spanish were distinguished from one other, as in Latin. However, after that period, [b] and [v] ‘se confunden’ (p. 15), and that currently, they are pronounced identically, and are only differentiated in spelling (p.13). However, as Lenz observes, the labiodental [v] may appear (though Lenz (1940b: 139) claims it only manifests in isolated cases, and is an ‘unnatural pronunciation’). The most common allophone of the bilabial stop /b/ is the bilabial fricative [β] or approximant [β̞], with the stop [b] appearing after /m/, and perhaps /r/ and /l/ (p. 140). Lenz claims that among working-class speakers, the /b/ is weakened so much it may be deleted, particularly when it is next to back vowels /o/ and /u/.

Lenz (1940b) mentions several primary characteristics of the *habla popular* (“popular speech”), below in Example 2²:

Example 2. Primary characteristics of Chilean Spanish according to Lenz (1940b)

1. Voiced stops /b,d,g/ are often weakened to the point of complete deletion³
 - a. Example: /kansado/ *cansado* ‘tired’ becomes [kan.‘sa.o]
 - b. If [β] is deleted, sometimes nearby consonants are labialized
2. Velar sounds are palatalized before /e/ and /i/
 - a. Ex. /xente/ *gente* ‘people’ becomes [‘xiẽte]
3. Alternation of /r/ and /l/, as well as weakening in coda position

² Unless otherwise noted, examples are my own.

³ He also claims that voiceless stops /ptk/ are ‘relatively invariable,’ but see Quilis (1993) for claims that these voiceless stops become voiced in certain positions in Cuban Spanish.

- a. Ex. [bar.'kon] for /balkon/ *balcón* ‘balcony’⁴
- b. Another interesting characteristic of the /r/ phoneme in Chilean Spanish, particularly in /tr/ clusters, is its so-called ‘assibilation,’ which Lenz likens the cluster found in English ‘try.’
 - i. Ex. /trajgo/ traigo ‘I bring’ as [ˈtɾaj.ɣo]
- 4. Before a vowel, /u/ is strengthened to [gw]
 - a. Ex. /webo/ *huevo* ‘egg’ becomes [ˈgwe.βo]

Finally, Lenz also mentions the voiceless affricate [tʃ̺], stating that in Santiago, it can be heard as nearly [tʃ̺s], or a fronted, alveolar double articulation (p. 150).

Lenz proposes that Chilean vowels are generally highly stable, and when there is variation, it is in quantity, not quality (1940: 167). He mentions a few generalizations about Chilean vowels, including that vowels are generally lengthened before a weakened [s] + VoicedC (so, in word-medial position), but that this lengthening also takes place before nasals. Lenz states that this lengthening is a particular property of emphatic speech. Additionally, he claims that all vowels are slightly more open in closed syllables. He also mentions a tendency to ‘cuchichear’ (whisper/murmur) final vowels, especially phrase-finally (169). He discusses briefly the *habla popular*, stating that its speakers frequently alternate vowel quality of unstressed vowels, as in *mesmo*, *escribir*, etc (171).

According to Canfield (1981), Chile has traditionally been divided into 3 dialectal zones: North, Central (including the Santiago metropolitan area) and South, as seen in Figure 1 below.

⁴ Example from Lenz (1940b) p. 113

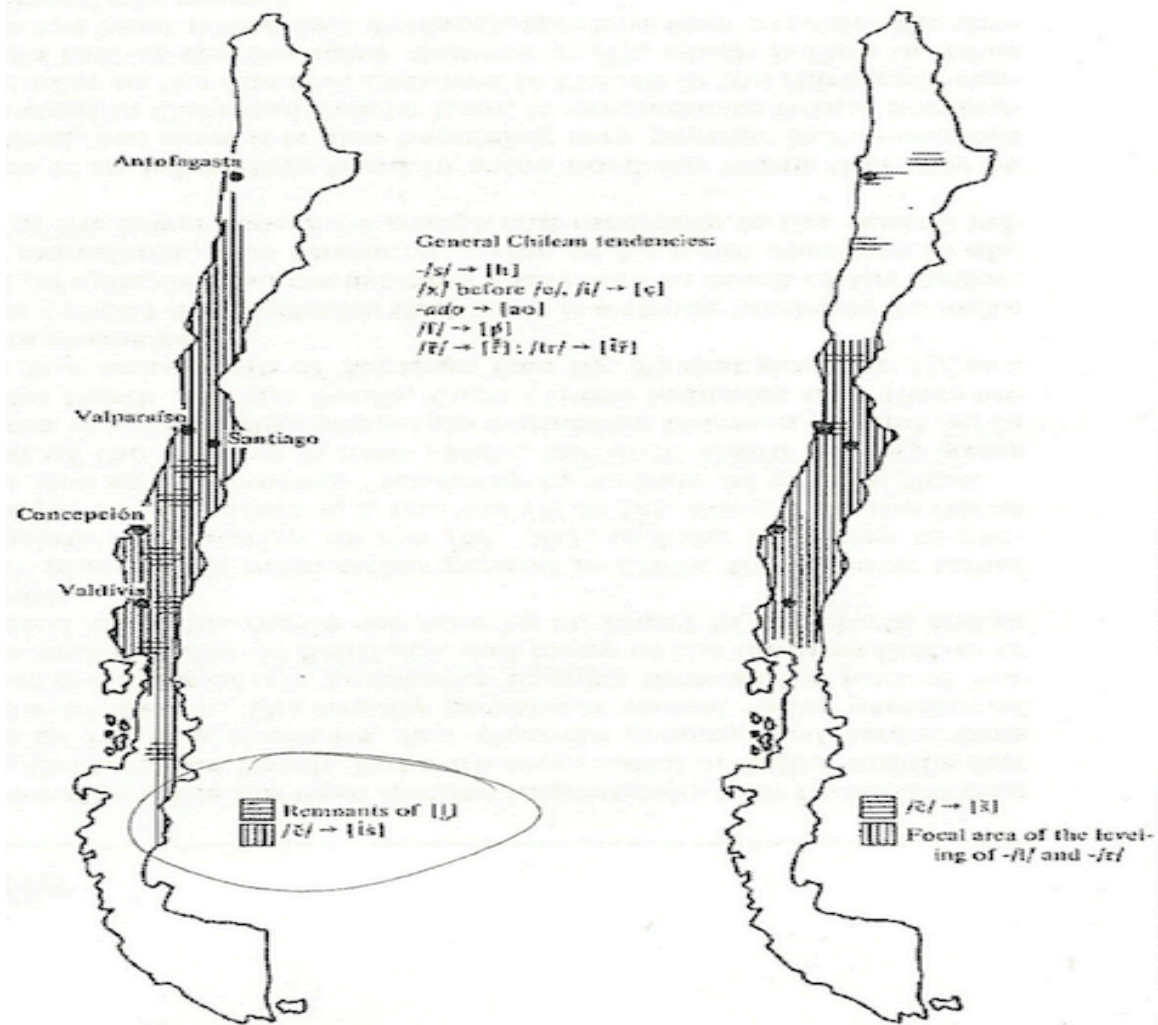


Figure 1. Dialectal zones of Chile, as delineated by Canfield (1981)

Canfield highlights four general phonetic and phonological phenomena in Chilean Spanish:

Example 3. Characteristics of Chilean Spanish according to Canfield (1981)

1. Alveolar pronunciation [ts] of the palatal affricate /tʃ/; so, [ˈtʃiːle] for /tʃile/ *Chile*
 - a. Also may desaffricate, into palatal fricative [ʃ]: [ˈʃiːle] in the Northern region
2. Palatalization of velar /x/, /k/ and /g/ before front vowels /e/ and /i/; [ˈxiːn.te] *gente* ‘people’
3. Assibilation of /r/ and /tr/ combinations; /kwatro/ *cuatro* ‘four’: [ˈkwa.tʃo]
4. Weakening of final /s/, as aspiration [h] or complete elision [Ø]: [ˈko.meh] or [ˈko.me] for /komes/ *comes* ‘you (inf.) eat’

He also discusses three other phenomena in Chilean Spanish, including the use of *yeísmo*, or the /j/ phoneme in place of the /ɰ/ phoneme, as in /kaje/ *calle* ‘street’; the assimilation of /r/ and /l/

syllable-finally (for instance, [kal.los] for /karlos/ *Carlos*); and finally, the use of the voiceless bilabial fricative [ɸ] for /f/ in ‘rural speech,’ so /fwer.te/ *fuerte* ‘strong’ becomes [‘ɸwer.te]).

Saez Godoy (2001) proposes that the most characteristic phonetic features of Chilean Spanish are the following:

Example 4. Primary characteristics of Chilean Spanish according to Saez Godoy (2001)

1. Palatalization of velar phonemes /x/, /k/ and /g/, commonly before front (palatal) vowels [e] and [i]
2. Aspiration and deletion of coda /s/
3. Approximation and deletion of /d/, especially in intervocalic position
4. Devoicing of [b] and [v]: [rehfa'lo] /resbalo/ ‘he/she slipped’

He proposes another set of features that are also highly characteristic:

Example 5. Secondary characteristics of Chilean Spanish according to Saez Godoy (2001)

1. Fricativization of the affricate /tʃ/: [ʃi'leno] /tʃileno/ *chileno* ‘Chilean’
2. Bilabialization of /f/: [ɸwera] /fwera/ *fuera* ‘out’
3. Assibilation of /r/, especially in /tr/ clusters: [‘kwatro] /kwatro/ *cuatro* ‘four’
4. Assibilation of /t/: [‘atlas] /atlas/ *atlas* ‘atlas’
5. Diphthongization of hiatus: [pel'jaron] /pelearon/ *pelearon* ‘they fought’
6. Assimilation of /rn/ clusters: [on:a] /onra/ *onra* ‘honor’
7. Vocalization of /l/ in /bl/ clusters: [abjar] /ablar/ *hablar* ‘to speak’
8. Insertion (*prótesis*) of [g] preceding diphthongs [we] and [wa]: [gwe'βon] /webon/ *huevo* ‘dude/asshole’

Rabanales (2000) confirms each of these characteristics of Chilean Spanish, as well as making several predictions for the future of the language. As he claims, the language will continue to evolve, and it is difficult to say in exactly which ways. For instance, he proposes that English terminology will continue to proliferate, particularly among lexical items related to technology. He also proposes tacitly that /s/ will continue to weaken, particularly in the *voseo* verbal forms.

Wagner (1996) also mentions each of these phenomena in his chapter in Alvar’s *Manual de dialectología*, and also adds a comment about the instability of unstressed vowels. Wagner claims that in certain areas of Chile, final vowels are devoiced, and in other areas, such as

Atacama in the North and Valdivia and Chiloé in the South, he proposes vowel quality alternation, such as ['ga:t.tu] for /gato/ *gato* ‘cat,’ and ['mon.ti] for /monte/, *monte* ‘hill,’ a common feature of rural Spanish (Real Academia Española and Asociación de Academias de la Lengua Española 2011).

In contrast with the different dialectal divisions proposed by the above authors, Figueroa (2011) claims that the Chilean dialect of Spanish is characterized by a prominent geographic unity (9). On the other hand, describes Figueroa, untrained listeners can easily and accurately identify the socioeconomic status of nearly any speaker they hear (9). The facility with which speakers can do this emphasizes the importance of the relationship between the social element and the perceptive one, particularly in terms of describing variants with variable levels of prestige and stigmatization.

Several authors have attempted to undertake studies of Chilean Spanish using a linguistic atlas methodology. For instance, in 1966, Lope Blanch and colleagues spearheaded the creation of a coordinated study of the linguistic norms of educated speakers in the principal cities of Spain, which was later also extended to Latin America as the “Proyecto de estudio del habla culta de las principales ciudades de Hispanoamérica.” Rabanales and Contreras, professors at the Universidad de Chile, led a team of researchers for the data collection of this project, and the transcripts of these interviews were published under the auspices of *El habla culta de Santiago de Chile: Materiales para su estudio* (1979).

Following the Peninsular tradition (as well as that of Navarro Tomás (1966) in Puerto Rico), Carillo (1969) undertook the project of a linguistic atlas of Chile, entitled *Atlas lingüístico y etnográfico de Chile* (ALECh). He published several preliminary descriptions of the study’s setup, such as a selection of research sites and a preliminary questionnaire. The Atlas was to

encompass three sociocultural levels, and include speakers from capital cities of each province, and Carillo had even begun data collection, but unfortunately the Atlas was never completed. Santiago was to be a part of this Atlas project, but the “phonetic” aspect of this study was limited to isolated word production (somewhat typical of linguistic atlases and dialectology as a whole).

Concurrently, Araya and his colleagues (1968; 1973) began the undertaking of the *Atlas lingüístico y etnográfico del sur de Chile* (ALESUCh). Similarly, preliminary descriptions of the study were published, as well as the questionnaire itself (focusing on lexical items as well as phonetic, morphological and syntactic characteristics of the various sites throughout southern Chile). The first volume was published in 1973, but the other three that had been anticipated were unable to be completed due to the military coup of the government and the dismantling of the research group. Wagner and his colleagues described several geolinguistic features of Chile that were included as a chapter on Chile in the Atlas of Hispanic America.

Building on these two initial attempts, another *Atlas lingüístico y etnográfico de Chile* (ALECh) has been undertaken by Wagner and his colleagues (1998, 2004), though its complete results have yet to be published. Wagner himself (2004) admits regarding the phonetic aspect of the Atlas that there is a tendency toward ‘mechanical answers,’ which the present study aims to avoid.

2.2. Final /s/ weakening in Chilean Spanish

In each of the above descriptions of Chilean Spanish, weakening of syllable-final /s/ has figured prominently. Let us examine these mentions more closely, approaching the main theme of this dissertation.

Lenz calls the weakening of /s/ before consonants and in utterance final position “el más notable de todos los cambios chilenos” (*the most prominent of all the Chilean changes*, p. 90). In discussing the /s/ weakening found in Chilean Spanish, Lenz mentions the Andalusian debate which states that /s/ weakening spread throughout Latin America due to the settlement patterns of Andalusian colonizers. However, he argues that nobody knows the exact origin of Chile’s settlers, noting instead that there are many Basque last names in Chile, a dialect zone not commonly associated with /s/ weakening. Additionally, Lenz argues that many Chilean Spanish features are based on an indigenous (Araucano) substrate, and that Chilean Spanish is basically Spanish words with Mapudungún pronunciation. Alonso (1940), however, contradicts this hypothesis. First, he shows that each of the phonetic elements on which Lenz bases his argument occur in other Spanish dialects. Lenz claims that /s/ is not a phoneme in Mapudungún, but Alonso shows that neither /s/ nor /h/ are phonemes in Mapudungún, so neither can be the inspiration for /s/ aspiration in Chilean Spanish.

Lenz claims that /s/ in the *habla vulgar* is most commonly aspirated or deleted before a consonant or a pause, but that resyllabification is possible. In other words, in connected speech, a coda /s/ may form the onset of the following onset-less syllable, as in /las alas/ *las alas* ‘the wings’ [la. 'sa.lah]. Additionally, Lenz claims that the *huasos*⁵ may also aspirate syllable-initial /s/, as in ['me.ha] /mesa/ *mesa* ‘table;’ [hi 'no] for /sepor/ *señor* ‘sir’ (examples from Lenz 1940b: 125). Lenz also asserts that /s/ is aspirated before a pause in stressed syllables, but that /s/ is completely deleted before a pause in unstressed syllables.

⁵ As Lenz describes, the *huasos* are the rural dwellers in Chile, characterized by demographics such as low incomes and high rates of illiteracy (1940b:92)

Lenz claims that /krus/ cruz ‘cross’ is more like (as he writes) [kru’], or “la corriente espiratoria no se debilita hasta el final, sino que es interrumpida repentinamente al separarse las cuerdas vocales que antes se habían acercado para vibrar” (‘the airstream does not continue to weaken until the end, but rather it is interrupted suddenly by the separation of the vocal cords that had just been vibrating close to one another’; 1940b: 126). His description, though not quite clear, seems similar to that of a glottal stop, though in a glottal stop the vocal folds actually slam together, ‘stopping’ the airflow through the glottal opening⁶.

In upper class speech, Lenz claims that speakers tend to use a sibilant [s] in a stressed syllable, such as in /ingles/ [iŋ.ˈgles] *inglés* ‘English.’ However, in unstressed syllables, speakers weaken the final /s/, using “una vocal aspirada y brusca” (‘an aspirated and abrupt vowel,’ p. 127). This apparent reference to breathy voice quality is the first in this dialect. Lenz also states that these speakers may delete the final /s/ entirely in unstressed syllables.

In general, Lenz states that /s/ tends to be deleted before other voiceless fricative consonants, such as /f/, as in *satisfacción* ‘satisfaction’: [satiφaˈsjon]. He also claims that /s/ is deleted before /p/, but that ‘se aspira la vocal’ (‘the vowel is aspirated,’ p. 130). Before /t/, due to the alveolar place of articulation of both sounds, the tongue moves quickly to close the vowel and occlude the airflow for the pronunciation of the *t*’s stop closure, as Lenz puts it, this is the energy of the /s/ passing easily to the [t] (p. 130). Before /k/, however, he claims that /s/ is often perceived as aspirated, due to the quick closure of the glottis for the stop closure of the /k/ (p.131). Before /m/, /s/ is often produced with a voiceless [m̥]; that is, lips are closed, but air is coming out through the nasal cavity, before the voicing of the /m/ commences.

⁶ As Chappell (2013) has shown in Nicaraguan Spanish, the glottal stop is an allophone of final /s/ conditioned by multiple intra- and extra-linguistic factors.

Silva Fuenzalida (1953) describes the phonological situation of upper-middle class speakers in Santiago. He characterizes /s/ with other voiceless fricative sounds /f x h/, stating that they may become strengthened or weakened depending on their environments. Specifically, he states that word-initially, /f s x/ are ‘relatively strong,’ while word-finally, /s h x/ may become weaker.

Silva Fuenzalida comments on the allophonic variation of the vowels in Chilean Spanish, stating that /ieou/ tend to raise in open syllables (i.e. syllables with C.V structure), and lower in closed syllables (i.e. syllables with a coda, or C.V.C structure). The low vowel /a/, he claims, becomes more back when it precedes a velar or glottal consonant, such as in /ago/ *hago* ‘I do/make’ or /axo/ *ajo* ‘garlic.’ (n.d.)

Silva Fuenzalida is among the only authors to assign phonemic status to /h/; he refers to it both in contexts where we would expect /s/ as well as /x/ (as in [ahá] *ajá* ‘aha,’ p. 163). He devotes an entire index to /h/’s phonemic status, stating that though it is tempting to assume that /h/ is an allophone of /s/ just because they appear to be in free variation as markers of plurality, a. one cannot conflate morphological and phonological issues, and b. [h] and [s] contrast in syllable-initial position, as in Example 6 below:

Example 6. Examples of word-medial and resyllabified /s/

a. [ká.sa]

b. [lo.ha.mí.goh]

Silva-Fuenzalida claims that it is possible for 6b to appear as [lo.sa.mí.goh], but that 6a will never appear as [ká.ha]. In 6a, [s] is underlyingly syllable-initial, but in 6b, [h] becomes syllable-initial only in connected speech (i.e. due to resyllabification). Therefore, according to his logic, it is impossible that [h] and [s] derive from the same phoneme, so the only alternative is to assign them both phonemic status. He is challenged by the fact that [s] and [h] alternate before a pause

(which, as he states, also forms a morpheme boundary), and claims that it is impossible to assign free variation status to sounds based on their environments when in the opposite environment (word-initially), a sound like /d/ is always [d].

Oroz's (1966) seminal work on the phonetics, morphology, syntax and lexicon of Chilean Spanish mentions /s/ weakening as well as vocalic alternations associated with this weakening (see Figure 2 below for Oroz's delineation of dialect zones).

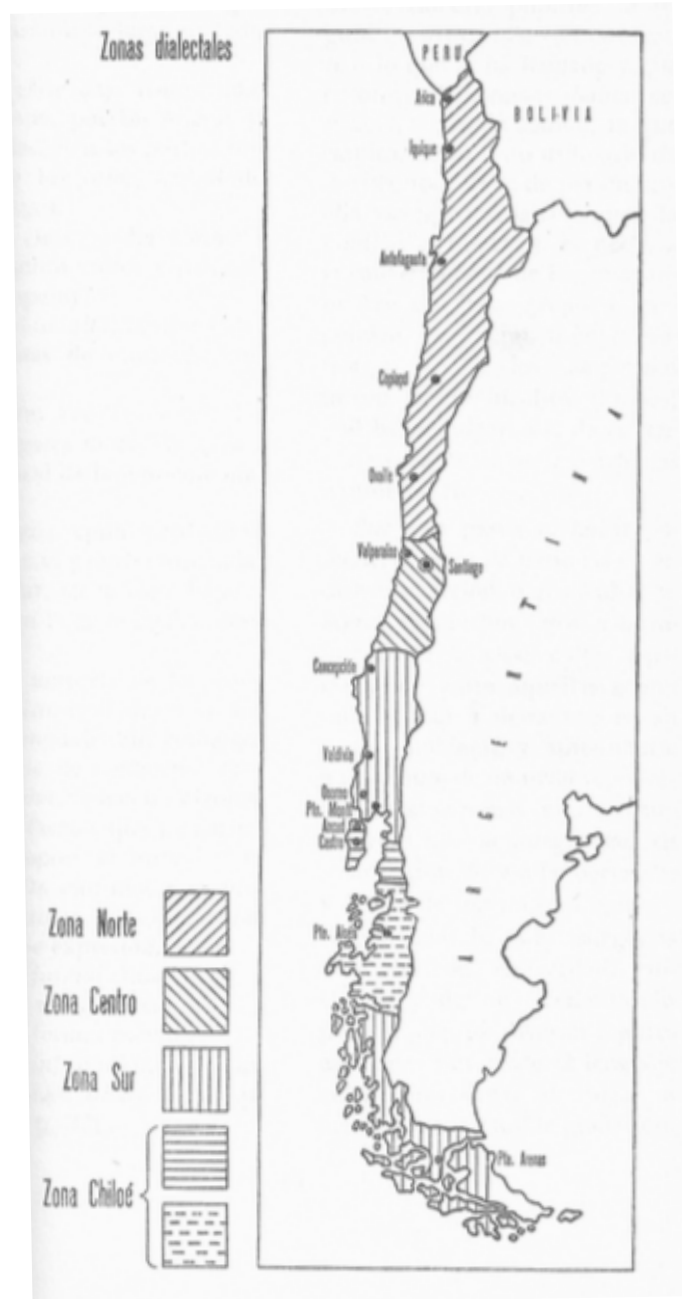


Figure 2. Dialectal zones of Chile according to Oroz

According to Oroz (1966), /s/ aspiration in Chile is a modern phenomenon that has been documented since the 19th century, but is said to have developed as early as the second half of the 18th century. Oroz states that /s/ aspiration depends on both the preceding and the following environment, and that /s/ production, even in “*personas cultas*,” (*educated people*) is variable

(102). He divides /s/ manifestation by classes, stating that upper class speakers tend to “semiaspirate,” while ‘popular’ speakers tend to aspirate or delete fully (101). Following Lenz, Oroz proposes that before /p/ and /t/, /s/ is usually lost. Before /k/, often /s/ is manifested as [h] or even as [x] (103). Again, confirming what Lenz had stated decades before, before voiceless fricatives such as /f/, Oroz claims that /s/ is lost entirely. Before the nasals /m/ and /n/, Oroz claims that in the “lengua culta” /s/ becomes voiced [z], or aspirates [h], sometimes leading to gemination of the nasal (eg. *mímmo*). In intervocalic position, resyllabification is common (eg. [lo.sa.'mi.goh]), though in less careful language the /s/ may be aspirated (eg. [lo.ha.'mi.goh], 104). Oroz claims that aspiration is common in all social classes, and that even deletion in some fixed phrases is common and not stigmatized, such as *muchas gracias* and greetings such as *buenos días* and *buenas noches* (105).

Oroz proposes that each of the five Chilean Spanish vowels vary based on environment, stress, and syllable structure. Additionally, he mentions a more open quality found in stressed /e/ before aspirated /s/, stating that “de este modo sirve para distinguir el plural del singular en los nombres” (*this serves to distinguish singular from plural nouns*, 56). He claims this happens in Valdivia and other sites (56). In other words, [ˈpjɛ] *pie* ‘foot’ in the singular becomes [loh.'pjɛh] *pies* ‘feet’ in the plural.

Additionally, when discussing /o/, Oroz states: “la aspiración de s y z finales de palabra, que a veces se atenúa hasta la pérdida completa, en la lengua popular, parece influir en la calidad de la vocal de la misma sílaba” (*Word final aspiration of s and z, which at times even weakens to complete loss, in popular speech, seems to influence the quality of the vowel in that same syllable*, 57). He cites Navarro Tomás’s proposal of vowel splitting (*desdoblamiento* in Spanish),

but goes on to claim that this phenomenon is rare in Chile, and less generalized than in other regions such as Central America and Andalusia (60).

Hanssen (1966) claims that the Andalusian and the Latin American [s] is identical to the French [s]. Similar to Oroz, he states that [s] may become [h] and may even disappear completely in certain situations (13). Specifically, he states that in Chile, [s] may become [h] before a consonant or before a pause, and may even be completely deleted before another consonant. He specifies, however, that this only occurs in the “lenguaje vulgar” (*common language*, 66).

Wagner (1967) relies on lexical geography methods to elicit materials for his description of the phonetics and lexical items of the province of Valdivia. His participants are 30-60 year old speakers who are almost exclusively illiterate, and each is a longtime inhabitant of the region. Similar to Silva-Fuenzalida (1953), Wagner comments on allophonic vowel variation in Valdivian Spanish, examining stressed and unstressed vowels separately. Specifically, he states that stressed /a/ undergoes some lengthening at times due to loss of a following consonant, such as /d/ in the word *cuadra* [kwa:ra] ‘block.’ This same phenomenon occurs in /e/ vowels. Alternatively, there are vowel quality distinctions in the back vowels: /o/ often raises to [u], while /u/ often lowers to [o] (a centralizing effect).

Regarding unstressed vowels, Wagner claims that when preceding plurals, sometimes the /a/, /e/, and /o/ lower (even when an overt marker of plurality such as an [h] is present), as in [koyuntura^h] *coyunturas* ‘circumstances,’ [ehtáyɛ^h] *estalles* ‘you burst,’ and [usanító^h] *gusanitos* ‘little worms.’ He also notes, however, that this lowering may take place in contexts not preceding an /s/, as in [auçerɔ] *agujero* ‘hole’ (250). Wagner states that this vocalic lengthening

may not be exclusive to /s/, or may not be regularized; Wagner claims that vowels are lengthened in conjunction with loss of other sounds, such as /r/ and /d/ (254).

Regarding /s/ itself, Wagner claims that the /s/ is produced as predorsal-alveolar, but that its production is highly unstable and variable. In utterance final position, /s/ often becomes [h], ‘que a veces actúa sobre la vocal anterior, abriéndola, fenómenos éstos que han adquirido el carácter de morfema de pluralidad’ (*that sometimes [this [h] segment] acts upon the previous vowel, opening it, and these phenomena have acquired the character of the plural morpheme, 257*). In other words, Wagner claims that this vocalic alternation has been regularized to the point of being ‘morphemeized.’ He states that /s/ may also be completely deleted, geminated, and exchanged for other sounds, including /r/, /x/, and /tʃ/.

Wigdorsky (1978) attempted to establish a description of several consonantal sounds produced in the informal speech of 10 professional-class speakers in Santiago between the ages of 29 and 40 (N=10, 5 males, 5 females), attempting to shed light on the current ‘código elaborado’ in the city (*intricate code, 53*). Each of the speakers was an executive or a university-educated professional, and the data were elicited through the use of informal conversations. Regarding the speakers’ use of /s/, he found an overwhelming preference for use of [h] in most contexts: prevocally, word-finally, and preconsonantly. He claimed there was a slight preference for deletion [Ø] in *n_t* contexts (such as *instalación*), but there were only a few tokens of each of this highly particular context.

In the sections above, I have provided a description of several key phonetic and phonological characteristics of Chilean Spanish, and I have focused in on the variable of interest, or final /s/. With these descriptions of final /s/ variation and vocalic alternation, my goal has been

to communicate the importance of the present study, in that it will contribute to the experimental analysis of this variable in this linguistically unique site.

2.3. Experimental studies of vowels preceding /s/ in Spanish

Based on mentions of vowel opening and closing and its potential correlation with /s/ weakening, Resnick and Hammond (1975) were among the first to empirically test for a possible correlation between vowel alternations and /s/ weakening. Their research goal was to verify experimentally whether speakers perceive any phonetic or phonemic differences between underlying final /Ø/ and underlying /s/ manifested as phonetic zero [Ø]. In other words, these authors attempted to determine whether listeners can distinguish singular *casa* /kasa/ [kasa] from plural *casas* with the final /s/ deleted /kasas/ [kasaØ]. They also tested listeners' ability to distinguish word-medial contrasts, using minimal pairs such as /patijas/ *patillas* 'sideburns' vs. /pastijas/ *pastillas* 'pills.'

Four Miami-Cuban Spanish bilinguals provided speech samples for this perception test, which were organized into the following four categories (in Example 7):

Example 7. Stimuli types used in Resnick and Hammond (1975)

1. Full sentences with [s] ~ [Ø] contrast in utterance-final position (including several control sentences)
 - a. *Hay varios problemas que no comprendes* /komprendes/
 - b. *Hay varios problemas que no comprende* /komprende/
2. Six isolated words with word-medial /s/ contrast
 - a. *Pescado* /peskado/ vs. *pecado* /pekado/
3. Isolated words in utterance-final position (extracted from the sentences in (1))
 - a. *Calles* /kajes/ vs. *calle* /kaje/
4. Isolated words in utterance-medial position
 - a. *Los* /los/ vs. *lo* /lo/
 - b. *Casas* /kasas/ vs. /kasa/

Exemplars from this production task were selected and presented to 20 participants who shared similar demographic characteristics with the speakers. Listeners participated in a forced-choice

task in which they listened to a sample and circled the word or sentence they heard, which was written orthographically on a paper response sheet.

The authors assigned “correct” values to answers that matched the underlying, phonemic form. In other words, if the underlying form was /kasas/ and the listener marked the singular *casa*, their answer was counted as incorrect. The highest rate of correct responses was 91.7% for Task 2, the word-medial contrasts. Most of the speakers were able to determine the correct underlying form for these minimal pairs. However, in each of the other categories (including word-final contrasts), rates of correctness hovered around 50%, approximating chance rates. According to the authors, this signifies low discrimination ability.

Following the collection of these initial results, the responses to Task 1 were analyzed more thoroughly. In this task, comprised of complete sentences, underlying final /s/ was only identified correctly 24.1% of the time by the listeners. In other words, participants heard /komprendes/ (2nd person) as 3rd person /komprende/, and marked the 3rd person verb accordingly. Resnick and Hammond claim that this indicates that listeners are expecting a sibilant [s] as the verbal marker for person.

The authors examined the results of the perception test for other correlates, but found no significant patterns in participants’ responses regarding the type of vowel, word class (verbs vs. nouns and adjectives), or region of origin of the respondent. Finally, the authors analyzed the length (duration) and quality (formant structure) of each vowel. They found that in Task 2 (the word-medial contrasts), vowels before a deleted /s/ were 33-40% longer, suggesting vocalic lengthening correlating with /s/ deletion. However, this lengthening was not found in the word-final contrasts (Tasks 1, 3, and 4). The authors state that there were some vowel quality alternations found in all tasks, but that they were inconsistent (86).

The authors acknowledge that the bilingual quality of the participants in this study may be considered a limitation, though it is representative of the Miami speech community. Additionally, as the authors state, the phonemic opposition of vowels described by previous Hispanic linguists may not pertain to Cuba specifically, but rather the larger Caribbean area, necessitating similar studies in different dialectal regions. Finally, the authors claim that phonemic contrast is not traditionally “subject to the methods of the behavioral sciences or the scrutiny of the statistician” (86). Therefore, it remains unclear what rate of accuracy of discrimination would be necessary for “the claiming and recognition of a phonemic contrast” (87).

In an effort to expand the experimental study of vocalic alternation and /s/ weakening, Figueroa (2000) replicated Resnick and Hammond’s study among speakers of Puerto Rican Spanish. Following Kiparsky’s Distinctness Condition, as Figueroa states, if final /s/ is deleted, we would expect to find some type of compensatory evidence for this missing information, be it phonological, morphological, or syntactic. Figueroa claims that the “unsubstantiated” expanded phonemic vowel system is the product of final-consonant deletion (66). She states that “this new phonemic system of eight vowels /a, ɑ, e, ε, i, o, ɔ, u/ results from phonemicization of the pre-s allophones after /s/ → [Ø] in these dialects” (66). This allophonic variation of non-high vowels has been claimed in Argentina (Honsa 1965), Andalusia (Zamora Vicente 1960), and Puerto Rico (Navarro Tomás 1966).

Figueroa’s research questions were slightly different from Resnick and Hammond’s in that she attempted to determine both whether there was a phonetic difference in production (that would support the theory of *desdoblamiento*) and whether or not listeners were able to perceive a difference. As in Resnick and Hammond’s study, 6 speakers of PRS recorded minimal pair

sentences in which the only differences were found in the coda /s/ or /Ø/ phoneme. Twenty subjects participated in the perception test, listening to the stimuli and selecting answers on a paper sheet.

In general, similar to Resnick and Hammond's results, listeners were able to distinguish the word-medial contrasts (Task 2) at a high rate of 93.8% and word-final contrasts at around 50%. Figueroa states that overall, "individual speech differences or speaker's gender were not a factor [sic] in determining the participants' performance on the perceptual task," (70) but does not explain how she arrived at this conclusion.

Again, similar to Resnick and Hammond's study, listeners were more likely to select singular /kasa/ when they heard /kasas/ without the [s]; therefore, Figueroa asserts that listeners did not find acoustic cues in the stimuli to correctly differentiate between these two types of tokens.

To determine to which acoustic cues listeners may have been paying attention, Figueroa analyzes the length and formant structure the vowels preceding these /s/ and /Ø/ phonemes. She finds, in keeping with Resnick and Hammond's results, that word-medial vowels before /s/ were significantly lengthened as compared to vowels at the end of a word, or before the /Ø/ phoneme. She also posits that the /a/ and /e/ phonemes were the easiest to differentiate (assumedly because participants had higher correct scores on these vowels). As she states, these data "suggest that the participants' hearing is 'better' trained to notice changes in /a e/ than changes in other vowels" (72). Finally, while she did find some vowel lengthening in the word-final tasks, she also found shortening as well as no change, leading her to state that there was not enough information to make a clear determination of vocalic alternation word-finally.

Carlson (2012) also replicated Resnick and Hammond's original study with Andalusian Spanish speakers. Instead of a paper-and-pencil perception task, however, Carlson chose to present her stimuli to listeners via an Internet platform in order to facilitate data collection. The 25 listeners' perception results were highly similar to those of Resnick and Hammond; listeners were able to correctly identify the word-medial contrasts at a consistently high rate, while word-final accuracy rate hovered around 50%. Additionally, Carlson included other linguistic and extralinguistic factors in her analysis of participants' ability to distinguish between the /s/ and /Ø/ phonemes including vowel type, grammatical category, regional origin, and gender. However, none of these other factors contributed significantly to listeners' scores on the perception task.

Again, similar to Resnick and Hammond (1975) and Figueroa (2000), vowel durational differences were only found in word-medial contrasts, in the same direction (i.e. vowels were longer before deleted underlying /s/). Word- and utterance-finally, states Carlson, there were no "consistent, systematic differences" (51) in vowel duration, though final lengthening did occur in some of the tokens.

In each of these three similar studies, no clear guidelines were provided for how speech samples were elicited, nor for how the exemplars of final /s/ deletion were selected for the perception task. Were the speakers trained to produce these sentences, one with the final sibilant [s] and one without? Additionally, no mention was made of stimuli recording equipment, or whether the number of listens in the perception tasks were controlled for.

Regarding the methods of analysis, only Carlson included spectrograms in her article. Segmentation and other measurement criteria were not operationalized in any of these three studies, making further comparisons difficult. Additionally, using discrete numbers and cutoffs for differentiating one vowel from another runs counter to elements of phonetic theory and vowel

dispersion theory; it might make more sense to run statistical tests to determine which vowels are significantly *different* from one another in singular and plural contexts.

Alternatively, Gerfen (2002) provides operationalized criteria for vowel and /s/ segmentation in his study of the phonetic implementation of word-internal /s/ aspiration in Eastern Andalusian Spanish (EAS). In this dialect, there is a lack of contrast for obstruents in coda position. In other words, /kasta/ and /kapta/ sound similarly, both manifesting as [ka^ht.ta]. Gerfen examines /s/ aspiration in word-internal position, such as in the structure /CVsCV/, as in item /pasta/, and compares these to words without coda /s/, consisting of a /CVCV/ structure such as /pata/.

Ten native, educated EAS speakers in Granada read the target words and other distractor items in the carrier phrase *Dime X, tío*, which served to emphasize the informality of the task. Gerfen took three measures of each experimental token, based on previous literature: stop closure duration (the voiceless stops /t/ and /k/); vowel duration (only including modal voicing periods); and what he terms vowel ‘aspiration’ or breathiness, measured from the offset of modal voicing of the vowel to the onset of the following stop closure. According to Gerfen, if both modal and breathy voicing were included in the measure of vowel duration, the vowels were significantly longer in CVsCV contexts than in CVCV contexts. Alternatively, if only the modal voiced segment of the vowel was included, the vowel was significantly shorter in CVsCV contexts than in CVCV contexts. Neither of these are particularly surprising findings, since we would expect that the vowel plus the breathiness of the weakened /s/ would be longer than a vowel by itself, since underlyingly it represents two segments. Additionally, the reduction in length of the modally voiced portion of the vowel is unsurprising, based on the universal generalization that vowels tend to be shorter in closed syllables than in open syllables.

Beyond this vowel distinction, Gerfen also claims that aspiration in EAS is slightly more complex, due to the gemination of the following stop. Consonant lengthening (at times referred to as gemination) was shown to be significantly correlated with coda /s/ aspiration, even more robustly than vowel lengthening. He also compares this stop closure lengthening effect to stop closure in words such as /palko/, or ‘box seat,’ to ensure that this consonant lengthening effect is actually correlated with /s/ aspiration rather than just syllable onset position, and he finds that it is.

Gerfen proposes that “vowel and consonant lengthening are not independent reflexes of /s/ aspiration” (265). In other words, if the consonant was lengthened, the vowel was not lengthened as much. Therefore, “the most regular indicator of the lengthening effect induced by medial s-aspiration resides in comparing the duration of the entire medial [...VC...] sequences in the 2 contexts” (that is, in the CVsVC vs. CVCV contexts; 265).

Gerfen also mentions the ‘interesting’ finding that in a particular token in his data, the vowel in /pesto/ appears aspirated (or breathy), despite being followed by a very brief (21 msec) sibilant [s]. I found similar tokens in my pilot data, and I return below to Widdison’s (1991; 1993; 1995) compelling explanation of this phenomenon in his acoustic and perceptive description of the potential origins of /s/ aspiration.

Expanding the investigation of /s/ aspiration before stops to other dialects, Torreira (2007) showed that aspirated /s/ before voiceless stops /ptk/ have several different acoustic phonetic characteristics in Western Andalusian Spanish (WAS) as compared to Porteño or Puerto Rican Spanish. He measured VOT, duration of stop closure, vowel duration, and what he terms ‘preaspiration’ on tokens of several types (shown below in Example 8):

Example 8. Types of word-medial measures used by Torreira (2007: 114)

Stop type: /p/ vs. /t/ vs. /k/, eg. /papa/ vs. /pata/ vs. /paka/

Coda type: Ø vs. /l/ vs. /s/, eg. /kako/ vs. /kalko/ vs. /kasko/

Vowel type: /i/ vs. /a/, eg. /tapo/ vs. /tipo/

Nine speakers (3 from each dialect group) read a word list within the carrier sentence *Digo X para mí*. By preaspiration, Torreira meant the duration of the C preceding the targeted voiceless stops (eg. /ka**l**ko/, /ka**h**pa/ (so, in words such as /kako/, the duration of preaspiration is zero).

Torreira provided criteria for the segmentation of the aspirated portion of the /s/, stating that the onset of the [h] was marked when the F2 showed a clear decrease in energy, regardless of whether the segment displayed some sort of breathy voicing or plain aspiration (115). The end of the [h] was marked with reference to 4-5kHz, where extra-segmental ‘spurious energy spots’ were not perceived (115).

Regarding VOT, Torreira found that the WAS speakers’ VOT values for the target consonants /ptk/ were higher when they were preceded by aspirated [h] (such as [pahta]) than for stops in other contexts, such as [pata]. Significant differences in the same direction were also found for Puerto Rican stop /k/, and for Porteño stops /t/ and /k/. Torreira also found that stop closure in WAS was longer when preceded by [h] than by [l] or [Ø], contributing to a perceived geminating effect. Contrastively, no such effect was found in the production data of either Porteño or Puerto Rican Spanish speakers. Thirdly, Torreira found that the duration of the preaspirated period (or, the duration of the coda [l] or [h]) was significantly shorter in WAS than in the other two dialects.

Torreira provided gestural timing analyses of target words in each dialect, showing that WAS speakers show a shorter preaspiration period, an earlier stop closure (contributing to a

longer stop consonant duration), and longer post-consonantal aspiration (i.e. longer VOT). Therefore, their tokens sounded more like [pa^ht:a] or [pa^ht^h:a] than similar tokens in other dialects. To explain his data, Torreira utilizes the syllable model provided in the Articulatory Phonology framework of Browman and Goldstein (1989), in which they claim that syllable *codas* have more variability of intergestural timing as compared to syllable *onsets*. Since it is the onsets of WAS syllables that seem to be different than the other dialects', Torreira proposes that the onsets of WAS speakers might be undergoing a shift or reorganization, as evidenced by the earlier stop closure as compared to the speakers of other dialects. He also hypothesizes that these longer VOTs may signal a change in WAS, positing that perhaps there will be a rise in aspirated stops in this dialect (a finding since confirmed by Vida Castro (2014) and others).

Both Torreira and Gerfen examined word-internal /s/ aspiration before the stops /p t k/ in specific dialects, determining that different dialects correlate /s/ aspiration with different phonetic features (i.e. lengthening of the following C in both Eastern and Western Andalusian Spanish, as well as a longer VOT in WAS). However, Widdison (1997) focused on another phonetic feature of the *vowel* preceding the [s], using an aerodynamic and coarticulatory account of /s/ production in order to explain the *origins* of /s/ aspiration. He critiques the use of both the economy principle (i.e. that /s/ is lost due to its syllable-final position requiring high articulatory effort) as well as the Autosegmental argument of debuccalization (i.e. losing the oral feature of the fricative /s/), and rather argues that aspiration can be conceived of as originating in the natural phonetic phenomenon of coarticulation. Specifically, Widdison (1993) proposed that /s/ aspiration arose as a misperception of the fricative [s], due to signal degeneration and coarticulation. He claims that an initial phonetic change led to a grammatical/phonological shift for both listeners and speakers.

Widdison carried out several different studies to highlight the importance of speech *perception* in the process of /s/ weakening. Specifically, he provides the results of several different experiments that show that due to high levels of airflow required for the production of a sibilant [s], the vocal folds begin to separate during the later phase of the vowel production, so the vowel itself has a breathy portion. According to Widdison, this secondary gesture might be camouflaged in normal circumstances (i.e. when a full sibilant is produced), but in contexts in which /s/ is reduced (such as in unstressed position, or preceding another consonant), this “hidden effect” might become more noticeable (Widdison 1997:258). Eventually, he claims, listeners may hear a reduced [s] coupled with this breathy vowel and interpret it as an [h] segment. In order to provide evidence for this claim, in one experiment a *tierras altas* Mexican Spanish speaker produced tokens such as [peso] and [peco], and Widdison extracted the [e] vowel in [peso] and inserted it in the [peco] frame. He presented these test tokens to two groups: a monolingual Chilean group in Bío Bío, Chile, and a dialectally heterogeneous group in California. In both cases, the listeners had to select (via an orthographic two-alternative forced choice) whether they were hearing *peco* or *pesco*, and a significant portion of both groups (33% and 49%, respectively) selected *pesco* when presented with the test item. Recall that there was no [s] in the test tokens, since they had been manipulated to disclude any sibilant frication. Rather, Widdison posits that the listeners were attending to the *breathy portion of the vowel* and interpreting it as an [h], representing an underlying /s/. As Widdison states, this breathy portion of the vowel occurs as a coarticulatory feature of the full sibilant [s] production, such that the “reassociation of [h] with the previous vowel occurs not as a stage of production, but as an error in perception” (Widdison 1997: 259).

In a follow-up experiment, in order to avoid influencing the participants by requiring them to see the orthographic word, he asked listeners to participate in an open-ended task, writing down the word they heard and determining whether the speaker was using a more formal or informal style of speech. Again, speakers heard an underlying /s/ even when no sibilance was part of the signal, and overwhelmingly considered these tokens as informal speech. This supports previous literature which associates ‘aspiration’ with more informal styles, and as Widdison states, these results strongly support the hypothesis that listeners are indeed “hearing breathiness over the test vowel and presume it to be an intended part of the signal” (1995:337). To demonstrate that listeners can, in fact, be influenced by this vocalic aspiration noise even when a sibilant *is* present, Widdison (1995) carried out another test with opposing stimuli, in which he took the vowel before a consonant (i.e. [peco]) and spliced it into a nonce word before an [s]. Listeners took a significantly longer time to determine whether there was an [s] in the test word as compared to control tokens, and Widdison proposes that this is due to the absence of the breathy vowel as a cue for [s].

However, if the explanation of /s/ aspiration is purely phonetic (i.e. based on coarticulatory properties which are then incorporated into the system based on perceptions and misperceptions), why isn’t aspiration conditioned in all dialects of Spanish? In other words, why does there exist a distinction between *tierras altas* dialects, in which the full sibilant production of /s/ is the norm, and *tierras bajas* dialects, which weaken final /s/? Widdison (1997) highlights /s/ aspiration and loss in other languages (such as classical Greek, Old French, and Brazilian Portuguese), which he claims is strong motivation for attempting to categorize and explain the patterns across languages. When comparing /s/ weakening cross-linguistically, he does admit that the processes are slightly different based on locale, since “language dependent forces

mediate how new patterns develop and fit into the existing framework of a particular linguistic system” (1997:257). Again, he only refers to language-specific forces, rather than dialect-specific ones, but I posit that different dialects also include these ‘dialect-dependent forces.’

In the present study, I follow Widdison in aiming to tease apart the cues that listeners might be using to differentiate singular from plural words in both production and perception. In the following section, I describe how previous analyses of perceptual cues informed this study.

2.4. Cue-based analysis

As described above, scholars have claimed that /s/ deletion occasions a compensatory alternation mechanism on the vowel preceding deleted /s/. For instance, Navarro Tomás (1918) and Alvar (1991) posit a 7-vowel system /i e ε a o u/ in Puerto Rican and Eastern Andalusian dialects of Spanish, claiming that /s/ weakening causes the preceding vowel to lower. Oroz (1966) claimed that when /s/ is deleted in Chile, its preceding final vowel is lowered and/or lengthened. Cepeda (1990a) reported that /s/ deletion is associated with alternations in the length of the preceding vowel, lowering or raising of the vowel, and what she calls *aspiración vocálica* ‘vocalic aspiration,’ which I interpret here as breathiness on the preceding vowel. Previous studies have explored whether listeners can recover plurality on synthesized or laboratory-produced utterances, and found that listeners are not very accurate at this task (Resnick and Hammond 1975; Poplack 1980; Figueroa 2000). However, these studies did not find any significant acoustic differences between vowels preceding underlyingly singular and underlyingly plural words, with the exception of word-medial pre-/s/ lengthening, though as mentioned above, these studies only examined laboratory speech. Studies have shown that phonological dimensions are cued by many continuous acoustic characteristics (Repp 1982), and

that speech processing consists of mapping these continuous measures onto functionally equivalent classes or categories (Holt and Lotto 2010). Stevens (2005) and other authors also claim that listeners determine the boundaries of phoneme categories based on their language-specific experience. For instance, Esposito (2006; 2010) showed that Mexican Spanish listeners are marginally sensitive to voice quality measures of H1-H2 and H1-A1 when listening to phonemically distinctive breathy and modal Mazatec vowels. Phonation type is contrastive in Mazatec via a three-way contrast between breathy, modal, and creaky voice, but voice quality is not contrastive in Spanish. That is, Mexican Spanish listeners were sensitive to these measures of breathiness when they were asked to categorize unfamiliar, Mazatec stimuli as more or less similar. The present study, on the other hand, asks Chilean Spanish listeners to make judgments about a meaningful contrast in their own language, the morpho-phonological contrast of singular vs. plural. Therefore, the present study examines what segmental and prosodic cues listeners attend to when asked to identify plurality on isolated words. Similar to Esposito (2006), and following other recent trends in perceptual analysis (Morrison and Kondaurova 2009; Winn, Chatterjee, and Idsardi 2012), listeners' binary identification of the stimuli as either singular or plural is analyzed as a function of the linguistic and social predictors, so the results do not reveal participants' accuracy, but rather what factors influence their identification of the stimuli as plural. Specifically, I provide the first experimental verification of previous hypotheses about vocalic compensation for /s/ deletion in Chilean Spanish by examining whether the continuous acoustic measures of breathiness (measured as H1*-H2*), the first formant (F1), and duration affect a listeners' identification of a stimulus as plural.

Additionally, in Chilean Spanish, previous studies have shown that coda /s/ deletes most often when it is produced by younger speakers, members of the working class, and sometimes

male speakers (Wigdorsky 1978; Valdivieso and Magaña 1988; Cepeda 1990b; Tassara 1991; Valdivieso and Magaña 1991; Cid-Hazard 2003). The bulk of this work was conducted in the early 1990s, motivating the question of whether /s/ has continued along a deletion trajectory, and also how listeners recover plurality once a final /s/ has been deleted. Additionally, studies have revealed that how a listener identifies a stimulus is based in part on who the listener is. That is, speech perception has been shown to vary based on qualities like the listeners' socioeconomic status (Warren et al. 2007), the region of origin of the listener (Ladefoged and Broadbent 1957; Willis 1972; Fridland and Okamoto 2009) and the sex of the listener (Drager 2011). In light of these previous findings, the present study also examines how a listener's social characteristics influence his/her identification of plurality.

Thirdly, as Foulkes and Docherty (2006) state, no natural human utterance offers linguistic information without simultaneously indexing some social factor. Over the past few decades, several social/demographic factors of who the speaker is perceived to be have been found to condition listeners' perceptions, such as perceived dialect area of the speaker (Niedzielski 1999; Hay and Drager 2010); perceived gender of the speaker (Strand 1999); perceived age of the speaker (Drager 2005; Hay, Warren, and Drager 2006); and perceived social class of the speaker (Hay, Warren, and Drager 2006). In the present study, I include an element to test whether listeners' perceptions of the plurality of the stimuli differ based on perceived social characteristics of the speaker. That is, each auditory stimulus is preceded by a visual prime representing two socioeconomic classes, two age groups, and both male and female genders. I analyze the data to determine whether any of the social characteristics of the visual primes affect listeners' identification of the plurality of the stimuli.

These questions have been informed by previous work in exemplar theory, which accounts for far more variation in both speech production as well as perception. In traditional phonological theory, sounds exist as categories (or phonemes). There may be some variation at the phonetic level in these categories (allophones), but each is subsumed under some discrete unit. In this type of model, differences between speakers are reduced, or normalized: speaker-specific representations are mapped to speaker-neutral abstractions (Johnson 1997:145). This normalization is also seemingly immune to social factors such as gender or age of the speaker, though we know that differences in (for example) vocal tract lengths between males and females do cause acoustic-productive differences.

Unlike traditional phonological theory, exemplar theory (ET) assumes that “detailed phonetic memories are associated with individual words and it implicitly defines word-specific probability distributions over phonetic outcomes” (Pierrehumbert 2001:3). Therefore, the lexicon and the phonological (grammatical) systems are closely intertwined in ET. Contrastingly, production in traditional phonological theory (PT) consists of a feed-forward model, in that lexical information feeds the phonological set-up (i.e. what phonemes need to be used), which are then fed into a set of articulatory ‘orders,’ in terms of the steps the articulators need to follow to reach each target. There is no direct connection between the lexical level and the articulatory level in production, according to standard phonological theory.

In Pierrehumbert’s (2001) version of exemplar theory, phonological categories are not completely done away with (cf. Bybee 2002, who argues for a word-based storage account). Rather, each phonological category is represented in memory by a large cloud of remembered tokens of that category, and variability is inherent in these stored exemplars. In the example used by Pierrehumbert, /ε/ tokens would have varying (for example) formant values, pitches,

durations, depending in part on the speaker him/herself, vocal tract size differences, the gender of the speaker, the style of speech, etc. There is then a mapping between points in a phonetic space (i.e. X amount of Hz) and labels of a categorization system. Each token may have multiple labels, and more frequent categories would have more tokens (samples). When an incoming token needs to be categorized, it is ‘perceptually encoded,’ locating it in a likely space. In other words, a vowel will not be compared to a stop consonant, since it has been encoded with certain characteristics (assumedly things like sonority, formants present, etc.). It is then compared to other, similar exemplars in the same neighborhood. For example, a token that had an F2 value that was ambiguous between /ε/ and /ɪ/ would be compared to exemplars of these two categories. Similarities to each category would be summed up, and one label would ‘win,’ or be determined as more likely to be the label of that category. One exemplar category might be stronger, based on its frequency in the lexicon as well as recency of tokens at that location. In other words, a label with stronger exemplars is more likely to win, so there is a bias towards a high-frequency label. A system like this one, based on probability, is predictable, and therefore systematic. Additionally, it is assumed that higher frequency words’ exemplar clouds are shifting faster than low-frequency words’. So, frequency effects on lenition should be observable in both real time as well as apparent time.

According to Hay and Drager (2010) and Foulkes and Docherty (2006), exemplars are also indexed with social characteristics associated to the speaker, such as (broadly) ‘female,’ ‘middle-aged,’ and ‘middle-class.’ Each exemplar may have several such indexed social components. Therefore, an exemplar that has many social indexes may be more quickly activated when similar social components are attributed to a novel auditory input. This difference in the speed of activation can result in overall biases toward variants associated with contextually

relevant characteristics (Hay, Warren, and Drager 2006). Niedzielski (1999) exemplified this by associating different dialect background labels with the same speech stimuli, and showed that perceptions about where a speaker is from activate exemplars with the appropriate labels, a finding replicated by Hay et al. (2006).

2.5. The present study

Several of the studies mentioned above found lengthening on plural vowels preceding word-medial weakened /s/. However, they found no distinctions in either length or vowel quality on vowels preceding /s/ in word-*final* position. The /s/ in this prosodic position is understudied, presumably due to its previously attested lack of systematic variation, as well as its challenges for segmentation. In word-final utterance-medial position, segmentation of the /s/ and preceding vowel may be relatively straightforward, since there are other segments and transitions that can be used to mark onsets and offsets of vowels and /s/ segments. However, phrase-final position is a far more challenging position for study due to several factors. First, phrase-final position is also a site of other types of variation in the voice source, so creaky voice is often present phrase-finally. Similarly, phrase-final position consists of lowered sub-glottal pressure, as well as a sharp amplitude drop (Barnes 2006), due to which it is conceived of as a common site for weakening in general, especially in informal speech. However, word-final position is a far more productive site for exploration than word-medial coda position, since word-final /s/ deletion throughout a plural Noun Phrase (NP) may occasion homophony with singular NPs.

Therefore, my goals for the production task are to determine whether speakers use any of three acoustic cues to mark distinctions between the final vowels of singular and plural words, and whether use of these cues is conditioned by the socioeconomic status, age, or gender of the speakers. Additionally, I examine whether listeners are sensitive to these same acoustic cues, and

whether perception of these cues is conditioned by social characteristics of the listener or who the listener believes to be speaking. The present study, therefore, contributes to the experimental literature regarding /s/ weakening in the particular dialect of Chilean Spanish, taking advantage of modern recording and analysis techniques to provide a fuller illustration of this frequently-studied variable.

Chapter 3. Field Methods

3.1. Introduction

The data for this study were collected during one fieldwork trip to Santiago from September to December 2015. In this chapter, I designate the criteria for selection of the two field sites, define the sampling and recruitment procedures used, describe the sociophonetic methodologies of the production tasks utilized, provide an overview of the participants' demographics, and finally, describe the perception tasks and methods.

3.2. Selection of neighborhoods and description of sites

As mentioned in Chapter 2, previous studies of final /s/ in Chile have been almost exclusively carried out among educated, high-income speakers. In order to provide a more representative description of Santiago final /s/ production and perception, I selected two specific and contrasting *comunas* ('neighborhood' or 'community') of Santiago to serve as my field sites. In this section, I will first present data regarding the city of Santiago, then describe the appropriateness of utilizing 'comuna of residence' as a correlate not only of socioeconomic status and education factors, but also how residents are perceived by other *santiaguinos* (i.e. residents of Santiago). I will then describe the history and present situations of the selected neighborhoods, Vitacura and La Pintana.

The Región Metropolitana (*Metropolitan Region*) of Santiago is segmented according to 34 *comunas*. Due to decentralization of administrative power during the military dictatorship of Augusto Pinochet (1973-1990), each *comuna* maintains its own financial system and resources (Cortés 2008). In other words, each *comuna* is mainly financed by its own income from a variety of personal and commercial sources, such as vehicle registrations and construction. Schools,

medical centers, and other infrastructure are all financed from this municipal fund. Therefore, wealthier communities tend to collect more revenue from these types of sources (since residents of higher-income communities are more likely to have personal vehicles, for example), while lower-income communities rely on smaller amounts of revenue (Cortés 2008: 421).

Currently, Chile is described as “one of South America’s most stable and prosperous nations” (BBC News 2014). However, according to the Organization for Economic Cooperation and Development (OECD 2011), Chile also has one of the highest rates of income inequality in the world. Santiago is both the capital of Chile as well as the largest city in the nation with a population of just over 7.3 million people; more than a third of Chile’s population of 18 million (Instituto Nacional de Estadísticas Chile 2013). Acuña and Schuster (2012) describe a well-known phrase among Chileans: “Santiago is Chile,” reflecting that within the city of Santiago is concentrated everything from jobs, healthcare, education, culture, sports, business and politics.

Additionally, as Cortés (2008) states, inhabitants of Santiago have strong prejudices and preconceived notions based on the *comuna* in which an individual resides; they can “identify and discriminate automatically” based on *comuna* of residence (422). The *comunas* of Vitacura and La Pintana are commonly perceived as belonging to opposite ends of a variety of spectra, including income, education levels, and indeed, geographical distance (as seen in Figure 3 below).

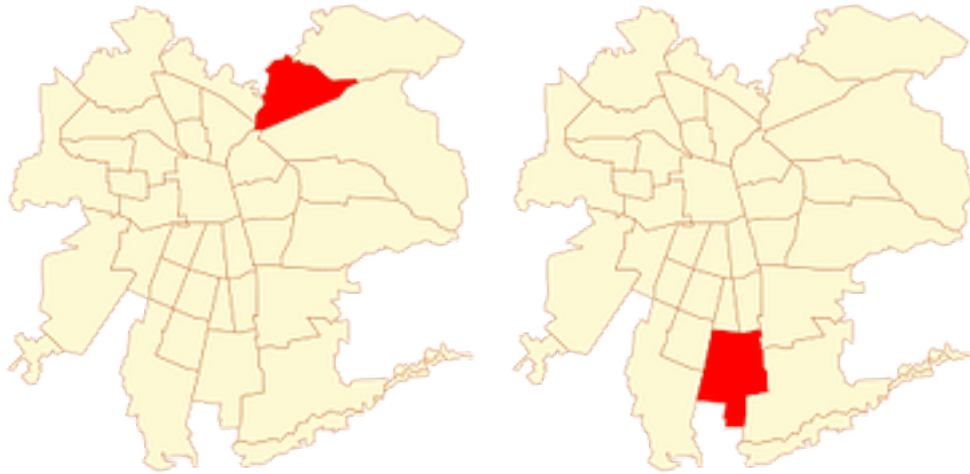


Figure 3. Vitacura (L) and La Pintana (R) within the Región Metropolitana of Santiago; maps from Wikipedia.org

These two communities belong to different zones of the city: Vitacura belongs to the high-income ‘cono oriente’ (*eastern cone*), while La Pintana belongs to the ‘periferia’ (*periphery*), as can be seen in the map below, in Figure 4.

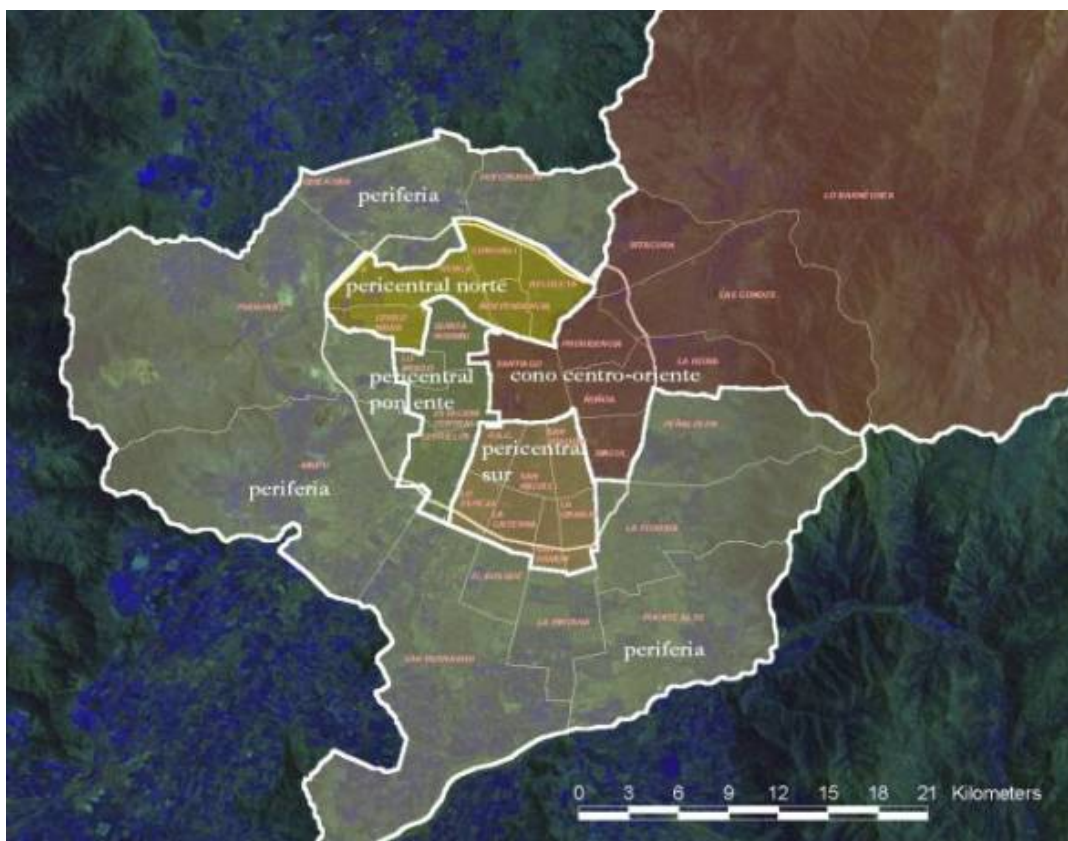


Figure 4. Differentiated metropolitan zones of Gran Santiago, from López Morales (2005:744)

In addition to the social demarcations denoted by one's *comuna*, the specific communities of Vitacura and La Pintana differ according to several other important demographics.

3.2.1. Income and other socioeconomic measures

The most frequent and informative measure of income per capita is not the Chilean census, but rather the *Caracterización Socioeconómica Nacional* (CASEN; National Socioeconomic Characterization) surveys. These surveys are realized by the Ministry of Social Development biannually or triannually, and focus on measures of income as well as access to services. In the November 2013 CASEN survey of average monthly income by *comuna*, La Pintana ranked at 9th lowest with a familial monthly income of \$656,093 Chilean Pesos (CLP), while Vitacura tops the list at \$3,177,830 CLP per month.

In 2013, CASEN began including a new type of measure in their report, that of “multidimensional poverty level.” Instead of the traditional measure of poverty based solely on income, this measure takes multiple dimensions of quality of life into account to arrive at a particular score or level. These four dimensions are education (including access to education and educational gap), health (including malnutrition and enrollment in the health system *Sistema Previsional de Salud*; Social Security Health System), work and social security (including occupation and whether people who are of retirement age can actually retire), and dwelling (including overcrowding and access to basic services). Based on these measures, La Pintana has a multidimensional poverty rate of 30.8%, the sixth highest in the Metropolitan Region, while Vitacura has the lowest rate, at .5% (SEREMI Metropolitana 2013).

3.2.2. Homogeneity

In his 1966 work and as detailed in *Principles of Linguistic Change Volume 2* (2001), Labov describes the perfect sociolinguistic sample: a truly random sample. He admits, however, that a truly random sample can be difficult to obtain, particularly for one researcher. In my case, a completely random sample was cost, time, and labor-prohibitive. Therefore, I was interested in a measure of homogeneity of the communities, relying on the assumption that a designation of *comuna* would also represent a designation of high- or low-income and education levels (also confirmed via demographic questions).

Based on the 1992 and 2002 Chilean censuses, Agostini (2010) provides a variety of measures according to neighborhood: income per capita measures, neighborhood poverty rate, and inequality within the community. La Pintana is one of the lowest-income communities, while Vitacura is the highest-income community. The poverty rate is highest in Cerro Navia and La Pintana, and lowest in Vitacura, Providencia, and Las Condes. Finally, Vitacura, Providencia,

Las Condes, and La Pintana are the four *least* unequal communities. In other words, these least unequal or *most homogeneous* communities are both the wealthiest (Vitacura) and the poorest (La Pintana). Agostini (2010) shows that low-income people who live in isolated, poor communities tend to live in worse situations of poverty than low-income people who live in more heterogeneous communities (222). Specifically, in poor communities, there are “fewer role models, crime and drugs are more visible, good jobs may not exist or are located far outside the community, and public services such as education have less funding and are of lower quality” (222).

The selection of these two communities as target areas of study was confirmed via anecdotal evidence: whenever I would tell people what *comunas* I was working in, they would often remark on the *brecha* or ‘gap’ between these two communities, as well as their perceived homogeneity.

3.3. Description of field sites

In this section, I offer a brief description of the history and settlement of both *comunas*.

3.3.1. Development and history of La Pintana

The *comuna* of La Pintana (established in 1981 as separate from neighboring community La Granja) was one of several *comunas de periferia* (outskirts communities) that were resettled between 1979 and 1989 as part of “Operación Erradicación Masiva” (Operation Massive Eradication), a plan by the Pinochet regime to eradicate temporary settlement communities in wealthy Santiago neighborhoods.

Thousands of families in situations of extreme poverty, living in *campamentos* (unstable encampments) within wealthier communities, comprised this massive resettlement. These

families were forcibly removed to (often far-away) communities that lacked many basic services. Gurovich (1989) attributes this resettlement to the Pinochet regime's desire for social reorganization and homogenization, and claims that this social reorganization was linked to Pinochet's policies of neoliberal economic development. He also proposes that this removal and resettlement contributed to continued polarization of the Santiago population.

The resettlement in La Pintana from wealthy, northern-Santiago neighborhoods was far more numerous than to any other resettlement community, as can be seen in the map below (Figure 5; reprinted from Gurovich 1989: 34). We also see in the map that the resettled families had mainly resided in the wealthier communities of downtown Santiago and Las Condes. Prior to this resettlement and the governmental appropriation of this land in the 1960s, the land in La Pintana had been utilized as rural farmland.

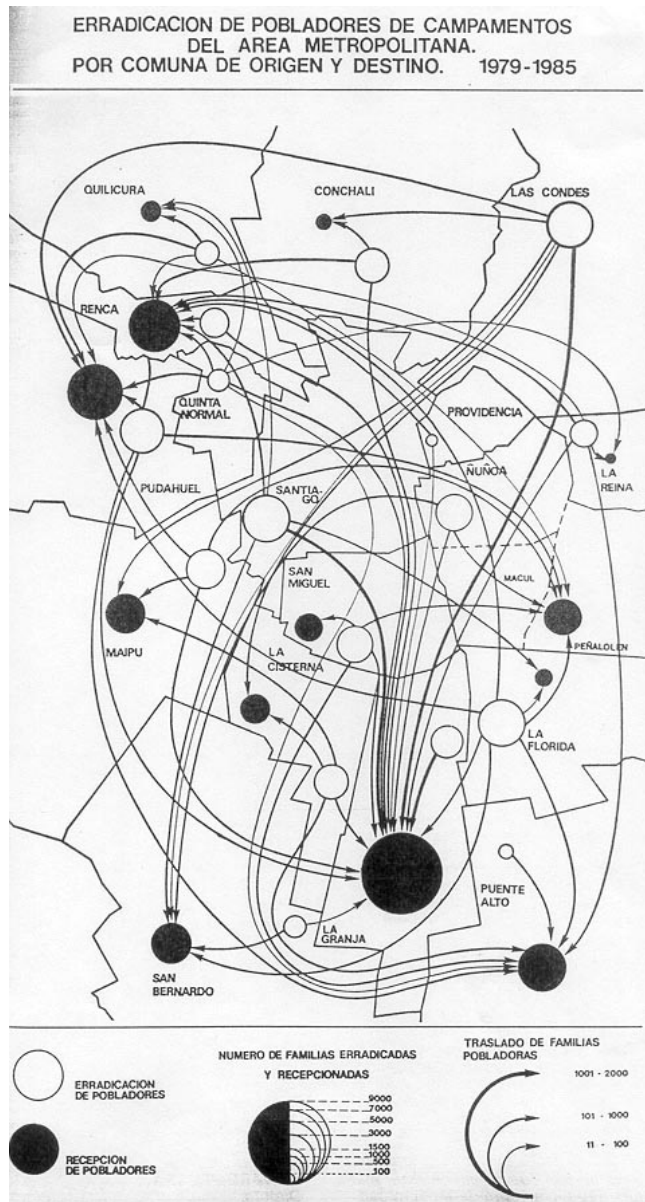


Figure 5. Poverty eradication plan, 1979-1985

According to Gurovich (1989: 35), this resettlement came with improvements in housing and general environmental health for the families. However, it was also accompanied by worse conditions in communications, transportation, education, nutrition, amount of space allocated per person, and above all, in work/employment possibilities. As Gurovich (1989) states, the resettlement program (specifically in the case of La Pintana), “perjudicó irreversiblemente el

potencial agrícola de su entorno rural, incrementó los costos públicos y privados de funcionamiento de la ciudad, y provocó deterioros en las condiciones urbanas de un numeroso contingente de familias de bajos recursos y capacidades de acción” (*irreversibly damaged the agricultural potential of the rural environment, elevated the public and private costs of the city’s function, and provoked deteriorations in the urban conditions of a numerous contingent of low-income and low-mobility families*; 35).

3.3.2. Development and history of Vitacura

According to the municipality’s website, the *comuna* of Vitacura was officially established in 1991, subdivided from the neighboring *comunas* of Las Condes and Lo Barnechea. These *comunas*, along with Providencia, Ñuñoa, and La Reina, are part of the *cono oriente* (the Eastern cone), the neighborhoods in which Santiago’s wealthiest residents reside.

Between 1840 and 1860, the *clase alta* (high class) of Santiago resided in the city’s downtown, in the 10-15 blocks nearest the Plaza de Armas (Palacios 2010). The wealthiest residents began to move eastwardly due to space constraints in the 1920s, as well as the commercialization of the downtown and the settlement of nearby *comunas* (Ferrando 2008). In the 1950s, El Golf in Las Condes was the most ‘elegant’ part of Santiago, and between 1955 and 1960, areas of Vitacura began becoming settled (Palacios 2010). Specifically, the wealthy families were in search of green space and access to outdoor areas as they traveled outside the limits of the developed city, which also led to the establishment of sports clubs, such as the *Club de Polo* in the center of Vitacura as well as exclusivity.

During the Pinochet dictatorship, the *comunas* of Santiago also underwent several structural changes, as outlined by Astaburuaga (2006). In 1979, due to the liberalization of the “mercados del suelo” (*land markets*) there was more movement towards peripheral areas of the

city. Additionally, due to the modernization of transportation systems, access to more peripheral spaces was facilitated. Finally, the development of *artefactos de la globalización* ('artifacts of globalization' such as malls and condominiums) made these outer areas more appealing.

Vitacura experienced its own 'boom' between the 1980s and the 1990s. According to Heinrichs et al. (2009), over these decades, only the wealthy could afford this 'suburban' land. This geographic and socioeconomic exclusivity was also due in part to conceptions of personal and familial security. Specifically, the perception of urban Santiago as "unsafe and potentially violent" led to the proliferation of exclusive, peripheral communities, particularly towards the end of the 20th century (Heinrichs et al. 2009:34).

In this section, I have motivated the selection of Vitacura and La Pintana as field sites. These two sites are differentiated by a variety of characteristics, most notably socioeconomic status, settlement history, and access to resources, as well as perceptions of the *comunas* by outsiders. In the following section, I will provide justification for the other demographic variables used.

3.4. Sampling and recruitment procedures

In this section, I describe the sampling methods used for this study. I also explain the other social factors included in my analysis: age and length of residence in a community, and speaker gender. Finally, I define the recruitment methods I used in each neighborhood.

Both neighborhoods can be difficult for outsiders to enter (La Pintana due to personal safety issues and Vitacura due to inhabitants' exclusivity and wariness of non-residents). However, I had previous contacts in both neighborhoods that enabled me to gain access to the communities. I had been a volunteer at a community center in La Pintana in 2006-2007, and had

maintained contact with their staff. Additionally, as a student at the private Pontificia Universidad Católica in Santiago during that same year, I had also created and maintained connections with several inhabitants of Vitacura and surrounding high-income neighborhoods.

I used chain referral sampling and quota sampling for this investigation. Chain referral sampling relies on a series of participant referrals to others (Penrod et al. 2003), in which multiple networks are “strategically accessed to expand the scope of investigation beyond one social network” (102). The chain referral sample may therefore be a more representative sample than the snowball or friend-of-a-friend method, which rely on the social networks of just a few individuals. This type of strategy has been used frequently with hard-to-reach populations, similar to those described here. I utilized slightly different recruiting tools for the two different neighborhoods according to personal safety issues in La Pintana and wariness of outsiders in Vitacura.

In La Pintana I gathered data at two main field sites: the Corporación Jesús Niño in the El Castillo neighborhood, and the Centro Acuarela in the downtown area of La Pintana, next to the municipal government building. I recruited among staff members and local members of the community involved in activities at each site, and also hung informational recruiting posters at nearby locations affiliated with the municipality. Additionally, I recruited in the plaza next to the Centro Acuarela and at businesses that I frequented while at my field sites. Once I had begun data collection, I would also ask participants if they had any family members or friends who might be interested in participating, and if so, if they would pass on my information. The referees could then choose to contact me. My main data collection in this neighborhood took place several days per week for 6 weeks in September and October of 2015.

I began recruitment for participants from Vitacura at the San Joaquín campus of the Pontificia Universidad Católica in September. I hung recruitment posters with tear-off tabs with my contact information throughout the campus (particularly in the areas of civil and commercial engineering; see Figure 6), spoke with members of the student centers throughout campus, and also performed some cold recruitment in which I approached small groups of people, briefly explained my project, and asked people to pass on my contact information to their friends and acquaintances from Vitacura. I also had the great fortune, as mentioned above, to have several friends who had lived and gone to school in the *comuna* and who worked tirelessly to help me recruit among their own friends and acquaintances.

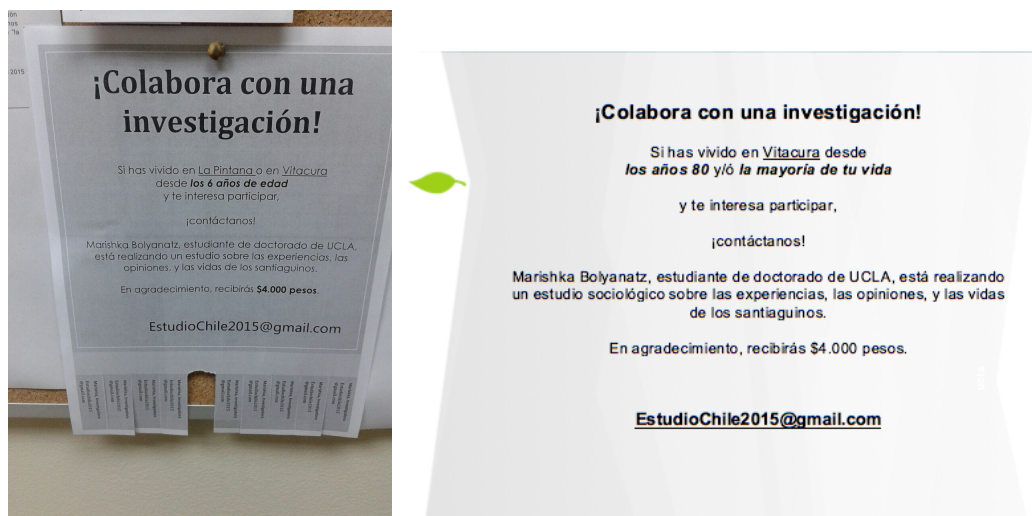


Figure 6. Recruiting poster hung around Campus San Joaquín (L). Handout for participants from Vitacura (R).

I also reached out to the Vitacura municipal library, hanging posters throughout and visiting small groups to recruit. Targeting the older demographic, I also made contact with several community organizations that catered to retired residents of the neighborhood. Finally, I reactivated my contacts and networks from previous residences in Chile.

Additionally, before beginning data collection and recruitment, I established quotas based on filling each cell in my data set with at least five participants. The cells were counterbalanced

according to the two neighborhoods, including both males and females, and three age groups. Previous research has shown that /s/ in Spanish has been shown to covary according to a speaker's gender, a traditional category within variationist sociolinguistics (Alba 1982; López Morales 1983; Lafford 1986; Cepeda 1995; Poblete 1995). For this reason, I gathered data from an equal number of males and females according to age group and neighborhood. In total, I collected data from at least five participants per cell according to each demographic category (age group, gender, neighborhood). Aguilar-Sánchez (2011) describes the varying standards used by variationist researchers in sample size establishment, using Silva-Corvalán's (2001) suggestion that sample sizes be based on both theoretical and practical issues. The latest statistical analysis available to deal with this type of data (data that is stratified along multiple levels, and also includes varying amounts of within-subjects data) is mixed-effects regression modeling, and Aguilar Sánchez suggests at least five subjects per category who will provide data for analysis.

Age is a typical demographic delineator associated with sociolinguistic studies, particularly since it has been shown that changes in progress can be discovered via alternations among age groups in Apparent Time (though see Cameron 2000 and Labov 2001 for caveats regarding age gradation). These apparent changes should also be confirmed via real time studies, for which this investigation establishes a baseline. Each participant was asked whether they would be willing to be contacted for a follow-up study (and asked for contact information with which to follow up with them), and each of my participants said they would be willing to participate in a future study.

As Delforge (2009) explains, there are no clearly established protocols for determining age group divisions in sociolinguistic research. Delforge herself utilizes historical and socio-

political events as a delineator of age groups for her sociophonetic research in Cusco, whose example I follow here. One of the most important socio-political events in Chile in recent years was the 1973-1990 military dictatorship. Therefore, the youngest age group (18-25) consists of young people who are at least 18, and who were born post-dictatorship. The second age group consists of those born under dictatorship, and also those who are most in the center of the marketplace (cf. Sankoff and Laberge 1978), ages 26-41. The oldest age group consists of individuals who were born prior to the establishment of the dictatorship in 1973 (42+). Life expectancy in Chile is currently at 79 years of age, so this older age group varies in exact ages.

Before conducting my data collection, I had aimed to gather data from participants who had resided in the community of interest (either Vitacura or La Pintana) since the age of 5 years old, to gather a more accurate picture of the speech of the community; similar to Delforge (2009). This was generally not a problem in the lower age group, since often these young adults still resided with their parents. However, in the middle age group, particularly for residents of Vitacura, many of my previous contacts no longer resided in the neighborhood since they had recently married and moved *comunas* (typically within the *cono oriente* ‘eastern cone’ to Las Condes, La Dehesa, or La Reina). The same situation applied to the older demographic in Vitacura. In La Pintana, many of my older age group participants were forcibly resettled in the operation outlined above, and so had only lived in the community since the 1970s and 80s, often when they were in their 20s. In order to meet my research goals, based on all of the above, I chose to relax my ‘residence in the community since the age of 5’ requirement, to be ‘residence in the community since the 1980s/a majority of one’s life.’ I had to explain this new constraint more thoroughly to potential participants, but all of my participants fulfilled this requirement, enabling me to complete my data collection.

The reader may note that these social variables of age, socioeconomic status, and gender are notions within what Eckert (2012) terms *first-wave sociolinguistics*. As Eckert states, in early first-wave studies such as those of Labov, “speakers emerged as human tokens—bundles of demographic characteristics,” most frequently those specified here, or age, gender, socioeconomic status, and style (88). Second wave studies, based on ethnographic approaches, “focused on apparently static categories of speakers and equated identity with category affiliation” (93), while speakers in third wave studies attribute particular values to salient linguistic features, and use or avoid these features in an effort to align or distance themselves from particular groups.

In this study, my goal is to establish a regular pattern of socioeconomic stratification of linguistic form (Eckert 2012: 88), while also observing and accounting for speakers’ agency regarding their selection of /s/ variants, in an effort to determine what values and identities these speakers are aiming to index via their use of particular variants.

In this section, I have described the sampling and recruiting procedures used according to *comuna*. In the next section, I describe the demographics of the individuals who participated in this project.

3.5. Participants

I collected several different types of data during fieldwork. The largest group of participants took part in a full sociolinguistic interview, a narrative retell task, and a perception experiment that included a visual prime. A control group (n=31) provided a brief production sample and took the same perception experiment without the visual prime. These experiments

will be discussed below in section 5. Finally, 30 other individuals provided information about the visual primes used in the perception experiment.

In total, I gathered 71 sociolinguistic interviews, each with an approximate duration of 45 minutes. These individuals also provided data for a narrative retell task. Each participant was paid \$4,000 Chilean pesos (approximately \$5.92 USD) for their time, though several participants expressed that they had enjoyed the experience and therefore refused payment. Of these initial 71 interviews gathered, however, several had to be excluded for a variety of reasons. Two had to be excluded based on screening issues. One participant had only lived in the community for 5 years (though had previously told me he was ‘from’ La Pintana), and one resided in Chicureo (though had led me to believe that he fulfilled the requirements of having resided throughout the majority of his life in Vitacura). Of the 69 interviews with participants who fulfilled the demographic requirements, six were eliminated due to lack of follow-up (for perception test and demographic information collection), and three were eliminated due to poor recording quality.

The production data analyzed in Chapter 4 of this dissertation come from the sociolinguistic interview tasks of 60 participants whose demographic information is included below in Table 1. The demographic questionnaire applied to all participants can be seen in Appendix 1. The participants’ household goods score was assigned based on how many of the household goods on page 2 of Appendix 1 the participant reported were in his/her home, with one point assigned for each (there are a total of 10 goods on the list). I also asked each participant how many cars they had; if they had more than one car, they were assigned an extra point. For instance, if an individual had two cars but no Internet at home, s/he would receive a score of 10. Regarding the education category, participants were marked as ‘primary complete’ if they had completed Chilean *básica*, the US equivalent of 8th grade. ‘Secondary complete’ was

marked for those who had completed secondary school, the US equivalent of high school (Chilean *media*). A technical degree is similar to an Associate’s degree in the US, and usually requires two years. A Chilean university education is similar to that of the US, though often takes 5 years instead of 4.

All participants had completed at least 1 year of primary school education. There is an apparent correlation between neighborhood and highest level of education achieved for the middle and older age groups, but this calculation could not be completed for the youngest age group since some were in the process of completing secondary school and others were still working on their university degrees. However, generally, the youngest age group in La Pintana had attained higher education levels than the middle or older age groups.

When reporting data regarding household goods, all participants were asked to count all the goods in the home, regardless of who was the actual owner of the item. Participants in the younger age group resided exclusively with family members, so reported these demographics. Similarly, in Vitacura, young participants who lived with their families reported the goods based on their whole household. It is common for young people of all social strata to remain living with their families until they marry, and even then, many in La Pintana continued to reside in multiple-generation homes after marrying.

Table 1. Participant demographic information: 60 participants who contributed sociolinguistic interview data to the analysis

Participant ID	Gender	Age	Age Group (1=18-25 2=25-41 3=42+)	Comuna LP=low SES V=high SES	Education	Household goods score
LP.f.1.01	F	19	1	LP	primary complete	7
LP.f.1.02	F	22	1	LP	secondary complete	7

LP.f.1.03	F	18	1	LP	secondary complete	10
LP.f.1.04	F	23	1	LP	technical complete	8
LP.f.1.05	F	18	1	LP	secondary incomplete	4
V.f.1.02	F	23	1	V	University incomplete	11
V.f.1.03	F	18	1	V	University incomplete	10
V.f.1.04	F	24	1	V	University incomplete	11
V.f.1.05	F	19	1	V	University incomplete	10
V.f.1.06	F	24	1	V	University incomplete	11
LP.m.1.01	M	22	1	LP	Technical incomplete	7
LP.m.1.02	M	22	1	LP	Technical incomplete	8
LP.m.1.03	M	23	1	LP	Secondary incomplete	7
LP.m.1.04	M	20	1	LP	Technical incomplete	9
LP.m.1.05	M	21	1	LP	University incomplete	9
V.m.1.01	M	24	1	V	University incomplete	11
V.m.1.03	M	23	1	V	University incomplete	11
V.m.1.04	M	22	1	V	University incomplete	10
V.m.1.09	M	22	1	V	University incomplete	11
V.m.1.10	M	20	1	V	University incomplete	10
LP.f.2.01	F	41	2	LP	Primary complete	5
LP.f.2.02	F	32	2	LP	Primary incomplete	6
LP.f.2.03	F	33	2	LP	University complete	10

LP.f.2.04	F	27	2	LP	Secondary incomplete	8
LP.f.2.05	F	34	2	LP	Secondary incomplete	8
V.f.2.02	F	31	2	V	University complete	11
V.f.2.04	F	34	2	V	University complete	11
V.f.2.05	F	41	2	V	University incomplete	10
V.f.2.06	F	26	2	V	University complete	11
V.f.2.07	F	32	2	V	University complete	10
LP.m.2.01	M	28	2	LP	Technical complete	9
LP.m.2.02	M	26	2	LP	Technical incomplete	9
LP.m.2.03	M	26	2	LP	Technical incomplete	8
LP.m.2.04	M	39	2	LP	primary incomplete	8
LP.m.2.05	M	31	2	LP	Technical complete	11
V.m.2.01	M	35	2	V	University complete	10
V.m.2.02	M	36	2	V	University complete	11
V.m.2.03	M	27	2	V	University complete	11
V.m.2.04	M	31	2	V	Technical complete	10
V.m.2.05	M	26	2	V	University complete	11
LP.f.3.01	F	52	3	LP	Primary complete	8
LP.f.3.02	F	69	3	LP	Primary incomplete	6
LP.f.3.04	F	66	3	LP	Primary incomplete	8
LP.f.3.05	F	59	3	LP	Primary incomplete	4

LP.f.3.06	F	43	3	LP	University complete	9
V.f.3.01	F	48	3	V	University complete	10
V.f.3.02	F	68	3	V	University incomplete	10
V.f.3.03	F	51	3	V	University complete	11
V.f.3.04	F	70	3	V	University complete	11
V.f.3.05	F	58	3	V	University complete	11
LP.m.3.01	M	53	3	LP	Secondary complete	6
LP.m.3.02	M	53	3	LP	Primary incomplete	8
LP.m.3.03	M	48	3	LP	Primary incomplete	10
LP.m.3.04	M	54	3	LP	Secondary incomplete	5
LP.m.3.05	M	48	3	LP	Primary complete	5
V.m.3.01	M	75	3	V	University complete	11
V.m.3.02	M	46	3	V	University complete	11
V.m.3.03	M	57	3	V	Technical complete	11
V.m.3.04	M	52	3	V	University complete	8
V.m.3.05	M	76	3	V	University Complete	11

As stated above, all of these participants also took part in the visual guise perception experiment, though four of them (V.m.3.05, LP.m.1.01, LP.m.3.03, and LP.m.3.04) were unable to complete the experiment due to a variety of factors as will be discussed below.

In addition to the sociolinguistic interview and the visual prime perception experiment, and following Hay, Warren, and Drager's (2006) paper, another group of 31 participants took

part in a baseline perception experiment without visual primes. These participants were paid \$1,000 CLP (approximately \$1.48 USD) for their participation, which usually did not take more than 15 minutes during which they provided a 5-10 production sample before taking the perception test. Table 4 below presents these participants' demographic information, with a total of at least 10 participants per age group.

Table 2. Participant Demographics, Baseline Perception Experiment

Participant ID	Gender	Age	Age Group	Comuna	Education	Household goods score
LP.f.1.06	F	21	1	LP	Secondary complete	6
V.f.1.07	F	23	1	V	University incomplete	10
V.f.1.08	F	23	1	V	University incomplete	9
V.f.1.09	F	25	1	V	University complete	11
LP.m.1.08	M	19	1	LP	Secondary complete	10
LP.m.1.09	M	18	1	LP	Primary complete	6
LP.m.1.10	M	18	1	LP	Secondary incomplete	8
LP.m.1.11	M	25	1	LP	University incomplete	9
V.m.1.07	M	18	1	V	Secondary complete	10
V.m.1.08	M	21	1	V	University incomplete	11
LP.f.2.06	F	28	2	LP	Secondary complete	10
LP.f.2.07	F	40	2	LP	Primary complete	9
V.f.2.08	F	27	2	V	University complete	8
V.f.2.09	F	31	2	V	University complete	11
V.f.2.10	F	28	2	V	University complete	11

LP.m.2.06	M	29	2	LP	Secondary incomplete	6
LP.m.2.07	M	37	2	LP	University complete	11
LP.m.2.08	M	35	2	LP	Técnico complete	7
LP.m.2.09	M	38	2	LP	Técnico complete	9
V.m.2.06	M	30	2	V	University complete	11
V.m.2.07	M	28	2	V	University complete	11
LP.f.3.07	F	50	3	LP	Secondary complete	10
LP.f.3.08	F	44	3	LP	Primary complete	4
LP.f.3.10	F	54	3	LP	Primary incomplete	6
LP.f.3.11	F	56	3	LP	Primary incomplete	3
V.f.3.06	F	75	3	V	University complete	11
V.f.3.07	F	70	3	V	University incomplete	10
V.f.3.08	F	74	3	V	University complete	10
LP.m.3.08	M	56	3	LP	Secondary complete	10
LP.m.3.10	M	72	3	LP	Primary complete	7
V.m.3.07	M	55	3	V	Técnico complete	10
V.m.3.08	M	53	3	V	University complete	11

The demographics of these participants closely mirror those who participated in the visual guise experiment.

Following data collection, participants were asked if they would like to be considered to participate in a follow-up study within the next few years. All said yes, and their contact

information is kept in a password-protected Excel file apart from any of their demographic information except for current age and neighborhood.

3.6. Methods

3.6.1. Production tasks

In this section, I will first describe the two production tasks. Then, I designate the equipment I used and the different recording environments in each *comuna*. Informants participated in two production tasks during elicitation. The first was the sociolinguistic interview as pioneered by Labov (1966). I conversed with each informant for approximately 45 minutes regarding a variety of topics such as work, family, holidays, cooking, and personal history. According to Labov, these topics contribute to reducing the observer's paradox by "emotionally involving" speakers, thereby helping them to forget that they are being interviewed or recorded. I relied on Tagliamonte's (2006) sociolinguistic interview questionnaire to begin many interviews, which she had adapted from Labov's original interview schedule.

Through familiarity of current events and conversations with contacts and participants, I added more community-appropriate questions and topics to the interviews. For interviews in Vitacura, for instance, contacts suggested that I discuss personal security and safety. This topic is currently a hot-button issue, as there are many incidences of petty crime as well as home invasion (sometimes violent or armed), and there is an unprecedented level of awareness of these crimes due to social media. Indeed, one of my Vitacura participants invited me to the Facebook group *Denuncia Vitacura* 'Vitacura Reports' to which approximately 10,000 people belong, and who publicize crimes carried out in the *comuna*. A crime that incites particular rage is the *portonazo*, in which wealthy residents of Vitacura, upon getting out of their cars to unlock their

garages or gates (*portones*), are held up at gunpoint and their car is either stolen or thieves use this opportunity to enter the victim's home. Personal security and safety were also topics of conversation in La Pintana, though for different reasons. Drug addiction and trafficking are unfortunately common in this community, and nearly every one of my participants had been affected by this either as a family member or friend of a drug user. Discrimination based on *comuna* was also a topic that encouraged participants' emotional involvement in the conversation. In Vitacura, participants claimed to have been discriminated against for being *cuicos*, Chilean slang often used derogatorily for wealthy, often snobbish individuals. Many participants in La Pintana claimed that they had been discriminated against for being from La Pintana, particularly in regards to employment opportunities, or perceived as *flaites*, a Chilean slang term for low-class, often delinquent youth.

Participants were encouraged to deviate from the questions I initially posed, and in many cases, I diverged from the interview guide and simply asked follow-up questions in attempts to engage the speaker more deeply in their narrative. For instance, often questions about family composition such as 'how many brothers and sisters do you have' led to questions such as 'did you ever get into big trouble with your parents' that might elicit a narrative run.

Following the sociolinguistic interview, participants were asked to narrate a wordless storybook, *Chalk* (Thomson 2010). The data from this task will not be analyzed in this dissertation, though see Brogan & Bolyanatz (forthcoming) for more information. In sociolinguistic research, style has been shown to be a factor that greatly conditions /s/ production (cf. Mazzaro 2005; Cid-Hazard 2003), in that more formal speaking situations such as reading narratives or word lists often occasion more formal expressions of /s/. However, the literacy rates in La Pintana can be low, despite the overall high literacy rate of the country, and indeed, several

of my participants categorized themselves as either ‘analfabetos’ (*illiterate*) or said ‘no leo bien’ (*I don’t read well*). Therefore, the use of a reading task was untenable, and the narration of this wordless storybook did serve to elicit similar items across speakers and a slightly raised frequency of use of aspirated and sibilant /s/.

3.6.2. Recording environments and equipment

All of the tasks were conducted during one elicitation session (with the exception of one participant) since it was difficult to follow up with participants. Nearly all interviews were conducted one-on-one, though in a few cases other members of the home (such as family members or roommates) would come in and out and participants may briefly direct comments toward them.

Recording environments varied based on neighborhood. In La Pintana, I recorded mainly at an informal radio station at the Centro Acuarela, a small upstairs room that had been partially soundproofed with cardboard egg cartons (see Figure 7 below).



Figure 7. Participant performing perception task at the Centro Acuarela radio station; note sound attenuating intents

Generally, recordings made in this environment were of excellent quality. A small amount of recordings were made at my other field site, though some of these had to be excluded based on recording quality, as there were few quiet places to record and loud ambient noises (such as car alarms and loud music from powerful sound systems) often compromised parts of the recordings. In Vitacura, I often recorded in speakers' homes, which tended to be quiet, carpeted, and free of ambient noise. These personal home recordings were almost exclusively gathered via previous participants or contacts. I was also granted access to a sound-attenuated cabin at the Pontifical Catholic University phonetics laboratory, which was where many of the university students chose to be recorded.

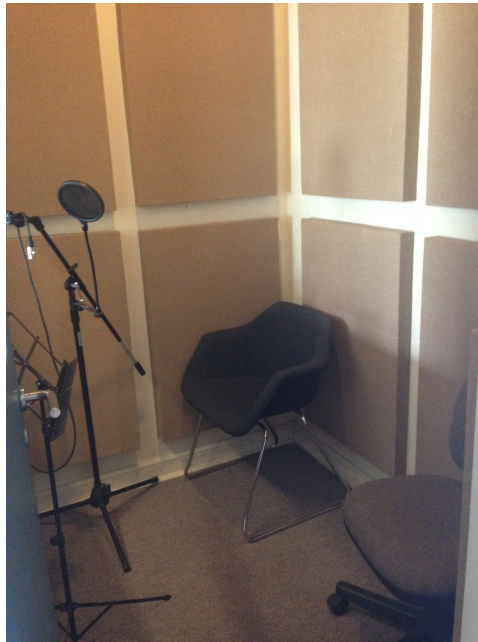


Figure 8. Sound-attenuated cabin at the San Joaquín campus

Recordings made at the municipal library mentioned above had to be thrown out based on ambient noise and echo.

All production data were recorded on an Olympus LS-14 Linear PCM recorder via an Audiotecnica ATR 3350 lapel microphone, digitized at 44.1 kHz and a 16 bit rate. The unobtrusiveness of the lapel microphone contributed to a relaxed recording environment, and many participants seemed to forget it was there.

However, the use of the lapel microphone did contribute to some variability throughout the recording as participants moved around. Additionally, the microphone's distance to the speakers' mouth varied greatly based on what the participant was wearing (i.e. to where I could attach the lapel clip). To combat this variability, I used the "Smart" mode on the recorder. In this mode, the recording level is "adjusted automatically to the optimum level to suit the volume input sampled during a preset time prior to the actual start of recording, so that even sudden loud sounds are recorded without distortion" (Olympus America Inc. 2016). In other words, levels are set based on a few initial seconds of speech. If I noticed that participants were speaking much differently later in the recording (especially if I saw that the recording was often peaking, I would surreptitiously stop the recording and re-start it so the level could normalize again.

In this section, I have described the method for the production tasks presented in this dissertation, including recording settings and environments and the procedure of the sociolinguistic interview.

3.7. Perception tasks design and methods

In this section, I first describe the purpose and design of the perception tasks. I then define how the auditory and visual stimuli were selected and how the experiment was delivered.

The purpose of the perception experiments was to target listeners' perceptions of final /s/ weakening and deletion. Broadly, I wanted to know: how do listeners distinguish between

singular items and plural items whose final /s/ has been deleted? To answer this question, I presented listeners with isolated words that had been extracted from sociolinguistic interviews, and asked them to determine whether they heard ‘one’ (singular) or ‘more than one’ (plural) item(s) by pressing a particular key.

I tested whether listeners would be more likely to provide ‘plural’ responses to the stimuli according to the listener’s demographic characteristics, based on the assumption that since *production* of final /s/ varies along demographic lines, this variation would also be present in the *perception* results. I also tested whether listeners would be more likely to identify a stimulus as ‘plural’ according to the acoustic characteristics of the stimuli, such as the duration, breathiness, and quality of the stimuli’s final vowel. These hypotheses are based on previous observations of production of final /s/, in which authors have claimed that final vowels preceding weakened /s/ are longer, different in quality, and breathier (Lenz 1940; Oroz 1966; Cepeda 1990).

Participants took part in one of two perception experiments: a baseline task and a visual prime task. The auditory stimuli of the visual prime task were identical to those of the baseline task, but in this experiment, the stimuli were repeated four times, and each time, the listener was primed with a different visual image representing members of a different age group and social class. In this way, I tested whether participants would be more or less likely to assume that the word they were hearing was plural depending on who they thought was speaking the word. For instance, if participants saw a picture of a younger, working class female, I hypothesized that they would be more likely to assume that she was producing a plural word with an /s/ deleted than an upper-class older male. I hypothesized that they would be more likely to assume that his words without overt /s/s would be singular.

The perception experiments took place following the production tasks. To avoid participant fatigue, informants were asked if they would like to take a break between production and perception tasks, and nearly all declined to do so.

3.7.1. Design of task

Both perception experiments consisted of a two-alternative forced-choice identification task, modeled after the one described in Hay, Warren and Drager (2006). The stimuli were delivered to each participant using a script in MatLab. Each participant wore the same pair of over-ear Sony headphones, and we set comfortable volume levels before the task began using the built-in volume control. Both perception tasks were delivered on a Dell Latitude D830 computer running version 7.7.0 of Matlab. Before beginning the task, I read the following instructions aloud (phrases in bold indicate text that was only included in the instructions of the visual guise experiment):

*Gracias por participar en el experimento. El experimento se trata de la pluralidad de las palabras. Va a escuchar una serie de palabras sueltas, y tendrá que decidir si están hablando de 'una' cosa, o 'más de una'. **Las palabras se pronuncian por 8 personas diferentes. Como a veces es difícil escuchar múltiples voces en un solo experimento, le vamos a mostrar una foto de cada hablante. Antes de escuchar cada palabra, verá una foto, para indicarle cuál voz va a escuchar. Mire la foto y escuche la palabra. Si escucha 'un' elemento o cosa, pulse la <U> tan rápido como decida. Si escucha 'más de un elemento' o cosa, pulse el botón <M>. Se repiten muchas palabras, así que no se preocupe si escucha una palabra repetida. Es posible que sea una tarea difícil, pero no se preocupe. Si no está seguro/a de la respuesta, adivine no más. No existen respuestas correctas o incorrectas. Sólo nos interesa su primera intuición. Una vez que proporcione su respuesta, verá la siguiente foto, y escuchará la siguiente palabra. ¿Tiene alguna pregunta?***

Thank you for participating in this experiment. This experiment is about the plurality of words. You will hear a series of isolated words, and you will have to decide whether the speaker is talking about 'one' or 'more than one' items. The words are produced by 8 different people. Since sometimes it is difficult to hear multiple voices in one experiment, you will see a photo of each speaker. Before hearing each word, you will see a photo, to indicate which voice you will hear. Look at the photo and listen to the word. If you hear the speaker referring to 'one' element, hit <U> [uno, one] as quickly as possible. If you hear the speaker referring to 'more than one' element or thing, hit the <M> button [más de uno, more than one]. Many words are repeated, so don't worry if you hear a repeated word. It is possible that this task will be difficult, but don't worry. If you're not sure about the response, just guess. There are no correct or incorrect answers.

We're just interested in your first intuition. Once you've answered, you'll see the next photo, and hear the next word. Do you have any questions?

Additionally, upon beginning the script, the participants had the opportunity to see these instructions written out, as in Figure 9.

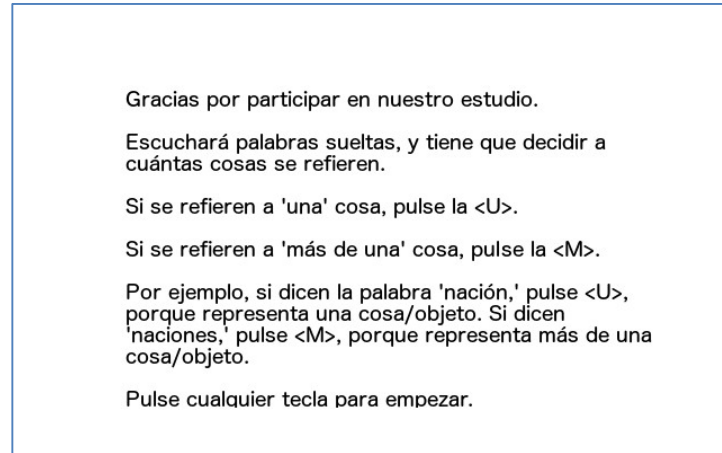


Figure 9. Screenshot of instructions shown to participants upon beginning both perception tasks

Again, in order to gain access to listeners' judgments of plurality, the main goal of this investigation, participants were asked to select whether they were hearing “one” or “more than one” items, by clicking on either a <U> or an <M>, taped to the letters <a> or <l> on the keyboard. I attempted to avoid saying “singular vs. plural,” during the instruction phase, but if a participant said something like, “Oh, so singular versus plural?” after hearing the instructions, I would confirm that. If asked for further clarification, I would offer examples of other singular vs. plural items. In each case, I made sure not to offer examples that were distinguished by only a final /s/. In other words, I offered items such as *sillón/sillones*, and *flor/flores* to ensure that participants would not focus on my own pronunciations of the final /s/ morpheme alone, using those as cues for the task. As a second language speaker of this dialect, I myself weaken final /s/, and I did not want my own pronunciations of /s/ to bias the listeners' responses, or cue them to listen for overt [s].







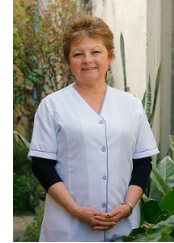

Test design for half of the participants (N=30) consisted of the <U> being placed on the “a” key; for the other thirty, the <U> was placed on the “l” key, effectively counterbalancing the response options since for half of the participants, the dominant right hand was over the *singular* key and for the other half over the *plural* key. The instructions did not need to be changed for these two versions, as the instructions referred simply to the <U> and the <M>. Visual guise auditory stimuli were completely randomized so that each audio would play with each of the 4 appropriate pictures. Once participants made a selection, the program included a one-second pause before advancing to the next stimuli pair.

In the baseline experiment, each participant heard each auditory stimulus once for a total of 84 test items and 6 control items with overt sibilant [s] (see Table 1 below), with an unchanging background showing a blue circle. The task took approximately 5-7 minutes, as participants were encouraged to proceed quickly but accurately. In the visual guise experiment, each participant heard the same auditory stimuli repeated 4 times. Each auditory stimulus was accompanied by a visual prime: pictures of a young, working-class speaker; a young, professional-class speaker; an older, working-class speaker; and an older, professional-class speaker, as in Table 4. The order of presentation of the photos and the auditory stimulus was completely randomized, or unblocked. In total, the participants in the visual prime experiment responded to a total of 360 unique stimuli (90 auditory tokens x 4 visual primes), as in Table 3 below.

Table 3. Stimuli for both perception tasks

Speaker	Control items	Plural items with final /s/ weakened	Plural items with final /s/ deleted	Singular items
Female	2 with overt final [s]	3 [h]	20	20
Male	4 with overt [s]	1 [h]	20	20

Table 4. Presentation of visual primes according to demographic guises

Gender	Age	SES: working	SES: professional
M	Younger		
	Older		
F	Younger		
	Older		

I had originally assumed that [h] final items would pattern similarly with the overt [s] items, but following data collection, I saw that these items patterned more closely with the [Ø] items. That is, participants were less accurate at correctly identifying these stimuli as plural,

more in line with the deleted /s/ items. I therefore decided to categorize these as experimental items post-hoc.

3.7.2. Auditory stimuli selection

Prior to this trip, I had carried out sociolinguistic interviews among Chileans residing in Los Angeles, and production data from two of these speakers were used as the stimuli for the perception study presented here. These speakers are an upper-middle class brother and sister from Puente Alto, a middle-class *comuna* in southern Santiago, and are both on US fellowships to study their PhDs in the U.S. With both participants, we discussed topics such as their own fields and areas of study, travels, romantic relationships, and differences between the U.S. and Chile.

Selecting items to use as natural stimuli in this perception task was challenging. I used my own familiarity with the city and the dialect to select stimuli that consisted of high-frequency, daily conversation items, and when possible, singular and plural versions of the same items. For instance, the female speaker produced both singular *amigo* and plural *amigos* with the final /s/ deleted, so I used these two stimuli as a pseudo-minimal pair. Controlling stimuli selection *a priori* was impossible, due to the nature of spontaneous data. I therefore attempted to include items from a variety of phonological environments, including items followed by phonological segments as well as pauses, by consonantal segments as well as vowels. All of the final syllables in the stimuli items were unstressed, following the Spanish stress system, and most also preceded unstressed syllables. Most words in Spanish have penultimate primary stress (Quilis 1993), so the stimuli follow natural speech distributions.

Additionally, *segmenting* these items from their continuous, analog speech stream was particularly challenging. I present my segmenting criteria here from simplest to most complex

cases. When a stimulus was followed by a stop consonant, I segmented the offset of the stimulus at the beginning of the stop closure signaling the onset of the following word, as in Figure 10 below, representing /separadospor/ [separaopor]<separados por> *separated by*.

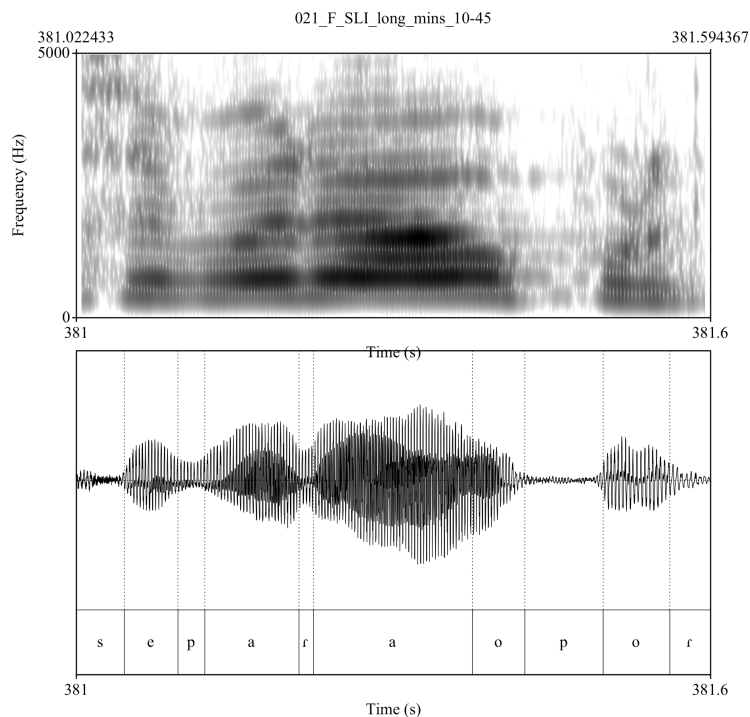


Figure 10. Waveform, spectrogram, and broad phonetic transcription of *{separados} por*

When followed by a fricative as the onset of the following word (though these cases were few), I segmented the offset of the stimulus at the onset of clear frication noise and when appropriate, the offset of voicing. When flanked by an approximant, I segmented the vowel at a clear change in amplitude. In the particular case presented here, below in Figure 11, part of the phrase <independientes de la policia> *independent of the police*, the fricative/approximant [ð] also had a brief, initial period of silence (which is to be included in the fricative segment). The final /e/ was also weakened, so the offset of voicing proved to be a helpful cue in this case.

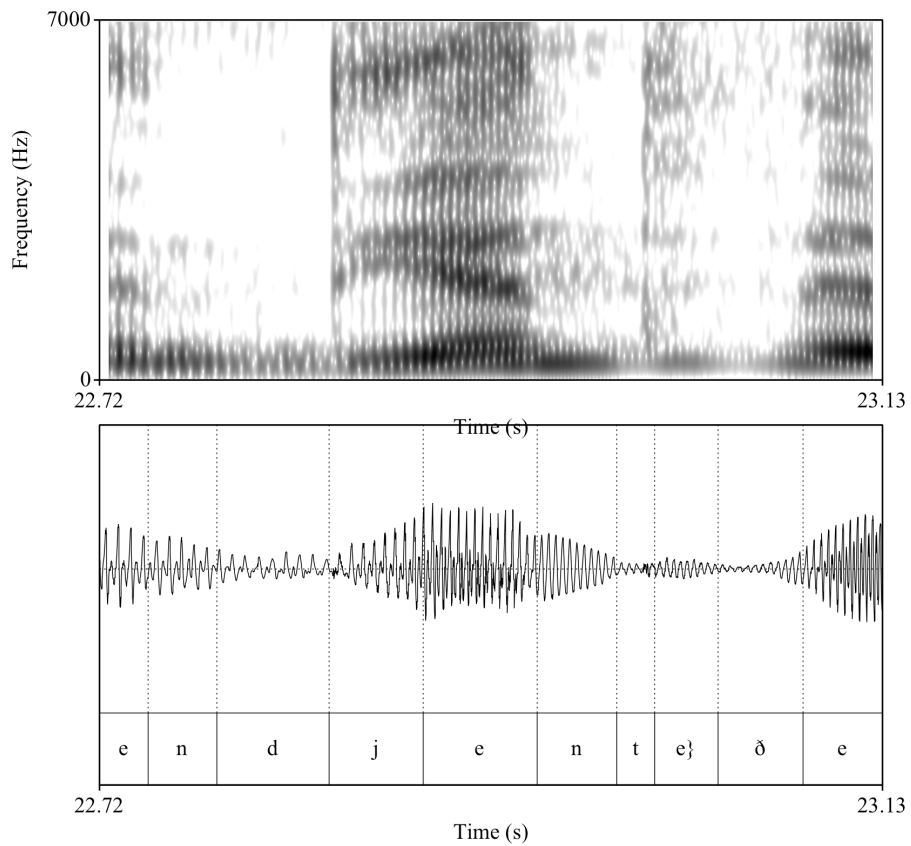


Figure 11. Waveform, spectrogram, and broad phonetic transcription of <endientes de>

In some cases, the phonological environment of /VsV/ proved helpful, as it provided a context for word-final, resyllabified initial /s/ aspiration, as in Figure 12 below, in which the final /s/ of inflected verb /bisitas/ <visitas> (*you*) *visit* followed by preposition /a/ is produced as a voiced [f].

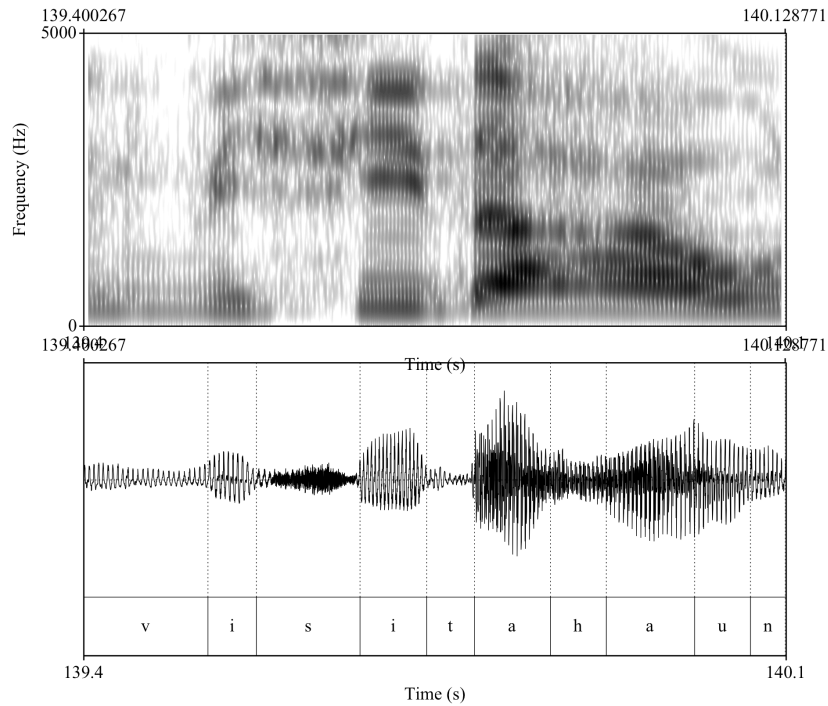


Figure 12. Waveform, spectrogram, and broad phonetic transcription of <visitas a un>

Vowel-final words followed by vowel-initial words were challenging to segment, such as in Figure 13 below. In this phrase, singular noun *teléfono* followed by conjunction *y*, <teléfono y>, I separated the final /o/ from the initial /i/ by selecting a segment that included the entire steady state portion of [o] and some of the transition into [i]. Again, due to the naturalness and continuousness of the speech signal, transitions into and out of the surrounding sounds were impossible to eliminate.

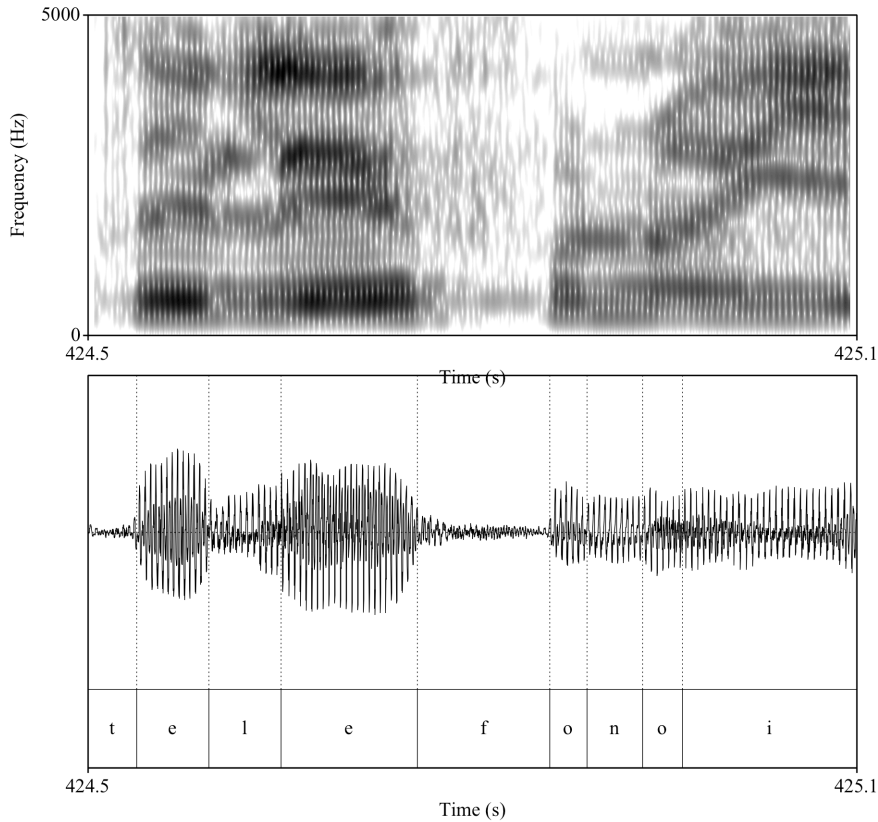


Figure 13. Waveform, spectrogram, and broad phonetic transcription of <teléfono y>

By far, the most challenging type of stimuli to segment were plural items whose /s/ was reduced, particularly in phrase-final position. I followed Garellek (p.c.) and Erker (2012) in using the final vowel's F2 and voicing bar to help distinguish between a breathy vowel at the end of the word, or a vowel followed by an h-like segment. Coarticulation between these two segments is, of course, unavoidable, so I provide other examples in Chapter 4 of distinctions I made between breathy vowels and vowel+[h]. For instance, in Figure 14 below, I show plural /gringas/, which the female speaker produced as [gəriŋgə]. In the final [ə], there is no steady-state portion of the vowel, followed by an [h]-like segment. Rather, the entire vowel is produced with a very open glottis, making a breathy vowel [ə̤].

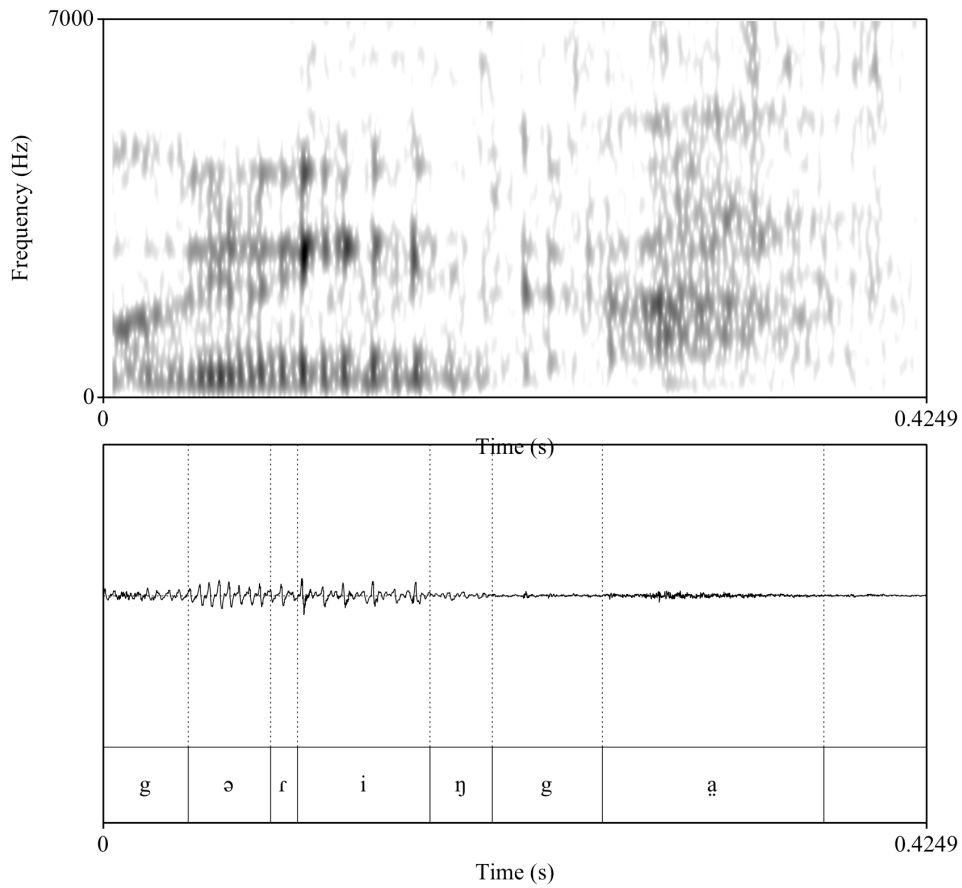


Figure 14. Spectrogram, waveform and phonetic transcription of <gringas>

The reader may also note the epenthetic, *svarabhakti* vowel between the voiced [g] and the tap [r]. Contrast the final /s/ in Figure 14 with that of Figure 15, a clearly separate [h̥] segment between the [o] and [i] vowels, that also serves as a transition between the two.

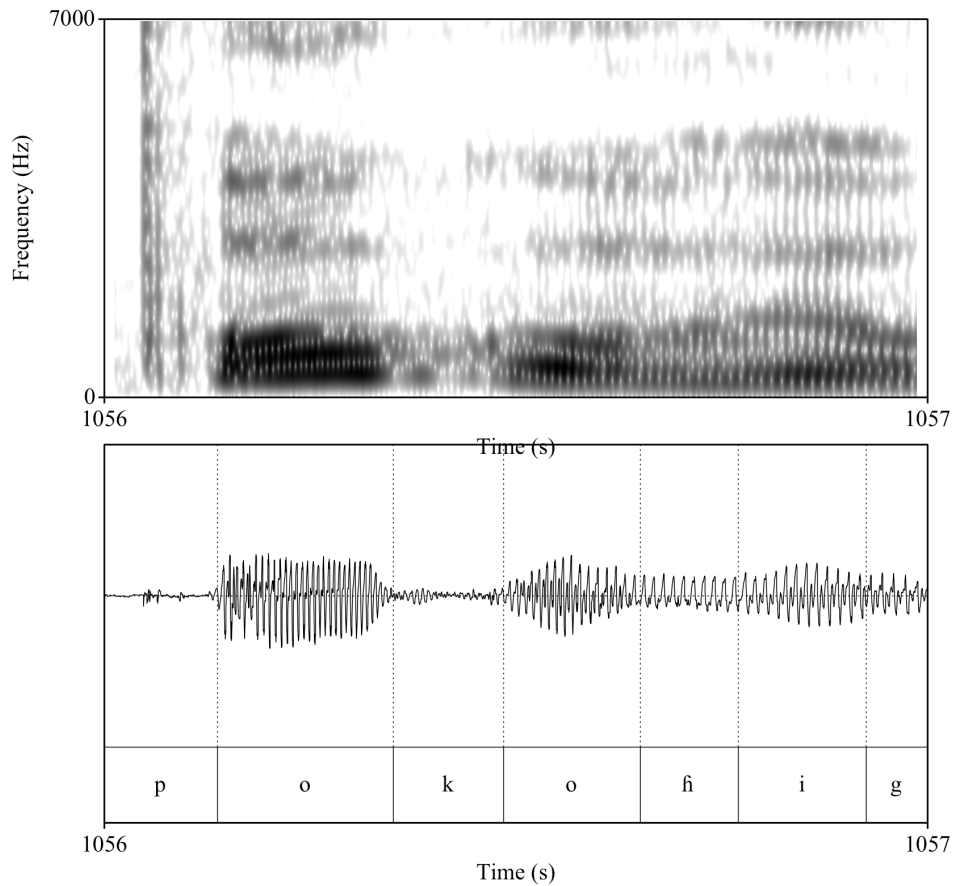


Figure 15. Spectrogram, waveform, and phonetic transcription of <{pocos} ig(ual)>

3.7.3. Visual stimuli selection

In this section, I briefly describe the selection of the eight photographs used as visual primes for the auditory stimuli in this experiment. For the selection process, I focused on the variables of interest (age and class) with which /s/ has previously been shown to correlate. Therefore, for each demographic, I performed a Google Image search that resulted in the selection of the images presented earlier in Table 4.

While conducting my fieldwork, I also carried out a control study in which 30 people (F=16, M=14) not included in the production or perception studies were asked to rate these

images based on a variety of scales (see Appendix 2; adapted from Hay, Warren, & Drager 2006 for a Chilean context). Participants were first asked whether they knew the people in the picture. They were also asked to select how old they thought the person was within a set of ranges. To target the SES variable, participants were asked how much education they thought the individual in the picture had, and what type of job they probably had. Responses to this task will be examined in Chapter 5, but overall, these 30 individuals confirmed my selection of these photographs as appropriate visual stimuli.

In this section, I have presented a description of the method and design of the perception tasks used to collect data for this dissertation. Experiments consisted of two-alternative forced-choice identification tasks that were designed in a manner to collect data regarding whether social and linguistic distinctions in perception mirror those that exist in production. In the following chapters, I will show that indeed, this experiment reveals the social and linguistic cues that are working in tandem to enable speakers to determine plurality of isolated words.

Chapter 4. Analysis and Results: Production Task

In this chapter, I present the method of analysis and results of the production experiment. The purpose of the production experiment was to target the following questions: do Chilean Spanish speakers use segmental or suprasegmental strategies to differentiate between the final vowels of singular and plural Noun Phrase (NP) components? If so, does use of these strategies vary according to social characteristics of the speaker? To my knowledge, this is the first instrumental study of Chilean Spanish identifying patterns of production of singular and plural items that originate in naturalistic speech, thus enabling us to more closely approximate what segmental or suprasegmental strategies speakers use in everyday speech to mark this distinction.

As mentioned in chapter 2, according to hypotheses formed on the basis of impressionistic observations, speakers of /s/ weakening dialects may variably use multiple strategies to mark the difference between singular and plural words. These strategies include both segmental and suprasegmental differences. Segmentally, scholars have proposed that speakers articulate final vowels of plural words with a *lower* tongue position in comparison to singulars. This lowering has been impressionistically attested in Puerto Rico, causing dialectologist Navarro Tomás (1966) to propose an 8-vowel system in which the low and mid vowels /a/, /e/, and /o/ also had lowered (more open) counterparts. Alvar (1991) has also attested this distinction in parts of Eastern Andalusian Spanish, and Oroz (1966) claimed that when an /s/ is aspirated or entirely deleted in Chilean Spanish, the preceding vowel may be produced as lower or more open, or as lengthened (1966: 102, 106). Indeed, the second strategy purported to be used by speakers is final vowel lengthening, as Oroz attests. Lengthening of plural vowels has also been attested in Argentina (Vidal de Battini 1949:42), particularly when the final /s/ is aspirated. Cepeda (1990a) attests several different “vocalic changes” associated with /s/

weakening, including vowel lengthening and shortening, opening and closing of the final vowel, and importantly for the present study, final vowel ‘aspiration.’ I have translated her original *aspiración vocálica* as something akin to final vowel breathiness, marking here a third strategy attested by this particular scholar: voice quality on the final vowel differentiating underlyingly singular words from underlyingly plural words with a weakened final /s/.

In order to test these hypotheses quantitatively, I conducted an analysis of vowels originating in sociolinguistic interviews with 60 individuals, as described in the previous chapter. I extracted minutes 10-45 of the sociolinguistic interviews via Audacity (Audacity Team 2013), and segmented the final vowels of the first 50 singular and the first 50 plural NP components in Praat (Boersma and Weenink 2016) according to several criteria. Within the envelope of variation I included determiners, adjectives, and nouns. Determiners *los*, *la*, and *las*, and the neuter article *lo* were included. Adjectives included items like *esta* and *estas* (as in *estas chicas*, ‘these girls’) and attributes such as color or size. Items such as *grande* were included since their plural morpheme is a simple –s while items such as *liberal* were excluded, since their plural morpheme is an –es suffix and therefore would not provide the one-to-one vocalic comparison of interest. Similarly, final vowels of nouns were included if they ended in a vowel in the singular, as in *profesora* and *profesoras*, while *profesor* and *profesores* were excluded. Additionally, I excluded word-final vowels that preceded voiceless fricatives /s/, /x/, or /f/, as in *la soda* /la soða/ ‘the soda-fem’, *la gigante* /la xiyante/ ‘the giant-fem’ or *una fuerza* /una fwersa/ ‘a strength-fem,’ since the frication of these sounds would be difficult to distinguish from a word-final [s] or [h]. I also excluded vowels preceding phonological /r/ due to its tendency to assibilate in this dialect of Spanish.

4.1. Segmentation criteria

Given that duration is one of the acoustic properties to be tested, I wanted to ensure that my segmentation criteria were conservative and clear. Marking the onsets and offsets of the vowels proved straightforward in some cases and challenging in others. In many environments, such as between voiceless stops, segmentation of the vowel is relatively simple. In these cases, I placed a boundary in an interval tier of a Praat TextGrid at the onset of voicing visible in the spectrogram, accompanied by the onset of periodicity in the waveform (following Peterson and Lehiste 1960). When followed by a voiceless stop, the boundary delineating the offset of the vowel was placed at the “abrupt cessation of all formants in the higher frequencies” (Peterson and Lehiste 1960: 695). At times, formants in the higher frequencies such as F3, F4, and F5 ceased earlier than the offset of the vowel’s F2, while other times the F2 offset first (similar to Oller’s (1972) findings). However, in order to remain consistent according to the advice of Turk, Satsuki, and Suguhara (2006) and following Torreira (2007), I chose to use the vowel’s F2 as the criteria for offset. That is, I placed a TextGrid boundary at the last point in the spectrogram that included a continuous F2. I will return to the F2 concept below when discussing vowels in utterance-final position. Figure 16 below shows the segmentation of a vowel flanked by voiceless stops.

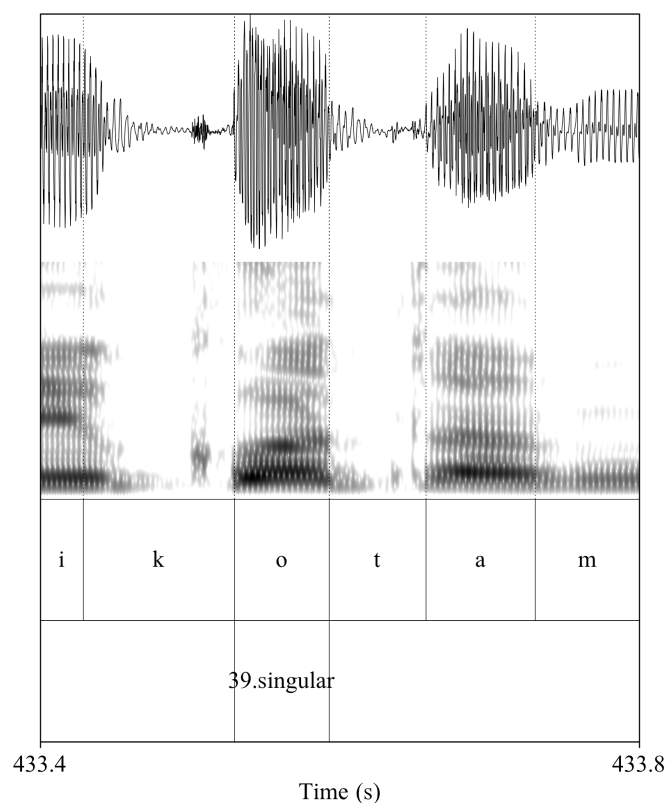


Figure 16. Singular [o] in [ikotam] from the phrase *y el médico también* (Speaker LP.f.3.05; note that the spectrogram ranges from 0-7kHz)

The onset of the [o] vowel of interest is marked at the onset of voicing following the phonologically voiceless stop, and its offset is marked at the offset of the higher frequencies. Though not included in the present analysis, I would like to draw the reader's attention to the offset of the [i] vowel. As mentioned above, I chose to pursue a conservative coding schema. That is, though the higher frequency formants F3 and F4 continue past the offset of the F2, as do voicing and periodic waves in the waveform, I elected to place the boundary at the offset of the F2 in order to provide consistency across all segmented items. Figure 17 shows an /s/ coded as a phonetic zero or deletion following an [o] vowel in the determiner *los* /los/ 'the-masc-plu'.

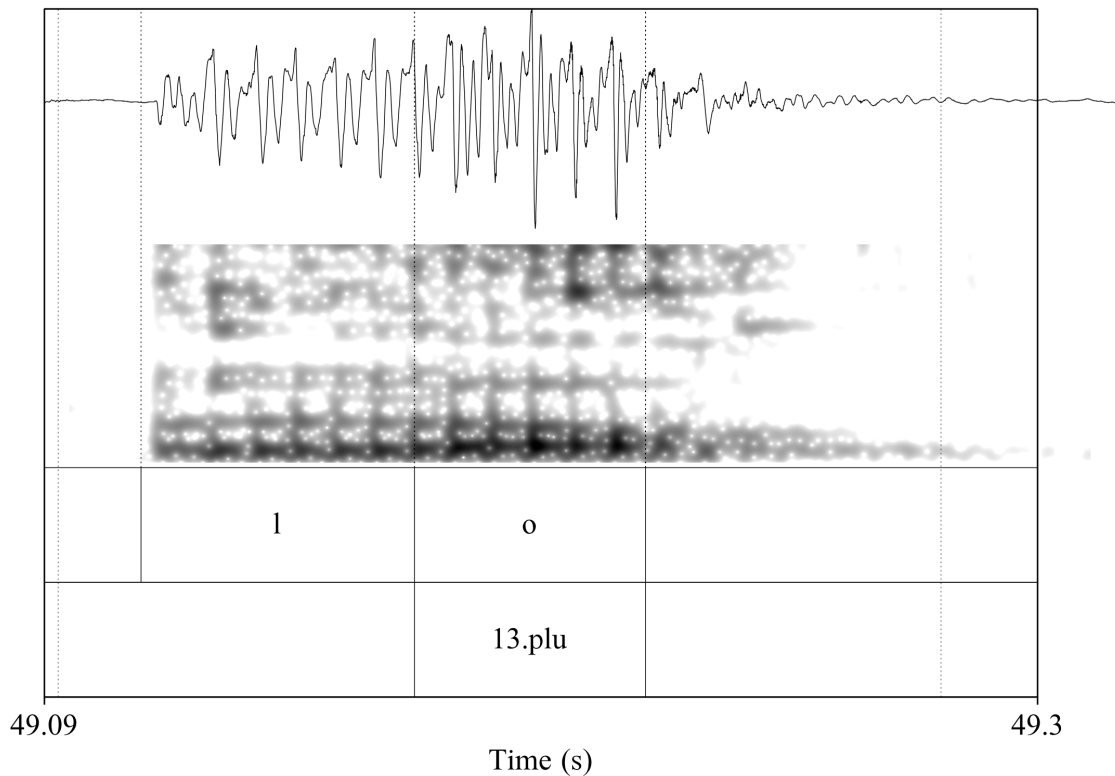


Figure 17. Plural [o] in [lo] from *los*, preceding a [k] (Speaker LP.m.3.01)

The onset of this [o] was placed at the point at which the waveform became more complex and the intensity increased from the [l] production, and its right boundary was placed at the offset of a continuous F2 segment. Though voicing continues past the delineated offset boundary of the vowel, I chose to adhere to the use of F2 as the cue for the vowel's offset. Some voicing at the beginning of a phonologically voiceless consonant (as in the /k/ above) is also not entirely unexpected given the continuous and coarticulatory nature of the speech stream.

Figure 18 below shows the segmentation of an [a] vowel from plural /las/, in which the /s/ was produced as an [h]-like sound with frication energy in approximately the same place as the vowel's formants, but produced with a stronger intensity. Again, in the interest of being conservative, I marked the vowel's right boundary at the offset of the continuous F2 (notice a

small break in continuity), which was accompanied by a simultaneous increase in higher-frequency noise, and a change in the intensity of the F1.

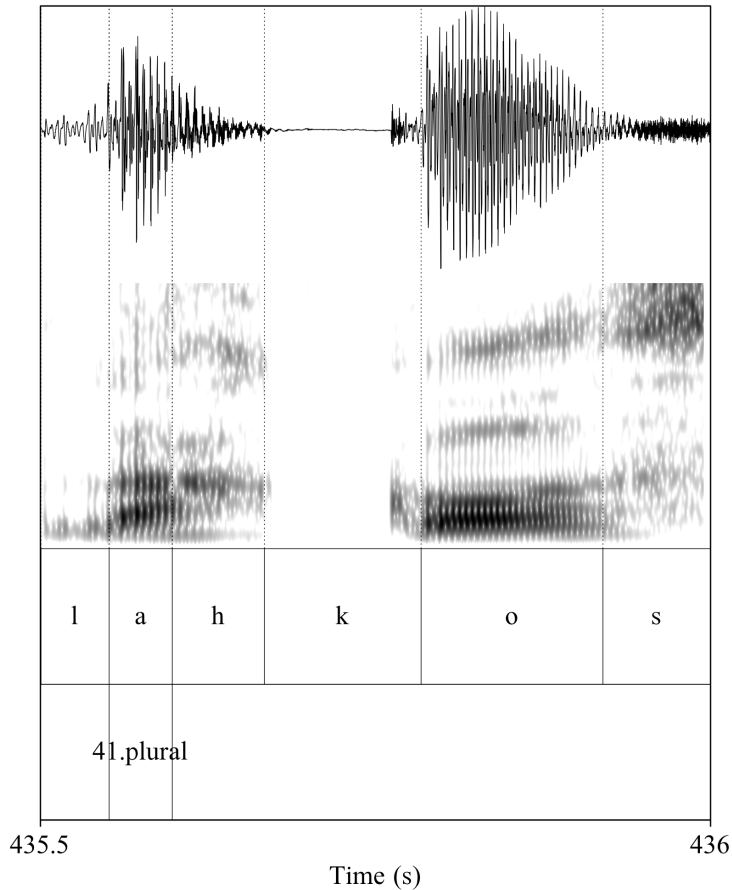


Figure 18. Plural [s] in [lahkos] from *las cosas* (Speaker V.f.1.02)

The onset of the vowel was marked at the point of amplitude change following the [l], when we see the formant frequencies strengthen and become regular. Similar strategies are used when segmenting a vowel that precedes or follows a nasal, as in Figure 19 below.

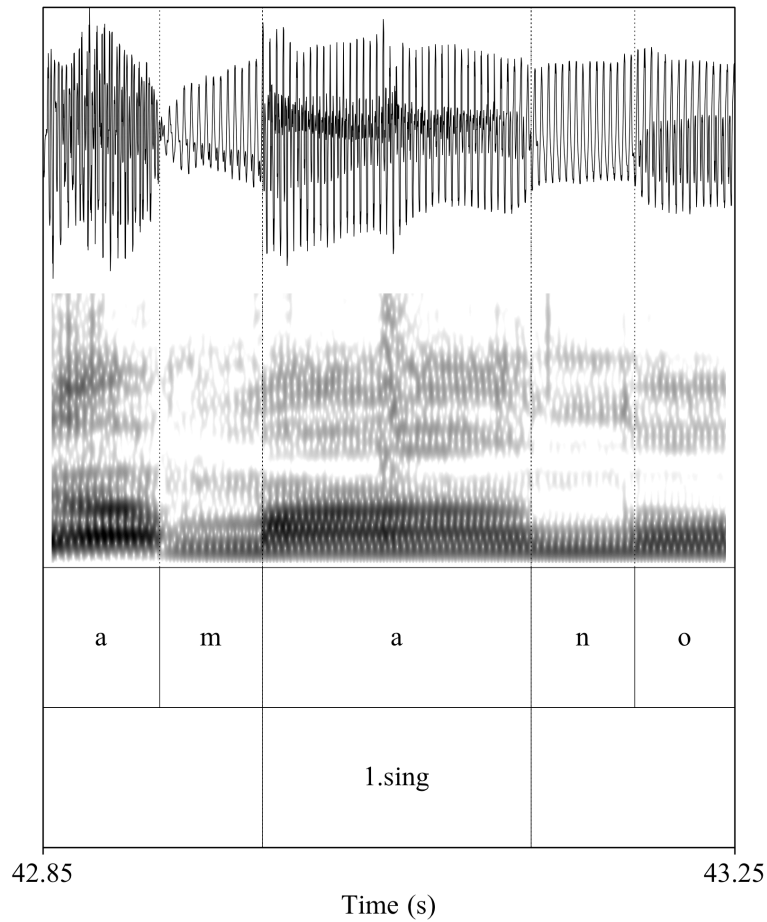


Figure 19. Singular [a] in [amano] from *cama no* (Speaker V.m.1.01)

Similarly, vowels following voiceless fricatives were coded in a similar manner: their leftmost boundary was placed at the onset of voicing of the vowel. In Figure 20 below, we see a vowel following an [s].

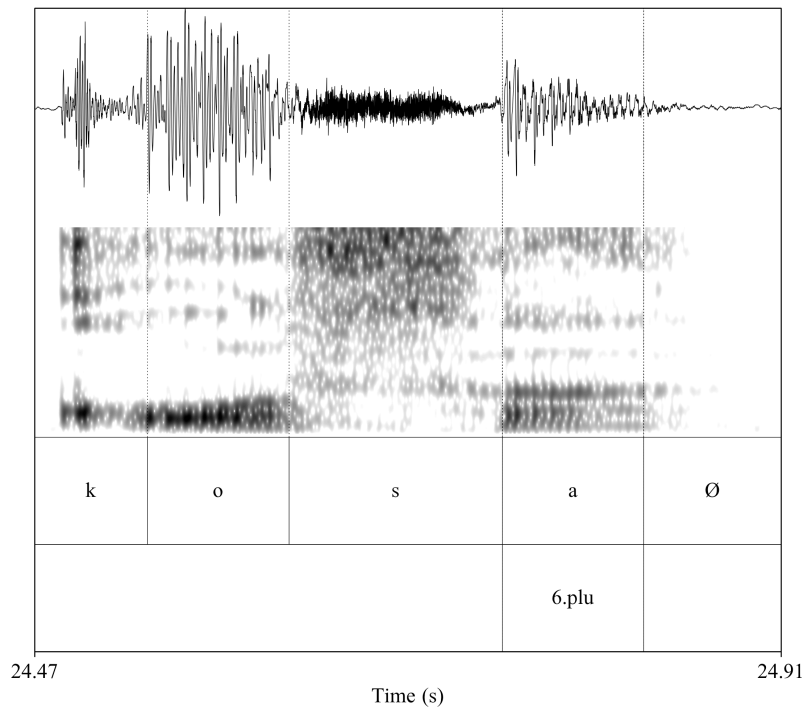


Figure 20. [kosa] from *cosas* (Speaker LP.m.3.01)

The [a] vowel of interest is in utterance-final position, a prosodic position with great amounts of variation in the world's languages (Turk, Satsuki, and Suguhara 2006). Following the criteria set out above, I marked this [a] vowel's rightmost edge at the offset of a continuous F2 which is also accompanied by a decrease in intensity in the waveform.

Figure 21 below is taken from Speaker V.f.3.03, an older professional-class female speaker, in which she uses a glottal fricative with some voicing (an [ɦ]-like sound) as a transition between 2 vowels (similar to Keating 1988). Voicing of [s] and [h] as [z] and [ɦ] were not coded for in this dataset; rather, the focus here was on oral constriction.

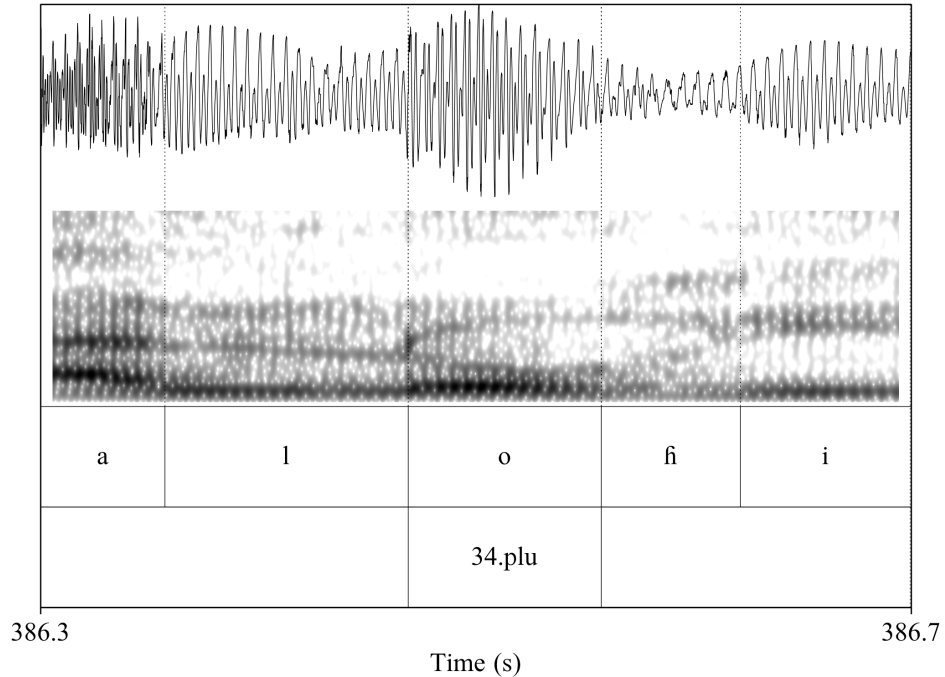


Figure 21. Plural [o] in [altofi] from *altos y* (Speaker V.f.3.03)

In this figure, I denoted the offset of the [o] vowel at the offset of a continuous F2. Between the two vowel segments, we see voicing in the voice bar and periodicity in the waveform, as well as formant-like transitions, particularly in the vowel's F2 trajectory.

The three figures below are taken from the same speaker, a young female speaker from the working-class neighborhood. Figure 22 represents an utterance-final plural with a final [h] produced. I segmented the offset of this vowel at the offset of the vowel frequencies and regular periodicity in the waveform. Note the high-energy frequency at approximately 4000 Hz, characteristic of an [h]-like segment, and the high-energy formant-like energy following a brief weakening in intensity between the formants of the vowel and the [h]-like segment.

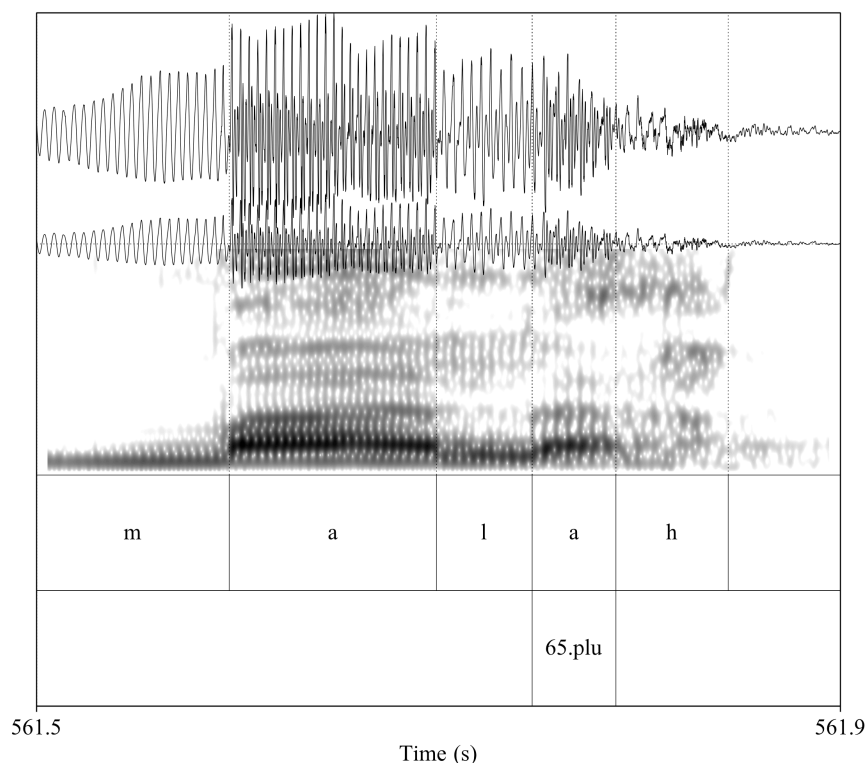


Figure 22. [malah] with utterance-final [h]-like segment from *malas* ‘bad-fem’ (Speaker LP.f.1.01)

In contrast, Figure 23 shows an utterance-final plural that I coded with a following [Ø], due to its F2 slowly trailing off. I segmented its offset at the point in which the F2 was no longer continuous, though the higher-frequency formants had offset slightly earlier and there was some noise and periodicity in the wave form after the offset boundary.

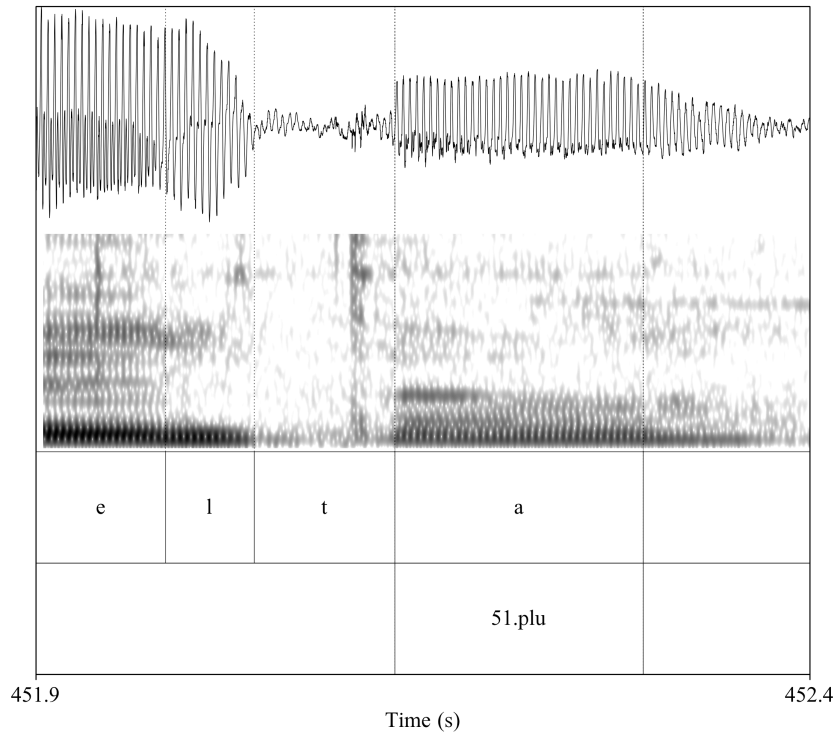


Figure 23. Plural [a] in [el.ta] with final /s/ deleted from *vuel*tas ‘rounds/turns’ (Speaker LP.f.1.01)

Similarly, Figure 24 shows an utterance-final singular whose F2 also trails off slowly, and I also coded this segment at the point in which the F2 was no longer continuous.

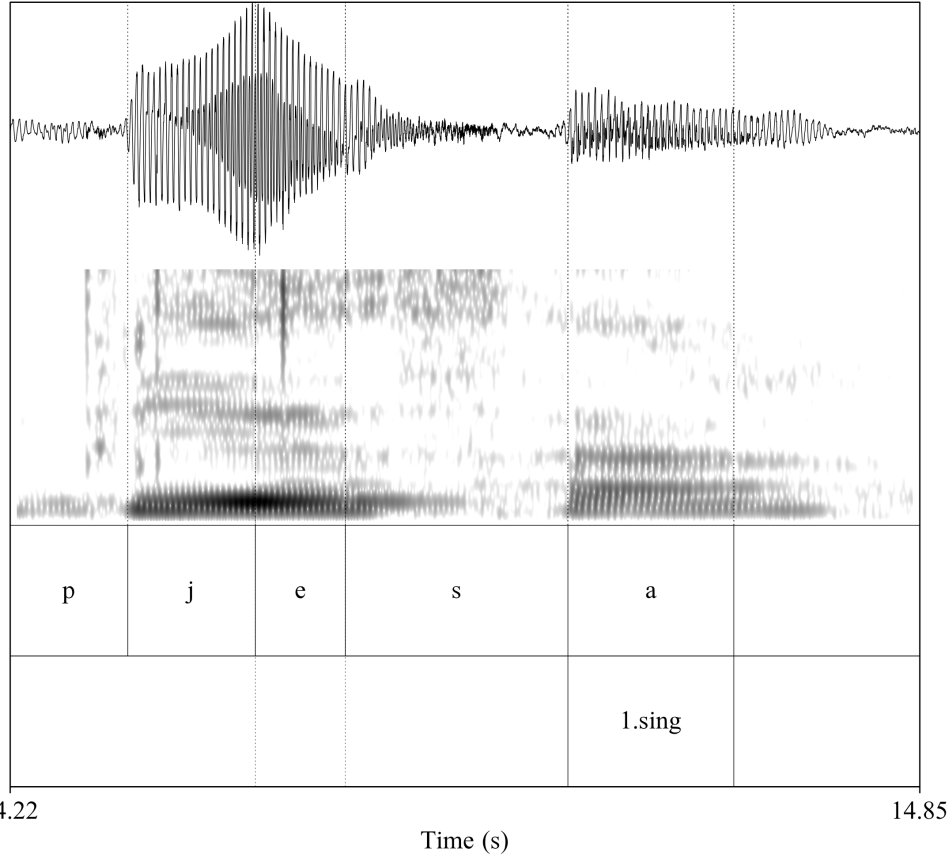


Figure 24. Singular [a] in [pje:sa] from pieza ‘bedroom’ (Speaker LP.f.1.01)

The final plural vowel in Figure 23 and the final singular vowel in Figure 24 are strikingly similar, providing confirmation of my decision to use F2 as a cross-word-type comparison metric. Again, Figure 22 through Figure 24 represent utterances spoken by the same speaker, and all are shown at the same dynamic range (40 dB) to facilitate their comparison.

Additionally, many instances of utterance-final vowels were produced as completely devoiced, as in Figure 25 below, or with laryngealization or creaky voice, as in Figure 26 below. The voice quality measure used in this paper, H1-H2, relies on an accurate measure of the first harmonic, which is also the fundamental frequency or F0. Therefore, in addition to using F2 as a delineator of vowel offset, I relied on the Praat pitch tracker to determine whether a vowel was ‘modal enough’ to be included in the analysis. That is, if the Praat pitch tracker could not find a

fundamental frequency, I excluded that vowel from analysis. This resulted in an average of 8.5 tokens per speaker (out of 100; SD 3.99) being excluded. In Figure 25, I show an excluded token, based on both non-modal (creaky) voicing, as well as vowel devoicing.

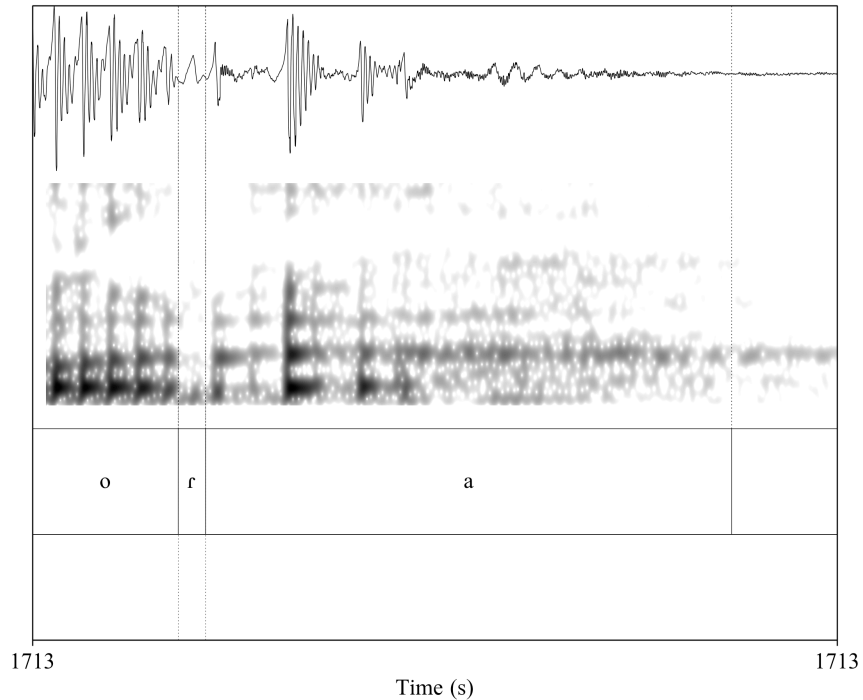


Figure 25. Excluded singular [a] in [ora] from utterance-final *discriminadora* (Speaker V.m.1.03)

In this figure, we can observe irregular glottal pulses throughout the segment of the [a] vowel, particularly in contrast with the more modal voicing of the preceding [o] vowel. We also note the devoicing of the vowel due to the absence of a consistent voicing bar in the area segmented as [a].

Figure 26 below shows the included portion of a vowel from a young male speaker from the professional class segmented from the excluded portion. As mentioned above, the vowel was segmented where the Praat pitch tracker could no longer detect a regular F0.

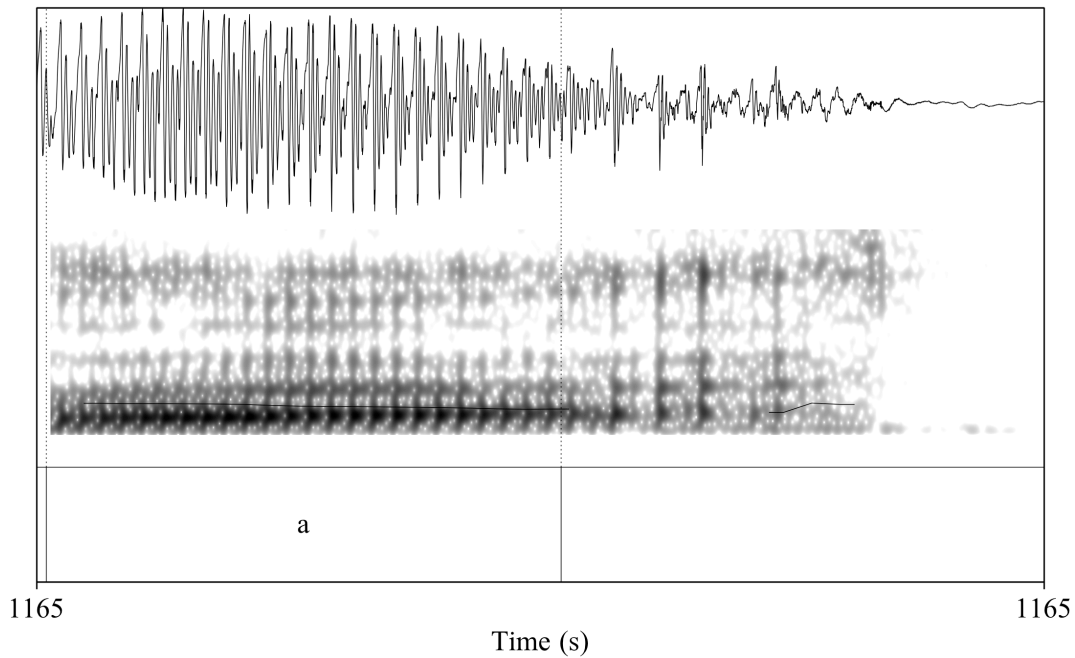


Figure 26. Singular [a] from *señorita* (Speaker V.m.1.01) with pitch track shown

In this section, I have provided the criteria used for segmentation of vowels, as well as for the transcription of the allophones of /s/, to be used in the analysis described below.

4.2. Segment labeling

After segmenting the vocalic boundaries, each token was coded for a variety of linguistic and social factors. Previous researchers have demonstrated that each of these factors may condition /s/ production in different dialects of Spanish, so I wanted to ensure that the possible effect of each could be tested in a future analysis. These predictors include: neighborhood of residence, age group, sex, speaker number, token number, preceding and following segment, preceding and following stress, number of syllables, grammatical function of the item, and type of redundancy (i.e. if the NP was part of a verbal subject, the verbal inflection would be a redundant marker of plurality), and word identity. The /s/ was also coded categorically as [s],

reduced [s] (as seen in Figure 27 below), [h], or [Ø]. This reduced [s] appeared most frequently preceding voiceless stops [p] and [t].

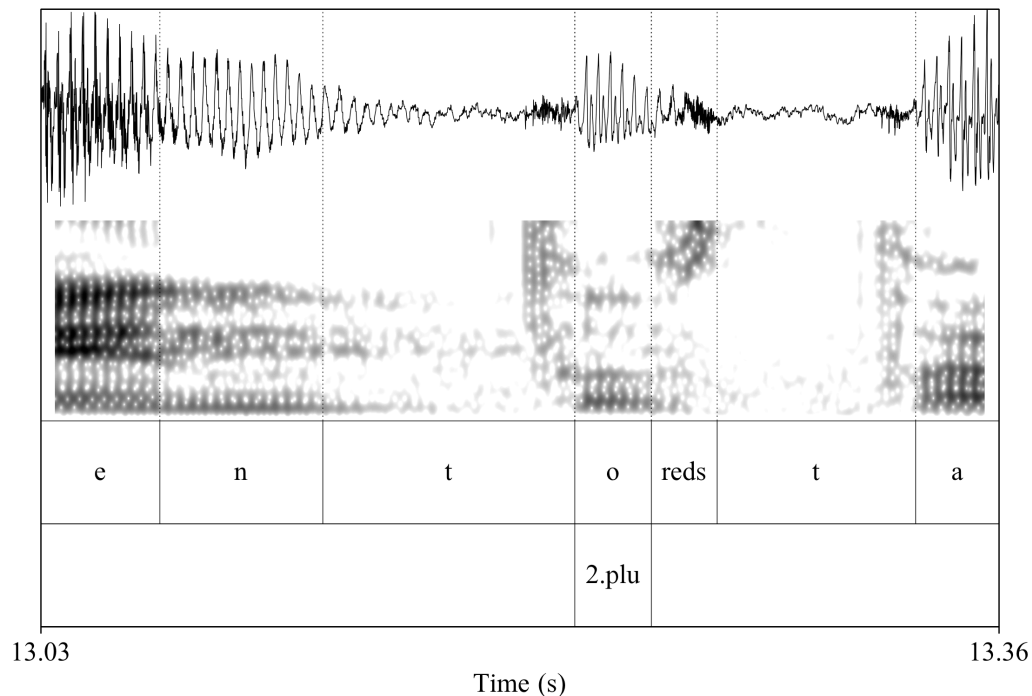


Figure 27. Reduced [s] segment preceding [t]; [entosta] from *eventos también* (Speaker V.f.2.02)

This [s] shows some high-frequency energy (the spectrogram’s y-axis runs from 0-7kHz) in the same zone as more canonical [s] sounds, but it is far shorter than a more typical [s] (~22 milliseconds). Though this shortening could be considered to be reduction or weakening of /s/, Farnetani and Recasens (2010) show that this [s] may be simply attenuated due to gestural overlap of the two alveolar sounds, and as this sound still maintains sibilant characteristics, I exclude vowels preceding this shortened [s] from the analysis below.

These /s/ categories are included in coding in order to evaluate an element of the hypotheses listed above: that vowels preceding a *deleted* /s/ are acoustically differentiated from singular vowels. For this reason, vowels preceding sibilant [s] (whether of a canonical duration

or this shortened version as in Figure 27 above) are excluded from the analysis below (N=140).

Figure 28 below shows the distribution of transcribed or perceived allophones of /s/.

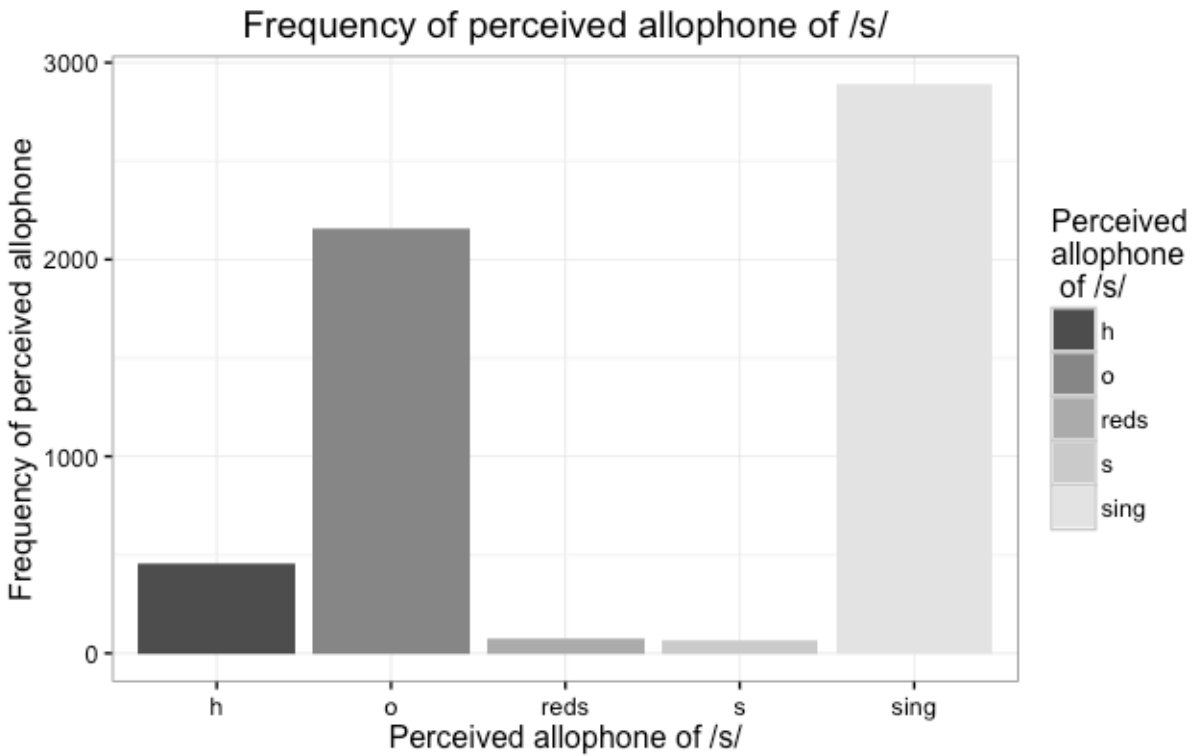


Figure 28. Frequency of perceived allophones of /s/

As can be observed from this figure, there were few sibilant [s] tokens, confirming a previous hypothesis that word-final /s/ weakening is highly characteristic of this dialect of Spanish. Again, in order to test the hypotheses set out in this dissertation (that speakers use strategies of vowel length, vowel height, and breathiness to mark distinctions between singular and plural vowels with a final /s/ weakened), I compare here these three continuous measures of underlyingly singular vs. underlyingly plural vowels with a final deleted /s/. I originally also included final vowels preceding an [h]-like segment, but later chose to include only vowels preceding completely deleted /s/ in order to test the hypotheses using a stricter dataset.

4.3. Acoustic analyses

Using a Praat script written by Adam Chong, *wav* files of vowels and their accompanying labeled TextGrids were extracted from the longer files and submitted to analysis via VoiceSauce (Shue 2010; Shue et al. 2011), an application within MatLab that also has a standalone program available for Windows operating systems. VoiceSauce can output many measures, but of interest for the present investigation are those of vowel duration, vowel height, and H1-H2. H1-H2, the amplitude of the first harmonic minus the amplitude of the second harmonic, is a correlate of the open quotient of the glottis, or the percentage of a glottal vibration cycle in which the glottis is open (Blankenship 2002). A higher H1-H2 measure corresponds with a more open glottis and a breathier phonation type, and this is generally considered to be the best measure of phonation (Keating et al. 2010; Esposito 2010). Figure 29 below shows a schematic of these measures and where they can be found in the spectra.

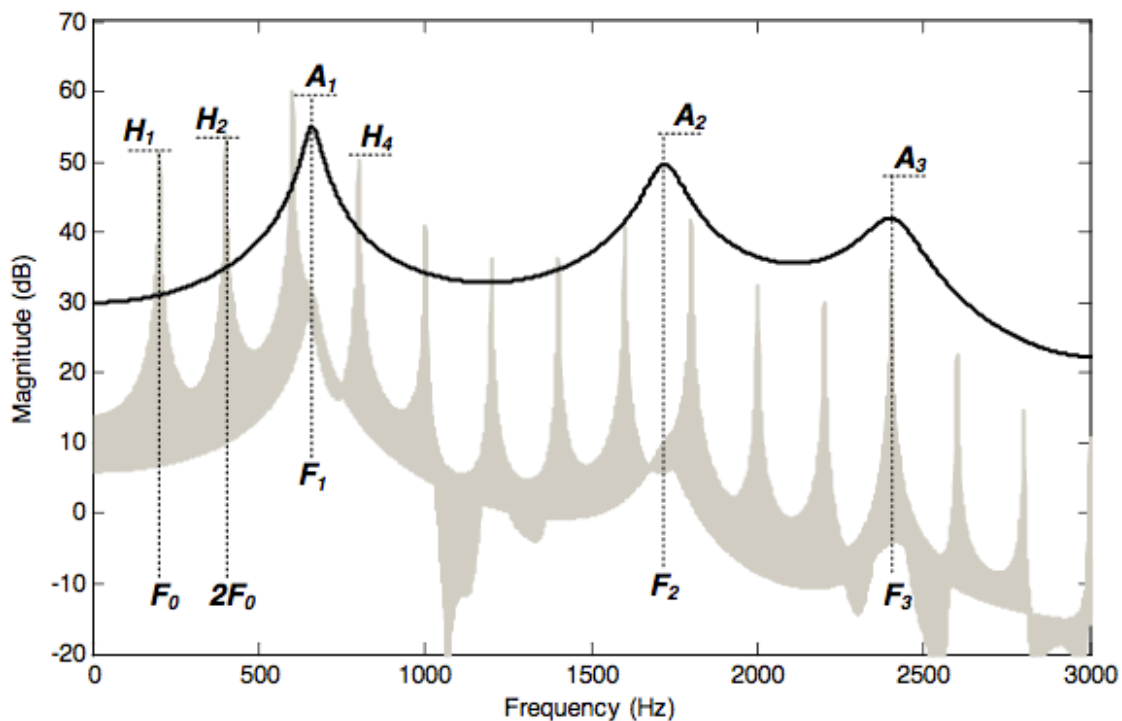


Figure 29. Magnitude spectrum of /ae/ vowel showing relevant measures of H1 and H2, from Shue (2010: 17)

VoiceSauce uses a function called STRAIGHT (Kawahara et al. 1999) to obtain fundamental frequency (F0) measures and Snack (Sjölander 2004) to estimate the frequencies and bandwidths of the first through the fourth formant, and these estimates are used to correct the harmonic amplitudes using the correction algorithm by Iseli et al. (2007). The corrected measures are denoted with an asterisk, so the remainder of this dissertation will use the standard notation of H1*-H2*. The output of the VoiceSauce measures may be ‘chunked’ into as many as 9 subsegments; using this option will average the data in each of 9 chunks using a certain amount of glottal periods. I chose to output the data in three chunks, so the data presented below represent the third of three chunks in order to examine duration, breathiness, and vowel quality strategies used by speakers across approximately the last third of the vowel. The original number of tokens submitted to VoiceSauce was 5713, including overt sibilant [s] tokens. From this original number, VoiceSauce was unable to process 75 files due to length of the files (that is, the files were too short for VoiceSauce to process). They are therefore excluded from the analysis, leaving 5638 tokens for analysis. Of these, VoiceSauce outputted zeros for 1205 tokens in the H1*-H2* category, so I inputted by hand each of these missing H1-H2 values by selecting the final third of each vowel in Praat, using the command “View Spectral Slice,” and manually inputting the values of the first harmonic (H1) and the second harmonic (H2) into Excel, then used a formula to find the value of H1-H2.

Additionally, in order to account for possible vocal tract size differences, male and female measures of duration, H1*-H2*, and F1 were scaled and centered using the scale function in the base R package. That is, I separated male and female data into separate files in R, then used the scale function to provide standardized z-scores for each of these measures. I then recombined the datasets using the rbind function. For each measure (H1*-H2*, F1, and

duration), outliers outside of 2 standard deviations were then excluded (N=272 for H1*-H2*, N=198 for F1, N=300 for duration). The total number of included observations following these exclusions is therefore N=4868. As mentioned above, I then wanted to ensure that I was examining the most stringent dataset possible, so I excluded a vowel before any overt allophone of /s/, leaving a total of 2499 singular tokens and 1846 plural vowel tokens before deleted /s/ (total N=4345). Table 5 below shows the original data for males and females of each of these measures.

Table 5. Original data prior to standardization

	Females		Males	
	Mean	Standard Deviation	Mean	Standard Deviation
Duration	82.9 msec	56.3	79.6 msec	52.7
H1-H2	6.91 dB	7.49	5.53 dB	6.73
F1	610 Hz	166	545 Hz	137

4.4. Results of production experiment

To answer the research questions about what strategies speakers use to distinguish between singular and plural vowels in this dialect of Spanish, I ran four generalized linear mixed-effects models (glmer) from the lme4 package (Bates et al. 2015) in RStudio (RStudio Team 2015). In each model, a random effect of participant was included, in which each participant contributed their own random intercept (Bates et al. 2015, 6). Each continuous acoustic measure was used in a separate analysis as the continuous outcome variable (H1*-H2*, F1, duration in utterance-medial position, and duration in utterance-final position) and the ‘singular vs. plural’ term was interacted with each categorical predictor (SES, age, and gender) to examine the effect of these social factors on differentiation of singular and plural words according to each acoustic measure.

4.4.1. Voice Quality ($H1^*-H2^*$)

Figure 30 below shows the differences between singular and plural word types by age and gender in the high SES group, and Figure 31 shows the same for the low SES group.

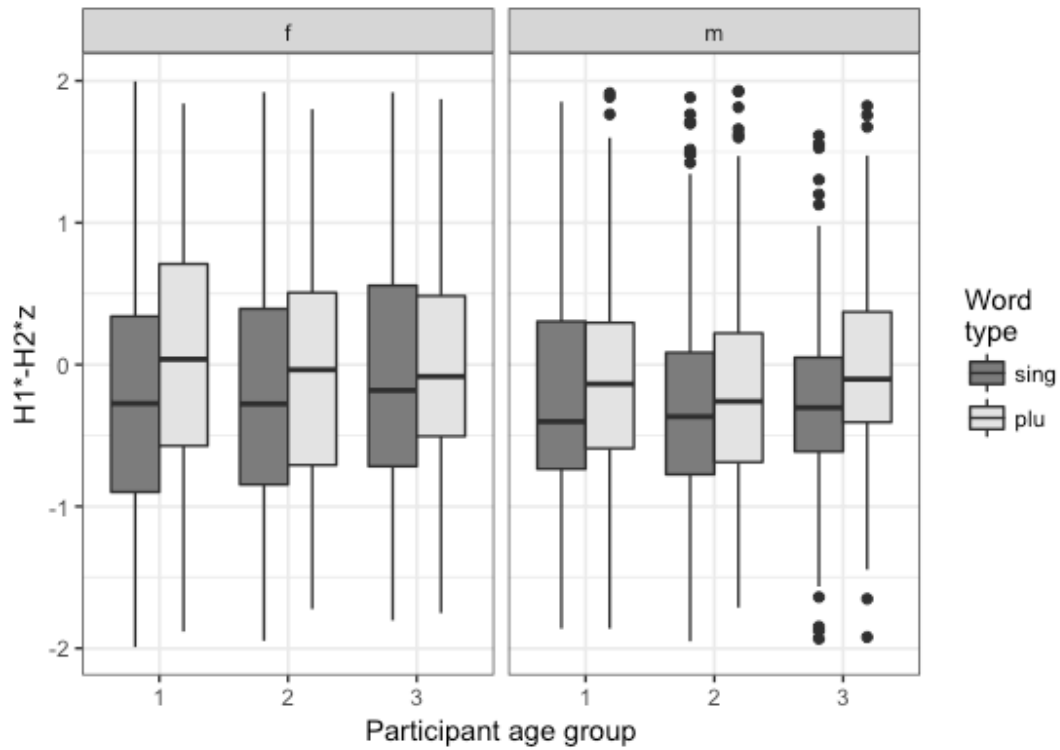


Figure 30. $H1^*-H2^*$ across ages and genders: High SES only

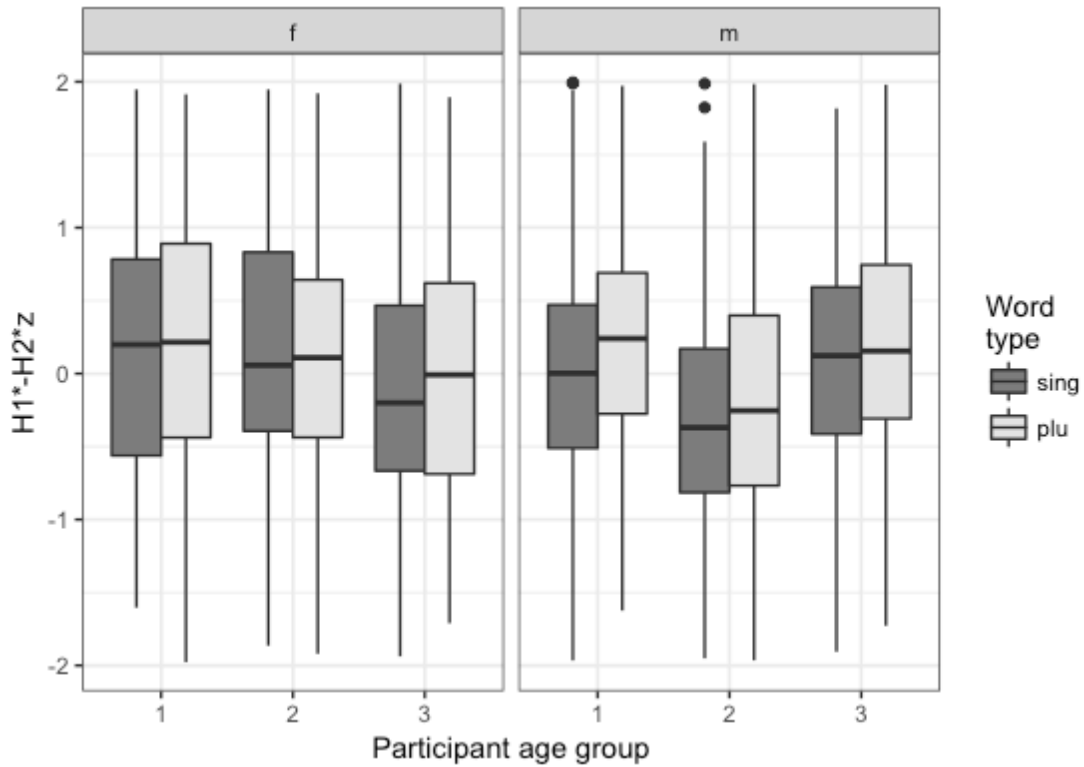


Figure 31. H1*-H2* by age and gender: Low SES only

In Example 9 below I show the R code used to run the first model taking standardized H1*-H2* as the continuous outcome variable.

```
Example 9. lineh1h2<-lme(fixed=h1h2z~
  singplu*age+
  singplu*ses+
  singplu*gender, random=~1 | part, data=proddatanoooutlierssingdel)
```

The results of this model are presented in Table 6 below.

Table 6. Results of linear regression taking H1*-H2* as continuous dependent variable

Linear regression: Effects of underlying plurality and social factors on vowel's H1*-H2*				
	β (coefficient)	Standard Error	<i>t</i> value	<i>p</i> value
Intercept	.06	.07	.79	.43
Singular or plural				
Singular	Ref	-	-	-
Plural	.12	.05	2.37	.02*
Age				
Young	Ref	-	-	-
Middle	-.05	.08	-.62	.54
Older	-.01	.08	-.14	.89
Participant SES				
Low	Ref	-	-	-
High	-.20	.07	-3.07	.00**
Gender				
Female	Ref	-	-	-
Male	-.07	.06	-1.07	.29
Interaction: Singular or plural by age				
Plural x Middle age	-.11	.06	-1.86	.06
Plural x Older age	-.05	.06	-.83	.41
Interaction: Singular or plural by SES				
Plural x High SES	.08	.05	1.61	.11
Interaction: Singular or plural by gender				
Plural x male	.05	.05	1.08	.28

Since singular vs. plural is interacted with the three categorical predictors of age, SES, and gender, the effect above for ‘Singular vs. Plural’ shows the effect for H1*-H2* for the reference group of the young, low SES, and female participants (the LP.f.1 group). That is, this demographic group uses H1*-H2* to differentiate between singular and plural vowels, producing plural vowels as breathier than singular vowels ($p < .05$). Given that this model only accounts for the reference level of each categorical variable (i.e. young, female speakers in the lower SES group), I then performed a simple effects analysis as described in Bretz et al. (2011: 108–11) using the multcomp package (Hothorn et al. 2008) to determine whether any of the other demographic groups uses breathiness to mark plurality. I performed a total of 11 separate

comparisons for each of the remaining demographic groups (2 levels of SES, 2 genders, and 3 age groups; $2 \times 2 \times 3 = 12$ total). For instance, in Example 10 below, I show the R code used to find the main effect of H1*-H2* for Singular vs. Plural when the reference group is high SES, older, male participants (or, the V.m.3 group).

```
Example 10. vm3line<-glht(lineh1h2,
  linfct=c("singpluplu+singpluplu:sesv+singpluplu:age3+singpluplu:genderm=00"))
```

As the outcome of this function shows ($\beta = .20$, St. E. = .05, $p < .001$), older male speakers in the high SES neighborhood produce their plural vowels with a higher measure of H1*-H2*. That is, older male speakers' plural vowels have a significantly higher H1*-H2* value, or in other words, are breathier. This is the same coefficient, standard error, and p -value given in the model below, which is the original model (lineh1h2) relevelled to the reference values of High SES, male, and Older age group. This can be seen in the R code in Example 11 and Table 7 below.

```
Example 11. lineh1h2vm3<-lme(fixed=h1h2z~
  singplu*relevel(age, '3')+
  singplu*relevel(ses, 'v')+
  singplu*relevel(gender, 'm'), random=~1 | part, data=proddatanoooutlierssingdel)
```

Table 7. Results of linear regression taking H1*-H2* as continuous dependent variable with alternate reference values (high SES, age=3, gender=male)

Linear regression: Effects of underlying plurality and social factors on vowel's H1*-H2*				
	β (coefficient)	Standard Error	<i>t</i> value	<i>p</i> value
Intercept	-.23	.07	-3.10	.01**
Singular or plural				
Singular	Ref	-	-	-
Plural	.20	.05	3.91	.00***
Age				
Older	Ref	-	-	-
Young	.01	.08	.14	.89
Middle	-.04	.08	-.48	.63
Participant SES				
High	Ref	-	-	-
Low	.20	.07	3.04	.01**
Gender				
Male	Ref	-	-	-
Female	.07	.07	1.07	.29
Interaction: Singular or plural by age				
Plural x Young age	.05	.06	.83	.41
Plural x Middle age	-.06	.06	-1.09	.27
Interaction: Singular or plural by SES				
Plural x Low SES	-.08	.05	-1.61	.11
Interaction: Singular or plural by gender				
Plural x female	-.05	.05	-1.08	.28

That is, according to this model, older, male speakers in the higher SES group produce their singular and plural vowels differently. Specifically, this model shows that an increase in H1*-H2* (according to the positive coefficient) is associated with plural outcomes ($p < .001$). Put another way, plural vowels are predicted to be approximately .25 standard deviations of H1*-H2* higher than singular vowels for older male speakers in the high SES neighborhood. Table 8 below shows the main effects of H1*-H2* for the singular~plural predictor for each demographic group.

Table 8. Main effects for singular vs. plural in H1*-H2* model

Main effects for singular vs. plural, H1*-H2* model			
Group	B	St.E	p value
LP.f.1	0.13	.05	.02*
LP.f.2	0.01	.05	.81
LP.f.3	0.08	.05	.14
LP.m.1	0.18	.05	.01**
LP.m.2	0.06	.05	.22
LP.m.3	0.13	.05	.02*
V.f.1	0.20	.05	.01**
V.f.2	0.09	.05	.10
V.f.3	0.15	.05	.01**
V.m.1	0.25	.06	.00***
V.m.2	0.14	.05	.01**
V.m.3	0.20	.05	.00***

From these effects, we can observe that most members of the professional class use breathier plural vowels, and that young males in this high SES group use breathiness to the greatest degree (as evidenced by the large coefficient associated with this group's H1*-H2* use). Older and younger males in the working class also use breathier plural vowels, as do younger females in this low SES group.

4.4.2. Vowel quality (F1)

We now turn to the second continuous acoustic measure of interest, or F1. Figure 32 and Figure 33 below show the differences in standardized F1 according to age and gender of speakers.

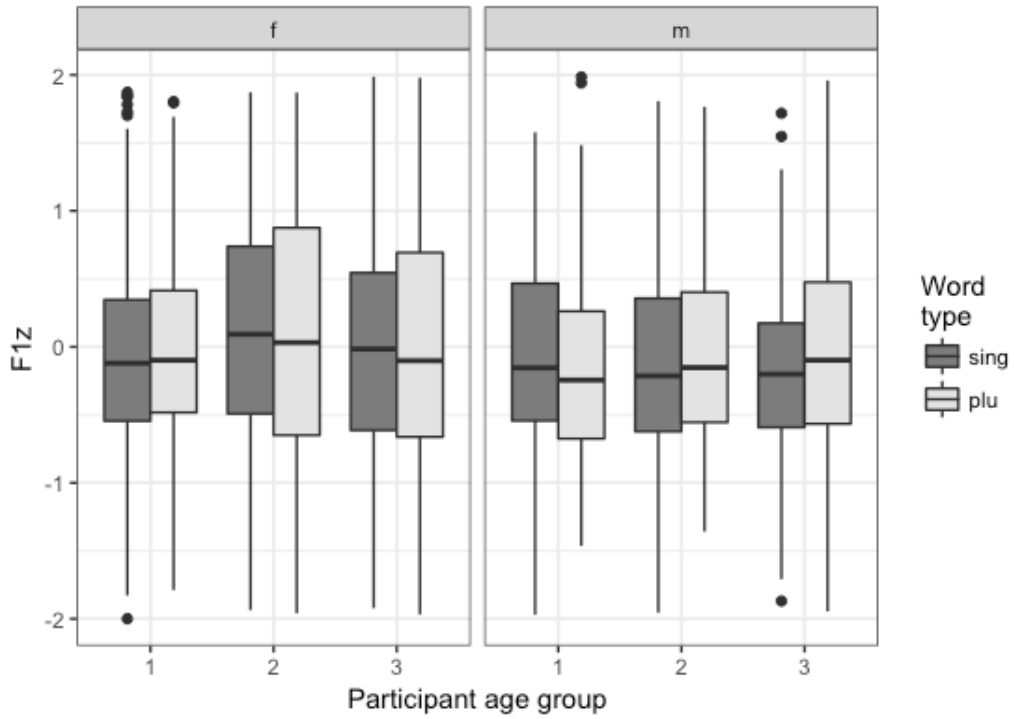


Figure 32. Standardized F1 by age and gender: High SES only

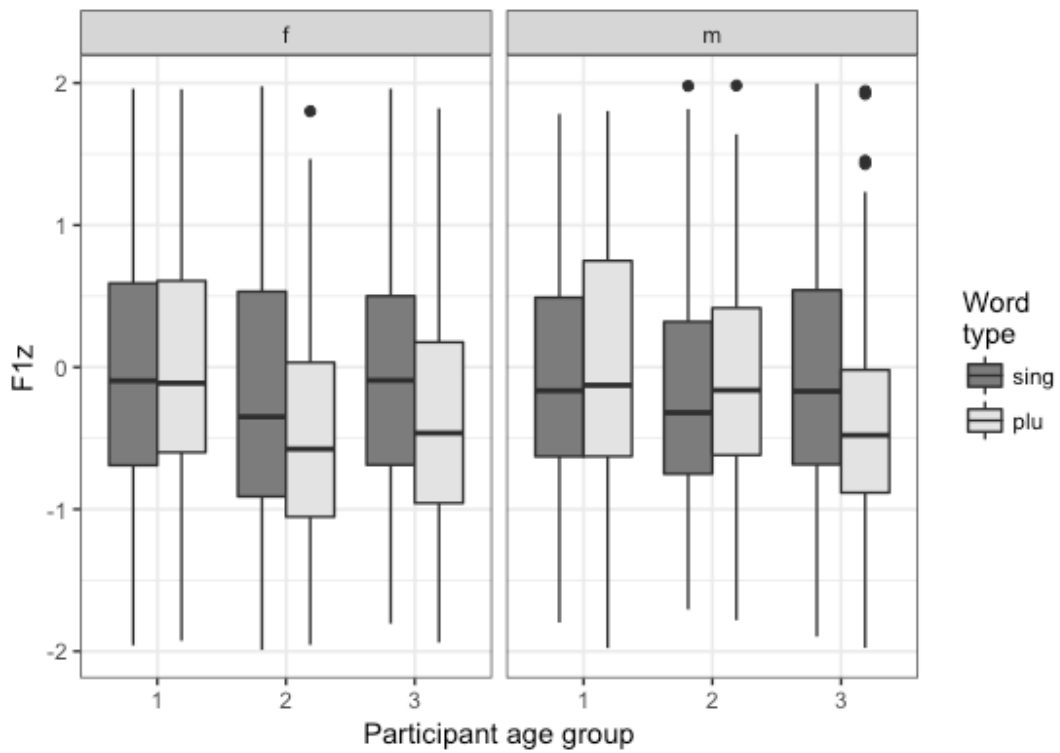


Figure 33. Standardized F1 by age and gender: Low SES only

As mentioned, the hypothesis predicts that plural vowels will be lowered, or produced with a higher F1. The model below in Example 12 and its output in Table 9 below enable us to verify this hypothesis.

```
Example 12. linef1<-lme(fixed=f1z~
singplu*age+
singplu*ses+
singplu*gender, random=~1 | part, data=proddatanoooutlierssingdel)
```

Table 9. Results of linear regression taking F1 as continuous dependent variable

Linear regression: Effects of underlying plurality and social factors on vowel's F1				
	β (coefficient)	Standard Error	<i>t</i> value	<i>p</i> value
Intercept	-.04	.07	-.59	.56
Singular or plural				
Singular	Ref	-	-	-
Plural	-.08	.05	-1.42	.16
Age				
Young	Ref	-	-	-
Middle	-.07	.08	-.89	.38
Older	-.03	.08	-.42	.68
Participant SES				
Low	Ref	-	-	-
High	.06	.06	.99	.33
Gender				
Female	Ref	-	-	-
Male	-.07	.06	-1.15	.26
Interaction: Singular or plural by age				
Plural x Middle age	-.06	.06	-1.05	.29
Plural x Older age	-.16	.06	-2.70	.01**
Interaction: Singular or plural by SES				
Plural x High SES	.15	.05	3.12	.01**
Interaction: Singular or plural by gender				
Plural x male	.09	.05	1.91	.06

This model shows that young, low SES females do not differentiate their singular and plural vowels by using F1 differences. I followed a similar procedure as that delineated above using the `glht` function to conduct a simple main effects analysis, or determine whether any other

demographic group used vowel lowering as a strategy to mark plural vowels, and a summary of the main effects is presented in Table 10 below.

Table 10. Main effects of singular~plural on F1

Group	Main effects for singular vs. plural, F1 model		
	β	St.E	p value
LP.f.1	-0.08	.05	.16
LP.f.2	-0.14	.06	.01*
LP.f.3	-0.24	.05	.00***
LP.m.1	0.02	.05	.76
LP.m.2	-0.05	.05	.38
LP.m.3	-0.14	.05	.01**
V.f.1	0.08	.06	.18
V.f.2	0.01	.06	.83
V.f.3	-0.08	.05	.11
V.m.1	0.17	.06	.00**
V.m.2	0.10	.05	.06
V.m.3	0.01	.05	.88

According to this simple main effects analysis, middle age group and older females as well as older males in the low SES group actually *lower* their F1 value, or raise their vowels, when they are producing a plural vowel, in the opposite direction of the prediction. Young females and young and middle-age group males, on the other hand, do not use vowel height differences to mark a distinction between singular and plural vowels.

In the high SES group, young males significantly lower their plural vowels, but no other members of the high SES use this strategy. That is, this is the only demographic group to use final vowel lowering (the hypothesized strategy in the hypothesized direction) to mark plural vowels to a significant degree.

4.4.3. Duration

According to the hypothesis to be tested, plural vowels are expected to have longer durations than singular vowels. However, we also expect utterance-final vowels to be significantly longer

due to domain-final lengthening (Klatt 1976; Wightman et al. 1992; Campbell and Isard 1991). Therefore, I separated the dataset into two smaller groups, according to the vowel's position in the utterance, in order to account for any potential differences due exclusively to prosodic position rather than plurality.

4.4.3.1. Duration: Utterance-medial position

I first performed an analysis of utterance-medial vowels (N=3030) using the same configuration of predictors as above. Figure 34 shows the standardized durations of singular and plural words according to speaker age and gender in the high SES group, while Figure 35 shows the same configuration for the low SES group.

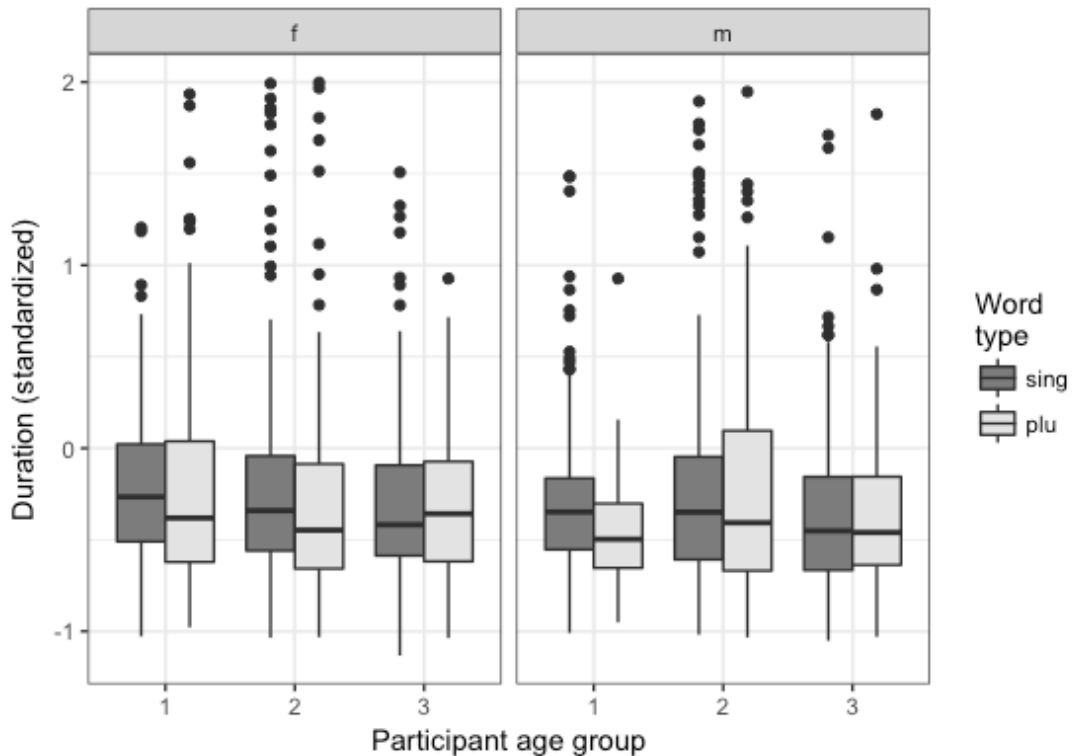


Figure 34. Standardized duration by speaker age and gender: High SES, utterance-medial position

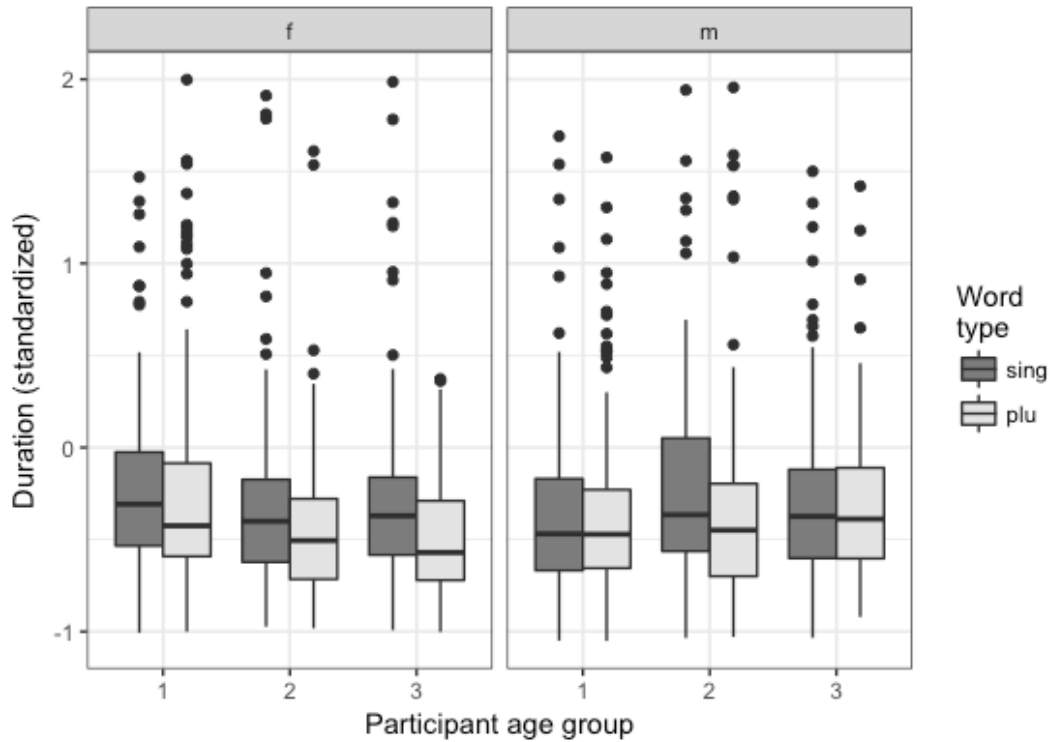


Figure 35. Standardized duration by speaker age and gender: Low SES, utterance-medial position

In Example 13 below I show the model used to examine duration of utterance-medial items and whether this varies according to whether the vowel is singular or plural, interacted with the social predictors.

```
Example 13. durmed<-lme(fixed=durz~
singplu*age+
singplu*ses+
singplu*gender, random=~1 | part, data=medialonly)
```

Table 11 below shows the results of this model.

Table 11. Results of linear regression taking duration as continuous dependent variable (utterance-medial position only)

	Linear regression: Effects of underlying plurality and social factors on vowel's duration (Utterance-medial position only)			
	β (coefficient)	Standard Error	<i>t</i> value	<i>p</i> value
Intercept	-.27	.04	-5.96	.00***
Singular or plural				
Singular	Ref	-	-	-
Plural	-.05	.04	-1.30	.19
Age				
Young	Ref	-	-	-
Middle	.04	.05	.79	.43
Older	-.06	.05	-1.24	.22
Participant SES				
Low	Ref	-	-	-
High	.04	.04	1.05	.30
Gender				
Female	Ref	-	-	-
Male	-.03	.04	-.66	.51
Interaction: Singular or plural by age				
Plural x Middle age	-.07	.05	-1.65	.10
Plural x Older age	-.02	.04	-.47	.64
Interaction: Singular or plural by SES				
Plural x High SES	.03	.04	.75	.45
Interaction: Singular or plural by gender				
Plural x male	.01	.04	.35	.73

In Table 12 below, I present the results of the simple effects analysis for this model, examining the main effect of singular~plural by demographic group.

Table 12. Main effects of singular~plural on utterance-medial vowel duration

	Main effects for singular vs. plural, utterance-medial duration model		
	B	St.E.	p value
LP.f.1	-0.05	.04	.19
LP.f.2	-0.13	.04	.01**
LP.f.3	-0.07	.04	.07
LP.m.1	-0.04	.04	.34
LP.m.2	-0.11	.04	.01**
LP.m.3	-0.06	.04	.14
V.f.1	-0.02	.04	.55
V.f.2	-0.10	.04	.02*
V.f.3	-0.05	.04	.27
V.m.1	-0.01	.04	.79
V.m.2	-0.08	.04	.03*
V.m.3	-0.03	.04	.43

As the results demonstrate, only the middle age groups are more likely to use duration to differentiate singular and plural vowels, but the result is in the opposite direction than predicted. That is, these middle age group speakers reduce the duration of a plural vowel in utterance-medial position. This is the opposite direction from the prediction for duration, though previous hypotheses did not overtly incorporate prosodic position. Interestingly, use of vowel shortening occurs across both SES groups and both genders.

4.4.3.2. Duration: Utterance-final position

Finally, I performed an analysis of the utterance-final vowels (N=1315), expecting plural vowels to be significantly longer than singular vowels. In Figure 36 I show the standardized utterance-final durations according to age and gender in the high SES group, and in Figure 37 I show the same for the low SES group.

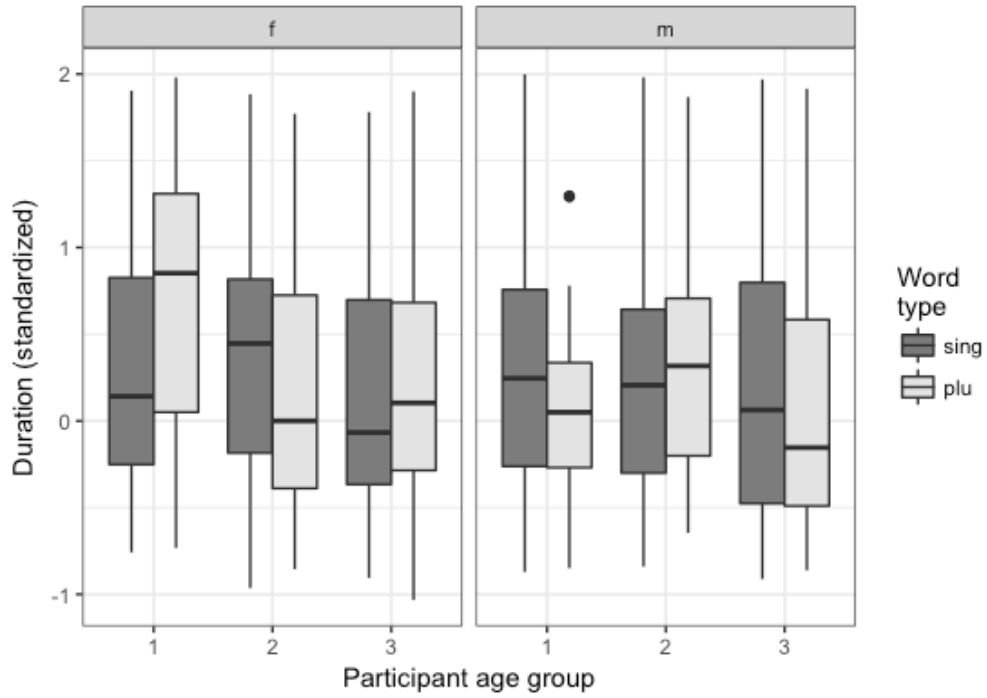


Figure 36. Standardized duration by speaker age and gender: High SES, utterance-final position

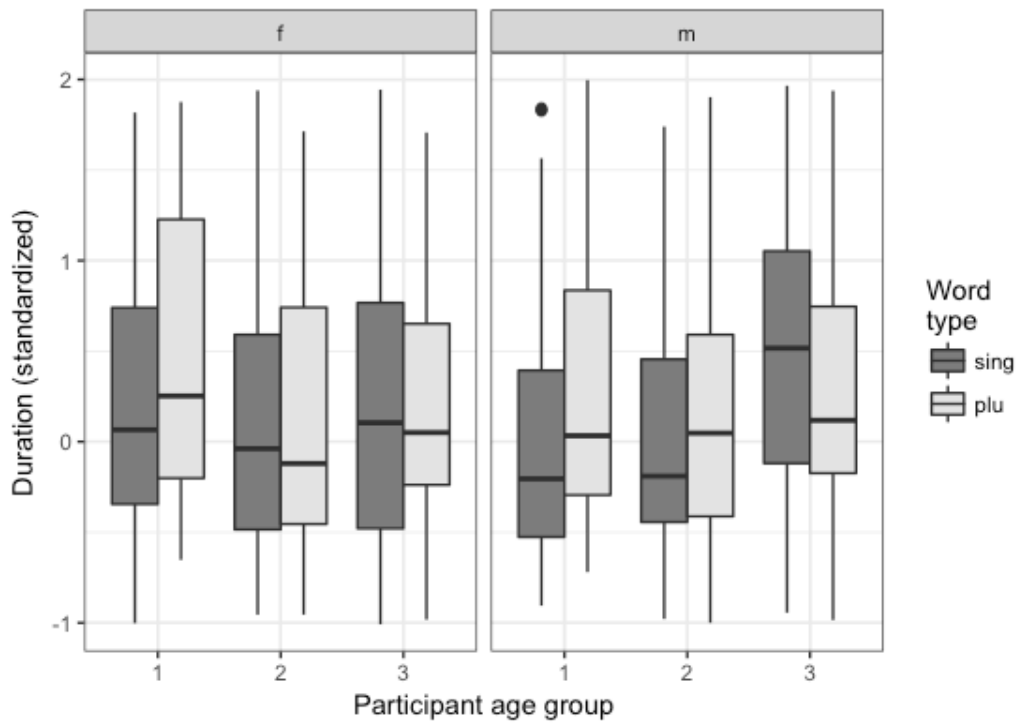


Figure 37. Standardized duration by speaker age and gender: Low SES, utterance-final position

Table 13 below shows the results of this model.

Table 13. Results of linear regression taking duration in utterance-final position as continuous dependent variable

Linear regression: Effects of underlying plurality and social factors on vowel's duration (Utterance-final position only)				
	β (coefficient)	Standard Error	<i>t</i> value	<i>p</i> value
Intercept	.17	.06	2.27	.02*
Singular or plural				
Singular	Ref	-	-	-
Plural	.25	.09	2.65	.01**
Age				
Young	Ref	-	-	-
Middle	-.04	.08	-.52	.61
Older	.06	.08	.76	.45
Participant SES				
Low	Ref	-	-	-
High	.11	.07	1.55	.13
Gender				
Female	Ref	-	-	-
Male	-.02	.07	-.26	.80
Interaction: Singular or plural by age				
Plural x Middle age	-.16	.11	-1.48	.14
Plural x Older age	-.22	.10	-2.24	.03*
Interaction: Singular or plural by SES				
Plural x High SES	-.09	.08	-1.11	.27
Interaction: Singular or plural by gender				
Plural x male	-.07	.08	-.90	.37

I then performed a simple effects analysis to examine whether any of the demographic groups (in addition to the young female low SES reference group shown here) used final vowel lengthening as a strategy to differentiate between singular and plural vowels. The results of this analysis are presented in Table 14 below.

Table 14. Main effects of singular~plural on utterance-final vowel duration

Main effects for singular vs. plural, utterance-final duration model			
	B	St.E.	p value
LP.f.1	0.25	.09	.01**
LP.f.2	0.09	.09	.33
LP.f.3	0.02	.09	.80
LP.m.1	0.17	.09	.07
LP.m.2	0.02	.09	.87
LP.m.3	-0.05	.08	.54
V.f.1	0.16	.10	.12
V.f.2	-0.00	.10	.98
V.f.3	-0.07	.09	.44
V.m.1	0.08	.10	.41
V.m.2	-0.08	.09	.42
V.m.3	-0.14	.09	.09

According to the simple effects analysis, only one demographic group uses final vowel lengthening to mark plural vowels: young females in the low SES group. Young males in the low SES group and young females in the high SES group also lengthened their utterance-final plural vowels, though these differences are only trending toward significance. All other speakers produce their utterance-final vowels as equally long or short whether they are underlyingly singular or underlyingly plural.

4.4.4. Summary of results of continuous measures

Table 15 below shows a summarized version of each of the findings presented here for the four continuous measures, including the directions predicted by the hypotheses under examination. Bold and italicized findings in the results symbolize results in the *unexpected* direction.

Table 15. Summary of significant results, including predicted differences and directions

Demographic group	H1*-H2*	F1	Duration	
			Utterance-medial	Utterance-final
Predicted difference	Plurals breathier (higher H1*-H2*)	Plurals lower (higher F1)	Plurals longer	Plurals longer
Young working class females (LP.f.1)	Plurals significantly breathier ($p<.05$)			Plurals significantly longer ($p<.05$)
Middle working class females (LP.f.2)		Plurals significantly higher (lower F1) ($p<.01$)	Plurals significantly shorter ($p<.001$)	
Older working class females (LP.f.3)		Plurals significantly higher (lower F1) ($p<.01$)		
Young working class males (LP.m.1)	Plurals significantly breathier ($p<.05$)			
Middle working class males (LP.m.2)			Plurals significantly shorter ($p<.001$)	
Older working class males (LP.m.3)	Plurals significantly breathier ($p<.05$)	Plurals significantly higher (lower F1) ($p<.01$)		
Young professional class females (V.f.1)	Plurals significantly breathier ($p<.05$)			
Middle professional class females (V.f.2)			Plurals significantly shorter ($p<.001$)	
Older professional class females (V.f.3)	Plurals significantly breathier ($p<.05$)			
Young professional class males (V.m.1)	Plurals significantly breathier ($p<.001$)	Plurals significantly lower (higher F1, $p<.001$)		
Middle professional class males (V.m.2)	Plurals significantly breathier ($p<.01$)		Plurals significantly shorter ($p<.001$)	
Older professional class males (V.m.3)	Plurals significantly breathier ($p<.001$)			

As can be observed in the table above, each group of speakers uses a unique configuration of strategies to differentiate between singular and plural vowels. The number of cues used by each group can be visualized in Figure 38 below.

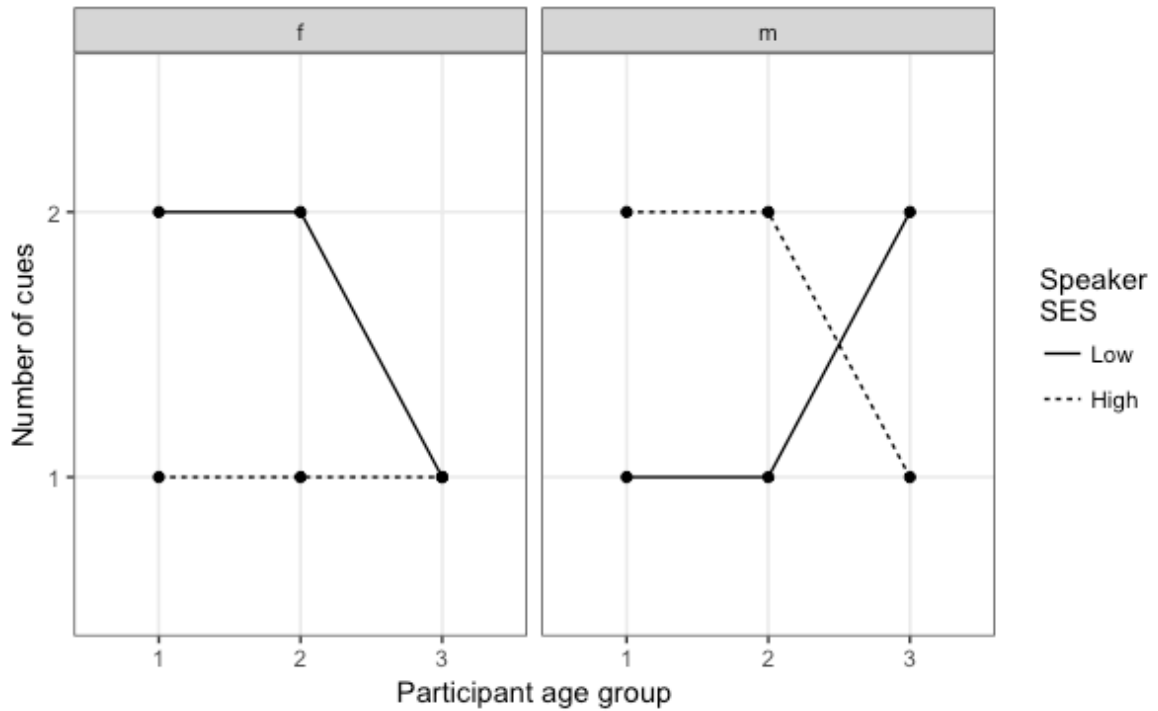


Figure 38. Number of cues used by age group, SES, and gender

As evidenced by this figure, the number of cues used by speakers varies by gender and SES group. For instance, young females in the low SES group use more cues than their older counterparts, while females in the high SES use only one cue to differentiate singular and plural words across all age groups. An opposing pattern is used among male speakers. Specifically, young males in the low SES group use fewer cues than their older counterparts, while young males in the high SES group use more cues than their older counterparts.

4.5. Discussion

In this section, I discuss some possible interpretations for the findings above according to each continuous predictor tested. Following the structure above, I first begin with breathiness, as measured by H1*-H2*, then explore the F1 measure, and then discuss durational indicators of plurality.

4.5.1. Breathiness

As shown, nearly all members of the higher SES group use significantly breathier plural vowels than singular vowels. Only the middle age group females (the V.f.2 group) do not use this strategy to a significant degree, though they are trending in the breathier plural direction ($p=.07$). This association of breathiness with the high SES group leads me to posit that using breathy voiced plural vowels is associated with some measure of prestige. Guy (1989) reminds us that social class is involved in the study of language change “because of the long-recognized link between social change and linguistic change” (39), and that many linguistic innovations have been shown to have originated in a particular social class and to have spread throughout society along particular and predictable social lines (39).

Additionally, previous work on /s/ weakening in Chilean Spanish has revealed that ‘aspiration’ or breathy voice has been associated with higher SES groups (Cepeda 1990b, 1990a; Tassara Chávez 1991; Valdivieso and Magaña 1988, 1991). As mentioned, these studies did not examine /s/ production among other socioeconomic strata, and examined /s/ production in both word-medial and word-final contexts, and examined all types of coda /s/-- that is, monomorphemic /s/ as in /mjerkoles/ <miércoles> ‘Wednesday,’ in addition to verbal and nominal inflectional /s/. However, the association of a breathier, aspirated-type voice with high SES speakers in the early 1990s, as well as its distribution in the present study, lends support to

the assumption that breathiness is a prestigious feature, one that has seemingly come to be associated with plurality for the high SES speakers.

If we assume that plural breathiness is indexed with high SES speakers, we then have to account for its presence and distribution patterns in the low SES neighborhood. As the results have shown, young males and females in the working-class neighborhood use breathy plural vowels, as do older males. Its use by younger speakers might suggest that these younger speakers are adopting the use of breathy voice to mark plurality. However, traditional conceptions of change from above (as posited by Labov 1990 and Trudgill 1972) would suggest that linguistically conservative, status-conscious women would lead the adaptation of the characteristic associated with a higher status. In order to understand, then, why both young women and men (and for that matter, older men) would use this particular cue to differentiate plural vowels from singular ones, it is necessary to adopt a less binary or clustered view of these speakers. That is, as Docherty and Mendoza-Denton (2012) suggest, instead of conceiving of these speakers as bundles of characteristics, it is necessary to delve deeper into the social construction of these neighborhoods to understand both the spread of variation and what this spread means to the speakers who are adopting it (52). Generally, male speakers in the low SES community have more social mobility and access outside the community than do the females. For instance, of the 15 male participants in this neighborhood, 7 of them (3 younger, 3 middle, 2 older) have consistent contact with members outside the community, and 5 of these work or have contacts specifically in the high SES communities of northeastern Santiago. In contrast, of the 15 female speakers, only 3 (1 younger, 1 middle, 1 older) of them have consistent contact with members outside the community. The remainder do have close networks within the community, though this could also be a correlate of the recruitment used through the two community centers

in the neighborhood. These patterns of contact between the SES groups could explain the males' use of the breathy plural cue. To explain the young females' use of the breathy cue, I posit that they may be affiliating (unconsciously, perhaps) with the male breathiness in their community, or adopting the characteristics of the high SES young people that spend time in the low SES community. Through the sociolinguistic interviews, I learned that several of the high SES young females do volunteer work in the low SES community, explaining possible degrees of contact between these speakers (or speakers like them) in the two disparate communities. Conceiving of variation in this manner allows individuals to present their own identities, aligning themselves in this case with a phonetic variant that is indexed to high SES speakers.

A final word on the finding that plural vowels are likely to be breathier among members of the high SES group. Another measure that might be used to compare singular and plural vowels, particularly in utterance-final position, may be vowel devoicing. Devoicing domain-finally is extremely common cross-linguistically, and as Barnes (2006) states, “[devoiced final vowels] often [figure] in descriptions as the addition of aspiration, or the epenthesis of final /h/” (116). That is, many linguists interpret devoicing on a domain-final vowel as the insertion of an [h]-like segment, which we see in descriptions of Spanish, and even the term ‘aspiration’ used. According to Barnes, final vowel devoicing is assumed to have its roots in the steep drop in subglottal pressure associated with the end of phrases or utterances along with final lowering of F0 (Gordon 1998). Therefore, in addition to breathiness, devoicing may be a useful metric of differentiation between singular and plural words in future studies.

4.5.2. F1 (first formant): vowel height

Above, I demonstrated that only young male speakers in the high SES group use vowel lowering to signal plurality (though the middle-age group males are trending toward plural

lowering; $p=.051$). However, older and middle-age group male and female speakers in the low SES group use the opposite cue: plural vowel *raising*.

There are several possible explanations for this difference. First, if in fact the impressionistic hypotheses regarding final vowel plural lowering were correct, and the low SES speakers use the opposite direction of this cue to signal plurality, this may be a case of flip-flop ((Labov, Yaeger, & Steiner 1972; Labov 1994:143; Di Paolo 1992:281; Hall-Lew 2013). That is, as Hall-Lew (2013) defines, flip flop consists of a merger-in-progress going *farther than expected*, in which “the merging vowels appear to move past the point of coalescence in at least one phonetic dimension; difference is maintained but the vowel quality is opposite to the historical pattern on one or both dimensions” (359). This, of course, relies on the premise that this vowel alternation (at least along this F1 dimension) is a merger in progress. Additionally, the previous findings of flip-flop tend to be among isolated speakers (for instance, one or two speakers out of a sample of 30 or so), while the users of F1 raising are consistently entire demographic groups. However, the lack of use of F1 raising (or lowering) among the young male and female speakers in the low SES group would point to loss of distinction between singular and plural vowels through the use of any variation in F1, or merging these vowels along this dimension.

Another possible explanation for the variation we find in the use of the F1 cue is the presence of unstressed vowel raising among many of the older speakers, both male and female, in the low SES group. Several of these speakers tend to use verbs such as *hacimos* [asimos] for /asemos/, or *tenimos* [tenimos] for /tenemos/, or the gerund *lluviendo* [juβjendo] for /jobjendo/. This leads me to assume that perhaps there is an element of raising among these older low SES speakers that has acquired some differentiating meaning between the singular~plural contrast.

Again, however, this vowel raising was not attested as frequently among young speakers in the low SES group, leading me to posit that this vowel raising is losing ground over time, causing singular and plural vowels lack a contrast along this dimension.

Finally, the use of vowel lowering by younger (and to some degree middle-age group) high SES group males aligns with traditional assessments of change in progress (which we assume since it is the *younger* speakers using this cue). Labov (1994, 2001:261-293) argues that women tend to use standard variants more than men when a change is in progress that is above the level of consciousness. I posit that this is indeed a change in progress, given its use by younger males, but that it is not above the level of consciousness. That is, no participants made any metalinguistic commentary related to plural vowel lowering, and as yet we do not know whether it is a salient cue for listeners. Therefore, this finding aligns with previous work that demonstrates that men can be leaders of change in progress, too.

There is one limitation that bears mentioning regarding this cue. Specifically, the normalization method I used consisted of normalizing all /a, e, o/ vowels within sex groups. However, more traditional vowel norming methods, such as the Nearey method (Nearey 1977), require the entire vowel system to be included to yield a normalized vowel space calculation for each speaker. Since final singular and plural /i/ and /u/ were not included in this dataset and exist infrequently given the phonotactics of Spanish, this normalization technique would be impossible. However, given the curious findings and shifting of this cue in multiple directions, I plan to tease apart the findings for this cue in future studies.

4.5.3. Duration: Utterance-medial position

Plural shortening was used in utterance-medial position by each of the middle age groups, across SES groups and across genders. Utterance-medial shortening, rather than lengthening, is

not entirely surprising given that phonologically, these are still nuclei vowels of closed syllables (i.e. they have an underlying coda consonant), and we expect vowels in open syllables to be longer than vowels in closed syllables (Lehiste 1970). However, its distribution pattern is curious.

Specifically, this curvilinear pattern shows a regular association of a variant with a particular life stage. This distribution pattern is defined as age grading (Wagner 2012:371). That is, there is a sense of individual variation (particularly among the middle-age groups) associated with either community stability or long-term linguistic change (Sankoff and Blondeau 2007). For many of these 25-41 year olds, the particular life stage in which they may find themselves is in the workplace, where standard (more conservative) language has been shown to be the norm (Eckert 1996:164). Indeed, Labov (1966), Wolfram (1969), and Trudgill (1974) have shown that working adults have been shown to use more conservative speech than their younger counterparts, and this conservatism (as described by Eckert 1996) has been attributed to the pressure for use of standard language in the workplace, as shown by Sankoff and Laberge (1978). Further examination of this particular dimension of singular and plural contrast will be required in order to determine whether these middle age group speakers, as they age, return to the non-differentiating use of utterance-medial duration.

4.5.4. Duration: Utterance-final position

As demonstrated above, the only demographic group utilizing utterance-final vowel lengthening to mark plurality are the young females in the low SES group. Interestingly, younger males in the low SES group also trend toward use of this strategy, as do young females in the high SES group. Use of this cue among the females in the low SES group, according to traditional variationist theory, causes me to posit that this is a change in progress from below the

level of consciousness. In essence, these young females are exploiting already lengthened utterance-final vowels to mark a difference on singular and plural vowels. The question of why young females would lead the way in changes in progress is one that has been intriguing variationists for decades. Indeed, Labov (2001:516) asserts that working or lower middle class women tend to lead linguistic changes due to their “particular ability to confront established norms and the motivation to defy them.” Chappell (2016) argues that the probability that women will adopt or not an innovative variant is dependent upon the prestige or status indexed with that particular variant. Specifically, she claims that men have access to more indices associated with positive characteristics related to the production of nonstandard [z] for intervocalic /s/ in Costa Rican Spanish. Conversely, the meanings that are indexed with [z] use by women incur a social cost, as intervocalic [z] for women is associated with characteristics of lack of education and low-class. That is, she concludes, that women use this variant less because they stand to gain very little socially from its production (2016:371). As of yet, there does not exist a clear affiliation or alignment of plural final vowel lengthening with degrees of prestige or status in the Santiago dialect of Spanish, disallowing a similar analysis of final plural lengthening by these young females. Providing a similar but alternate approach, Eckert (1990) claims that young women are just finding out through their increasing exposure to societal norms that they have less power than men in their same demographic, and that, “deprived of power, women must satisfy themselves with status” (256). In Eckert’s data, the most extreme users of phonological variables “are those who have to do the greatest amount of symbolic work to affirm their membership in groups or communities” (259). Therefore, language (perhaps in this case of final plural vowel lengthening) may become a tool used by young women to demonstrate creativity, status, and independence.

4.6. Multiple cues, multiple directions

In the previous section, I posited that in essence, each cue examined in this dissertation associated with plurality has a different distribution and variation pattern, and that some of this variation appears to be stable (such as utterance-medial shortening of plural vowels), and some may consist of a change in progress from above (plural breathiness), or below (utterance-final lengthening, loss of vowel height distinction).

Evidence for multi-directional shifts in gestures and cues marking phonological contrasts have been found in several languages. For instance, Coetzee, Beddor, and Wissing (2014) have shown that the /b~/p/ contrast in Afrikaans demonstrates an ongoing change in progress along one dimension of the contrast: prevoicing, or Voice Onset Time. Beddor (2015) discusses the findings of this project, and states that older female speakers are approximately three times as likely to produce /b/ with prevoicing, while there are no age-related differences for the F0 cue of /p~/b/. That is, voice onset time among these speakers is variable, demonstrating a change in progress toward less prevoicing of /b/ as demonstrated by its reduced use among younger speakers, while F0 remains a consistent differentiator of /p/ and /b/. Additionally, this same group of researchers demonstrates through a perceptual study that this same cue differentiation is evident in a perceptual study. F0 is a stable indicator of /b/ and /p/ and a reliable cue in perception regardless of the listener's age. Perception of VOT, however, varies based on listener age: older speakers are more likely than younger speakers to produce prevoiced /b/, and their perceptual judgements of stops are more influenced by the presence of voicing.

Similarly, Beckman et al. (2014) demonstrate through the use of diachronic production data that female speakers are leading a change in the Seoul Korean lax/aspirated stop contrast. They claim that this sound change is “very far below” the level of conscious awareness that

another change in progress ([w] deletion) has in this dialect, which is overtly associated with orthographic spelling (159). The real-time findings of this study demonstrate that VOT distinction between lax and aspirated stops has decreased over time, meaning that a change is taking place for these speakers, who are less likely to distinguish between tense and lax stops using VOT across time. The authors also show that, whenever previous studies report values for females and males separately, females distinguish lax and aspirated stops using VOT to a lesser degree than their male counterparts. This leads the authors to suggest that this is a female-led change from below the level of consciousness, that was well underway by the 1970s, and is now close to completion in the Seoul dialect (164). These authors posit that:

if degree of aspiration were to remain the primary correlate of the Korean contrast between lax and aspirated stops, there would be a merger or near-merger (i.e. a loss of contrast or a reduction in the robustness of the contrast) in the Seoul speech community today. However, there is no evidence that the contrast is any less robust today than it was in the 1960s. Instead there is evidence of corollary changes, which can be characterized as the ‘phonologization’ of differences in the voice quality and in the pitch pattern (167-168).

That is, the authors posit that a pre-existing difference in F0 between the vowels following the two types of stops (lax and aspirated) has *gained* phonological significance over time as a marker for the distinction between the two stop types, as speakers have *reduced* the importance of VOT over time for distinguishing the contrast. Kang and Guion (2008) show that speakers were more likely to produce an increased difference in average F0 on vowels following lax and aspirated stops in clear speech (that is, speech elicited by asking participants to read minimal pairs on flash cards by “imagining they were teaching Korean to second language learners of Korean”). These authors interpret these effects as indicating a change in progress in the role of F0 from being a “mere secondary correlate” of the contrast to becoming a primary acoustic correlate of the contrast in this position in the prosodic hierarchy (Beckman et al.:171).

Kirby also uses this phonologization approach (Hyman 1976) to account for the incipient use of F0 to distinguish a lexical contrast in Phnom Penh Kmer. According to Kirby, phonologization is the historical process by which the distribution of a predictable and phonetically natural process becomes phonologically determined (1995). That is, intrinsic differences become a perceptual cue for a contrast, and if other cues to the contrast are lost, this intrinsic difference may become a contrastive feature. Recall that this was also Widdison's (1993, 1995, 1997) argument for the use of 'aspiration' to mark underlying /s/ vs. /Ø/ identity in word-medial contrasts.

Similarly to the present study, Kirby examines the presence vs. absence of the trill /r/ phoneme in Phnom Penh Khmer in Cambodia. In colloquial speech, words such as /kru:/ are variably realized as something like [kù:], [k^hǔ:], or [kɹ:], or with some tonal or aspirational cues. Kirby (2014) examines VOT, pitch, vowel quality, and voice quality in comparing the /CrV/, /CV/, and /C^hV/ forms in this dialect, and finds that participants reading from a word list and participating in a repetition task were more likely to use a lower F0, increased VOT and greater differences in spectral magnitude in the more informal task. He claims that loss of /r/ in this dialect is associated with several sound changes, particularly in the development of increased aspiration, a low-falling or falling-rising F0 contour, and low vowel diphthongization. He also shows that F0 is a highly salient cue to native listeners, who are able to use it to distinguish between lexical items. He does not, however, find differences between age, gender, or education levels in realization of this variable.

Yang et al. (2015) provide evidence for a tone split in progress in Lalo, a Tibeto-Burman language of China. The authors demonstrate that voiced stops' depression of Tone 1 F0 is increasing in apparent time, especially among young speakers and women. They also

demonstrate that VOT of voiced stops is decreasing as educational levels improve, which is correlated with higher levels of contact with Mandarin Chinese. That is, the authors posit that contact with Standard Mandarin is a key social factor driving the change (55). The same 38 speakers also participated in a perception task, revealing the use of multiple acoustic cues (consonant voicing, F0 onset, and F0 shape) to identify the voiced initial.

Regarding vowels, Gordon (2001) has demonstrated that speakers participating in the Northern Cities Vowel Shift shift their vowels in multiple directions, including backing and lowering, and fronting and raising. Gordon (2002) also shows that shifting of all the different vowels (specifically /æ/, /ɔ/, and /ɑ/) occurs for some speakers, while other speakers shift none of these three. Gordon argues that these cases “suggest that changes come as a kind of package deal” (2002:263). However, Gordon also argues that some speakers shift /ɑ/ at a higher rate than /æ/, revealing that this change as a ‘package deal’ logic may not apply to all speakers.

Finally, Jacewicz et al. (2011) examined production of /ɪ/, /ɛ/, and /æ/ among 21-65 year old females from three dialect groups (North Carolina, central Ohio, and Wisconsin). While they find no age-related differences for these vowels’ duration, suggesting stable variation, they find that young speakers from all three communities are more likely to lower these vowels and produce them as increasingly monophthongized, suggesting that these variable dimensions of the vowels provide evidence for changes in progress among these speakers.

The above studies provide evidence for the arguments made here: that one single contrast (singular~plural) may be cued across multiple acoustic dimensions, and these dimensions do not all have to undergo the same sociolinguistic patterning, or direction of change.

4.7. Conclusion

The results of these analyses reveal that speakers of Chilean Spanish use strategies relating to vowel quality, voice quality, and duration to differentiate between the final vowels of singular and plural words. The results also demonstrate that use of these strategies varies according to demographic characteristics of the speakers. The initial assessments of changes in progress across time would have to be confirmed by future studies, but for now, these results establish a baseline to which future studies can be compared. They also lay the groundwork against which to examine the results of these same speakers' perception of this variable, discussed in the next chapter.

Chapter 5. Analysis and Results: Perception Experiment

In this chapter, I present the results of the perception experiment. The goal of this experiment was to determine which acoustic cues listeners relied on in order to identify a stimulus as plural, and whether use of these cues differed according to either the listener's demographics or who they perceived to be speaking.

5.1. Participants

Five of the sixty informants who participated in the sociolinguistic interview were unable to complete the perception task. In one case, an equipment issue prevented a young male in the La Pintana neighborhood from completing the test. Additionally, one older male participant did not have normal hearing so could not complete the task, one did not understand the task (taking approximately 2 minutes per stimulus to discuss his perceptions aloud and checking with me to see what button he should press), so his results were considered null, and one suffered from narcolepsy so fell asleep several times during the perception task, nullifying his results. Finally, one older female participant from the professional class neighborhood received a phone call during the experiment and did not wish to continue. In the cases of these first four, in order to reach my goal of 60 participants in the perception experiment, I carried out abbreviated interviews with four further participants (between 10-20 minutes) and had them perform the perception task. These four speakers' demographic data are reported in Table 16. These participants conversed with me for 10-20 minutes and then participated in the perception experiment. These participants were paid \$2,000 CLP (approximately \$2.96 USD) for their time, and each took no more than 30 minutes to complete the two tasks.

Table 16. Demographics of Additional Participants

Participant ID	Gender	Age	Age Group	Comuna	Education	Household goods score
LP.m.1.06	M	23	1	LP	Técnico incomplete	10
LP.m.3.09	M	50	3	LP	Secondary incomplete	10
LP.m.3.11	M	60	3	LP	Primary incomplete	11
V.m.3.06	M	66	3	V	Técnico complete	10

Additionally, three speakers' sociolinguistic interview data were thrown out due to equipment or recording issues, but they did contribute data for the perception experiment. Their demographic information is included in

Table 17.

Table 17. Demographics of participants in the perception task whose sociolinguistic interviews were excluded *a posteriori*

Participant ID	Gender	Age	Age Group	Comuna	Education	Household goods score
V.f.1.01	F	23	1	V	University incomplete	9
V.m.1.02	M	25	1	V	University complete	11
V.m.1.05	M	19	1	V	University incomplete	11

Therefore, a total of 62 participants completed the perception experiment.

5.2. Stimuli analysis

Before examining participants' responses to the stimuli, I performed an analysis on the stimuli themselves to determine whether the two speakers used any continuous acoustic strategies to differentiate between singular and plural words.

Similar to the analysis described in Chapter 4, I hand-checked each of the stimuli values, and excluded one item for each speaker with a duration of over 300 milliseconds. Additionally, I normalized each of the acoustic measures (H1*-H2*, duration, and F1 values) according to speaker gender, and in order to explore these potential differences statistically, I conducted a similar analysis to that of Chapter 4: I ran three generalized linear models (glm) with continuous outcome variables of the three acoustic measures, interacting each of the continuous predictors with underlying plurality. That is, I am examining whether the underlying plurality of the word can predict a vowel's H1*-H2*, F1, and duration. I also included utterance position as a predictor in the duration model to account for potential utterance-final lengthening. In Example 14 below I show the R code used to run the model examining H1*-H2, and Table 18 below presents the results of this first model.

Example 14. `stimdiffh1h2<-glm(h1h2z~
undernum*gender, data = stimvalues)`

Table 18. Results of linear regression of stimuli values, $\text{outcome}=\text{H1}^*-\text{H2}^*$

Linear regression: Effects of underlying plurality and gender on vowel's H1*-H2*				
	β (coefficient)	Standard Error	<i>t</i> value	<i>p</i> value
Intercept	-.23	.22	-1.05	.30
Undernum				
Singular	Ref	-	-	-
Plural	.45	.31	1.44	.15
Gender				
Female	Ref	-	-	-
Male	.07	.32	.23	.82
Interaction: Undernum by Gender				
Plural x male	-.14	.44	-.31	.76

The results of this model reveal that underlying plurality does not predict any difference in H1*-H2* for either the male or the female speaker. That is, neither the male or female speaker

use breathiness to differentiate between singular and plural vowels in the selected stimuli items, as can be seen in Figure 39.

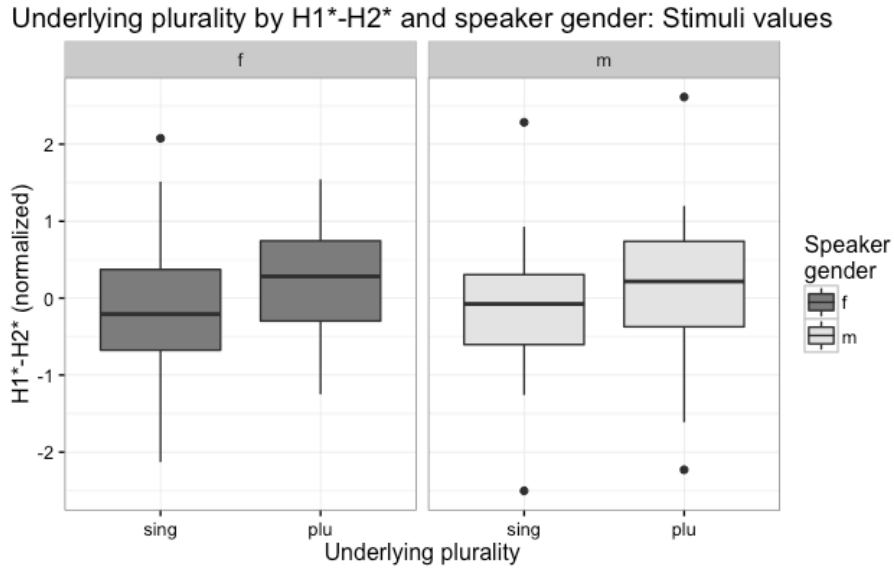


Figure 39. H1*-H2* of stimuli by underlying plurality and speaker gender

I followed this same procedure to determine whether underlying plurality predicted any differences in the speakers' F1 values, and the results of this model are presented in Table 19.

Table 19. Linear regression results of F1 of stimuli values

	Linear regression: Effects of underlying plurality and gender on vowel's F1			
	β (coefficient)	Standard Error	<i>t</i> value	<i>p</i> value
Intercept	.16	.22	.74	.46
Undernum				
Singular	Ref	-	-	-
Plural	-.30	.30	-1.02	.31
Gender				
Female	Ref	-	-	-
Male	-.62	.30	-2.04	.04*
Interaction: Undernum by Gender				
Plural x male	1.16	.43	2.73	.00**

This model revealed that the female speaker does not use F1 to mark plurality, but the model did show a significant interaction effect for underlying plurality for the male speaker. I

then revealed the ‘gender’ variable to find the effect of underlying plurality for the male speaker. The outcome of this revealed model revealed a significant difference for the ‘undernum’ predictor. That is, a plural vowel spoken by the male speaker predicts a significant increase in the vowel’s F1 ($\beta=.86$, St. E=.30, $p<.01$). In other words, the male speaker’s plural vowels are more likely to have a higher F1 value, or be produced as lowered, as evidenced by Figure 40.

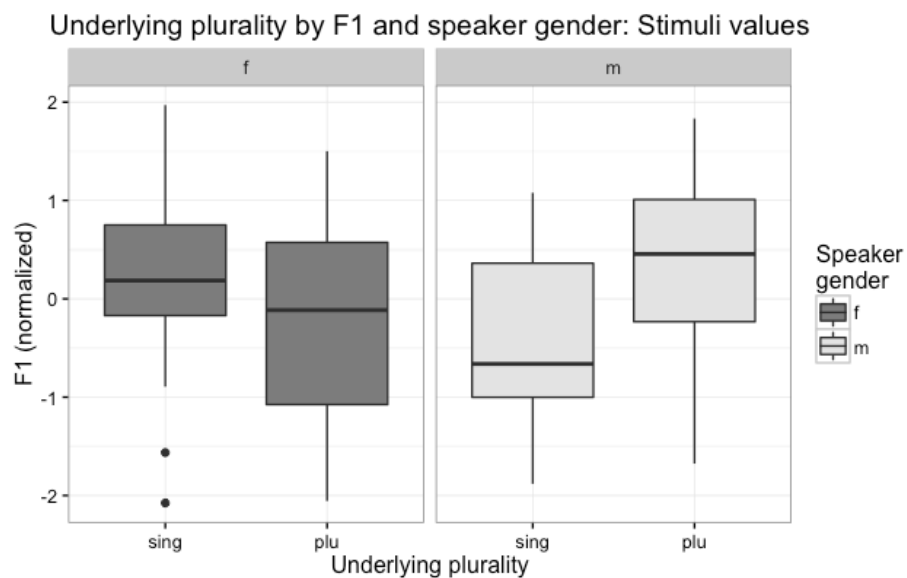


Figure 40. F1 of stimuli by underlying plurality and speaker gender

This male speaker belongs to the upper-middle class, so this finding of male plural vowel lowering aligns with the strategy used by males in the professional class shown for the speakers in Chapter 4.

Finally, I performed a regression taking duration as the continuous outcome variable, and included interaction terms of underlying plurality by utterance position as well as underlying plurality by gender, as in Example 15 below.

```
Example 15. stimdiffdur<-glm(durz ~
undernum*gender+undernum*utterance, data = stimvalues)
```

The results of this model are presented below in Table 20.

Table 20. Linear regression results for duration

	Linear regression: Effects of underlying plurality, gender, and prosodic position on vowel's duration			
	β (coefficient)	Standard Error	<i>t</i> value	<i>p</i> value
Intercept	.33	.20	1.60	.11
Undernum				
Singular	Ref	-	-	-
Plural	-.54	.31	1.73	.09
Gender				
Female	Ref	-	-	-
Male	.02	.24	.07	.95
Utterance position				
Final	Ref	-	-	-
Medial	-.82	.45	-3.31	.00**
Interaction: Undernum by Gender				
Plural x male	-.47	.34	-1.38	.17
Interaction: undernum by utterance				
Plural x utterance medial	-.39	.35	-1.11	.27

This model revealed a simple main effect for utterance position, showing that utterance medial vowels are significantly shorter than utterance-final vowels. This finding also reflects differences obtained in Chapter 4. No other simple main effects or interaction effects obtained, as evidenced by the figures below.

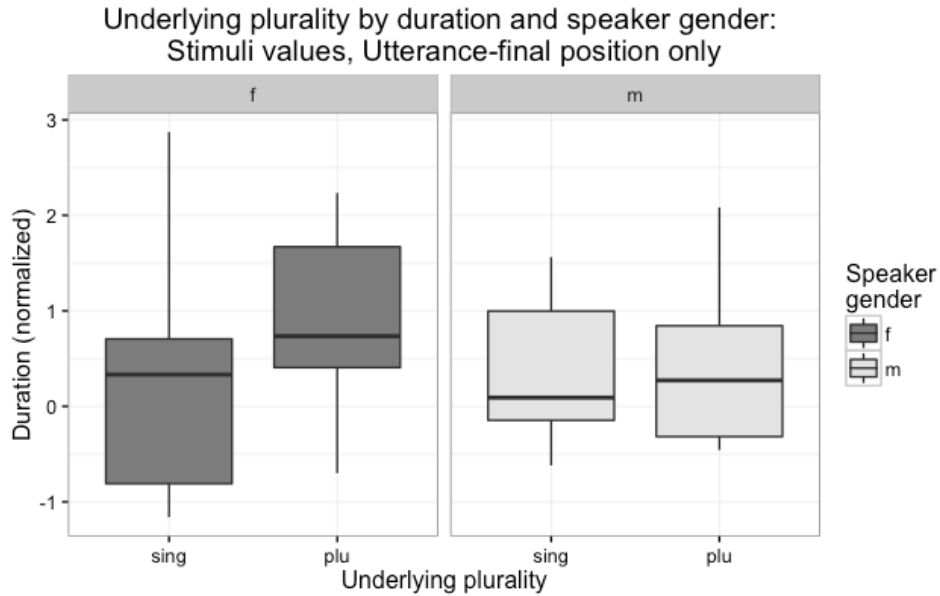


Figure 41. Duration of stimuli vowels by underlying plurality and speaker gender; utterance-final position only

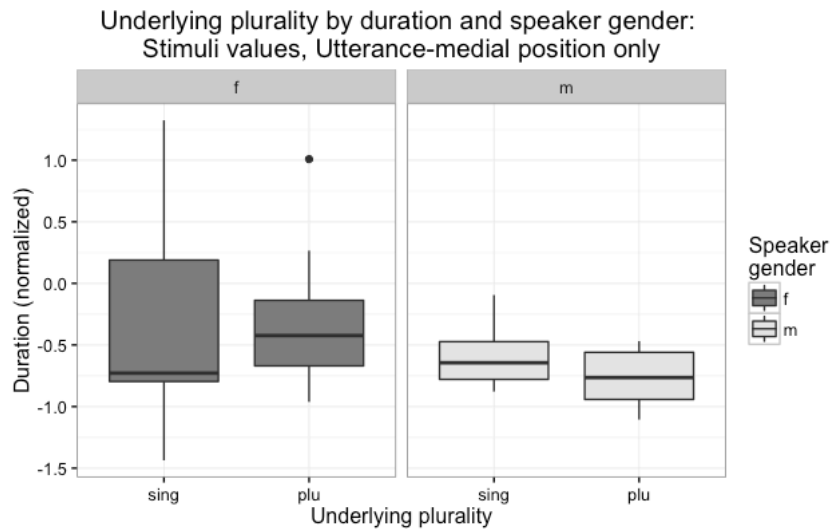


Figure 42. Duration of stimuli vowels by underlying plurality and speaker gender; utterance-medial position only

In sum, the female stimuli speaker did not differentiate her singular and plural vowels according to their breathiness, height, or vowel quality, while the male speaker was more likely to lower his plural vowels.

5.3. Visual Prime Analysis and Results

In order to ensure that my initial assessments of the visual primes were accurate, participants throughout Santiago (N=30) were asked to fill out the questionnaire in Appendix 2. For each image, participants were asked if they knew the people in the picture, how old they thought the person was, how {responsible, ambitious, funny, kind} they thought the person was, how much education they thought the person had, and what kind of job they might hold. The order of presentation was the same for all 30 participants, after randomizing the order using a random number generator. To see whether my selection had been successful, I gathered the means and standard deviations of the measures of interest, or perceived age, perceived education, and perceived job. Each of these is presented in figures below.

One of the photos, the young, professional class female, was a picture of a relatively well-known Chilean singer and actress. Therefore, for the assessments of this participant, I only included the responses of the participants who reported that they did not know who she was (N=14).

I first present the results of the ‘perceived age’ question. Again, participants were asked to select the age they attributed to the person in the picture, based on previously delineated age groups.

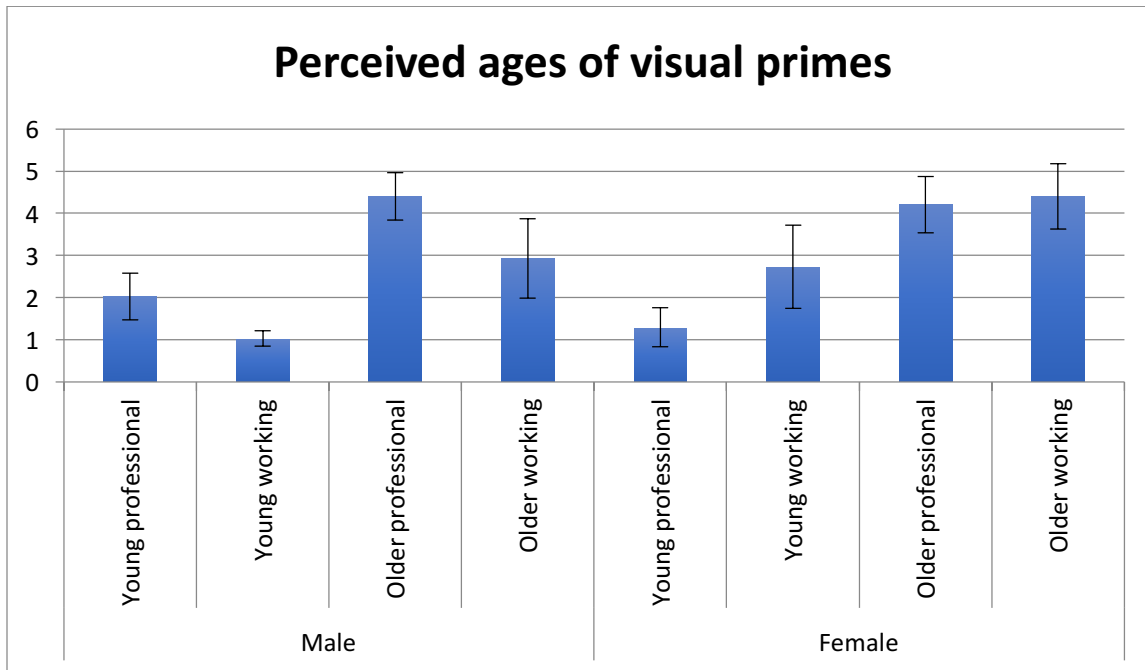


Figure 43. Perceived age of visual primes

As shown in Figure 43, generally, the working class male photos were perceived as younger than their professional class counterparts. The older working male and the younger working female were perceived to be approximately the same age, as revealed by the results of a two-sample unpaired t-test ($t(58) = .805, p > .4$), showing that this particular guise for age may be less accurate than assumed.

We now turn to education levels. Figure 44 below shows the mean values for responses to “how much education do you think this person has.”

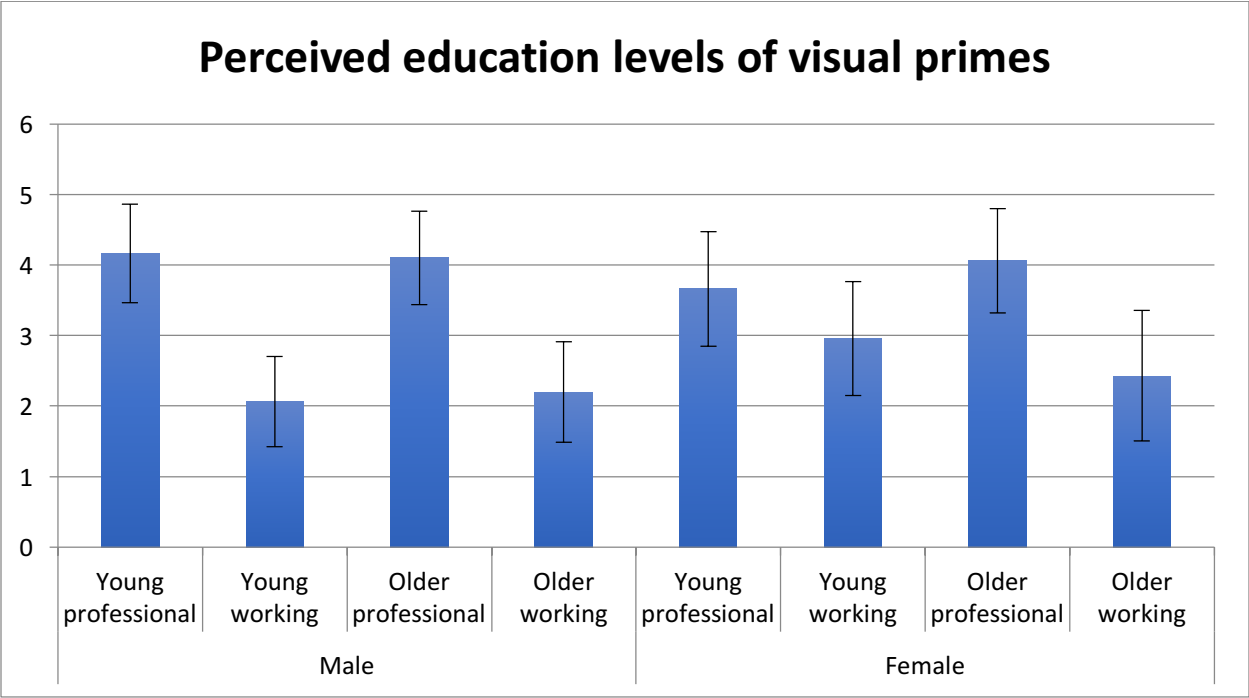


Figure 44. Perceived education levels for visual primes

As the figure shows, lower education levels are attributed to the visuals with the working-class guise, with the exception of the young females. However, when only including the participants who did not know who the young professional female was, these participants considered the young professional female is more educated than the young working-class female ($t(26)=2.70, p<.01$).

Finally, I present the results of the ‘job’ or ‘profession’ question. Respondents were asked to select what type of job the person in the picture probably had, in Figure 45 below.

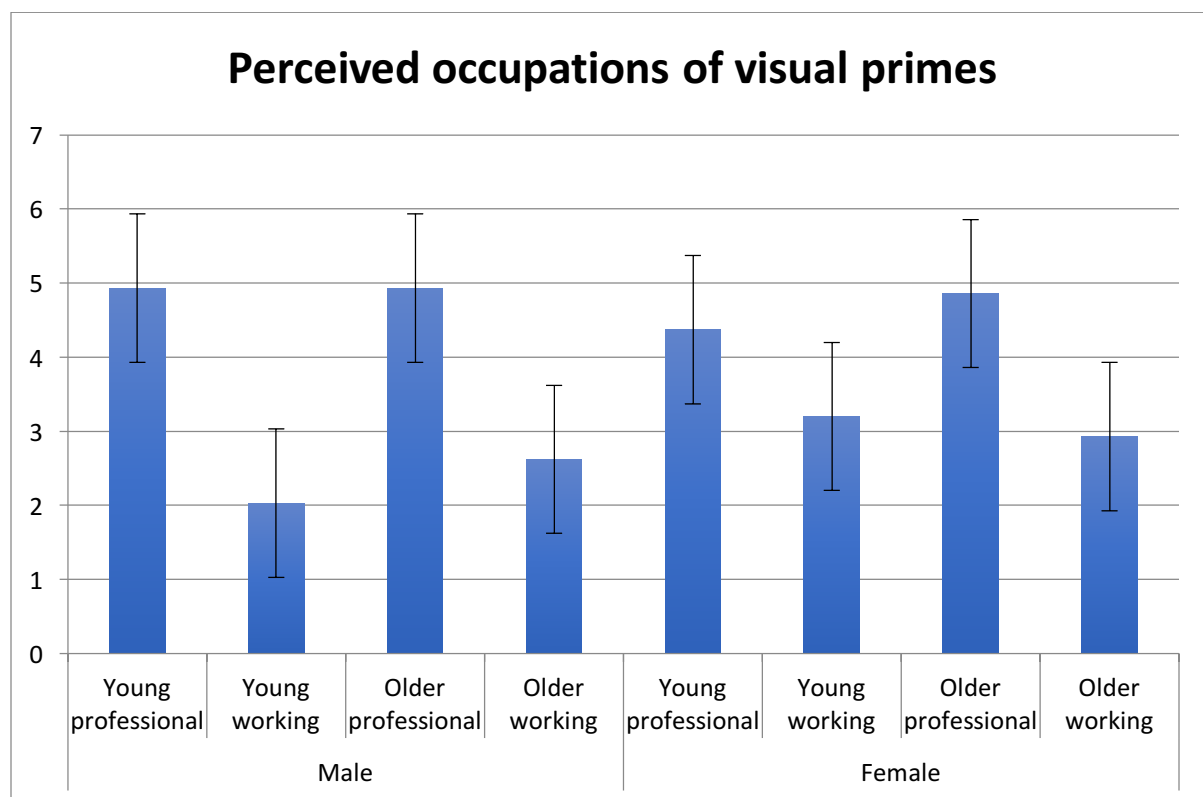


Figure 45. Perceived occupation of visual primes

Each of the working class guise visual primes obtained a significantly lower rating for possible occupation, including the young females (as evidenced by the results of an unpaired t-test; $t(56)=-5.87, p<.001$). It is clear that my original perceptions of the class distinctions of the visual primes held true based on these final two measures of education and occupation. In sum, the selected visual primes were overall well selected, particularly in regards to levels of education and occupation of the image, though the perceived ages of the images were not perfectly correlated with my original assessments.

Following the task, when I told participants what I was doing, several commented on the ‘appropriateness’ of the pictures. For instance, several said that it made sense that the young professional male picture was photographed in the snow, as skiing is a sport reserved for mainly middle- and upper-class *santiaguinos*. They also commented on the older working class male and

young working class female, implying that the construction work setting aligned them with the working class. Finally, several commented on the ‘*flaite*’ aspect of the young working class male, that is, his perception as low-class and/or uneducated.

5.4. Perception Experiment Results

5.4.1. Detection sensitivity

Participants’ sensitivity to the experimental paradigm was then calculated using the d' (d-prime) statistic described in Macmillan and Creelman (1991), which is a standardized score of the participant’s Hits ($z(H)$) minus a standardized score of the participant’s False Alarms: $d'=z(H)-z(F)$. That is, this score accounts for both sensitivity to the test items (items that were underlyingly plural), and also whether they incorrectly reported a plural response on underlyingly singular items. Table 21 below shows a 2 X 2 contingency table for this paradigm.

Table 21. Sensitivity paradigm for perception experiment

		Response of listener	
		Plural	Singular
Underlying stimuli type	Plural	Hit	Miss
	Singular	False Alarm	Correct Rejection

To arrive at the d-prime score, in Excel, I first calculated each participant’s hit rate (that is, the proportion of PLURAL trials to which the participant responded PLURAL, or number of plural responses over the total number of plural items, N=176) and false alarm rate (that is, the proportion of SINGULAR trials (N=160) to which the participant responded PLURAL). The mean hit rate was .295 (or 29.5%; SD=.18), and the mean false alarm rate was .165 (16.5%, SD=.18). I then used the standardize function in Excel to provide a z-transformation of these

proportions, to give the $z(H)$ and $z(F)$ values. Finally, I created a column for d-prime scores in which I subtracted $z(F)$ from $z(H)$ for each participant (mean=.009, SD=.599). Figure 46 below shows a histogram of d-prime scores.

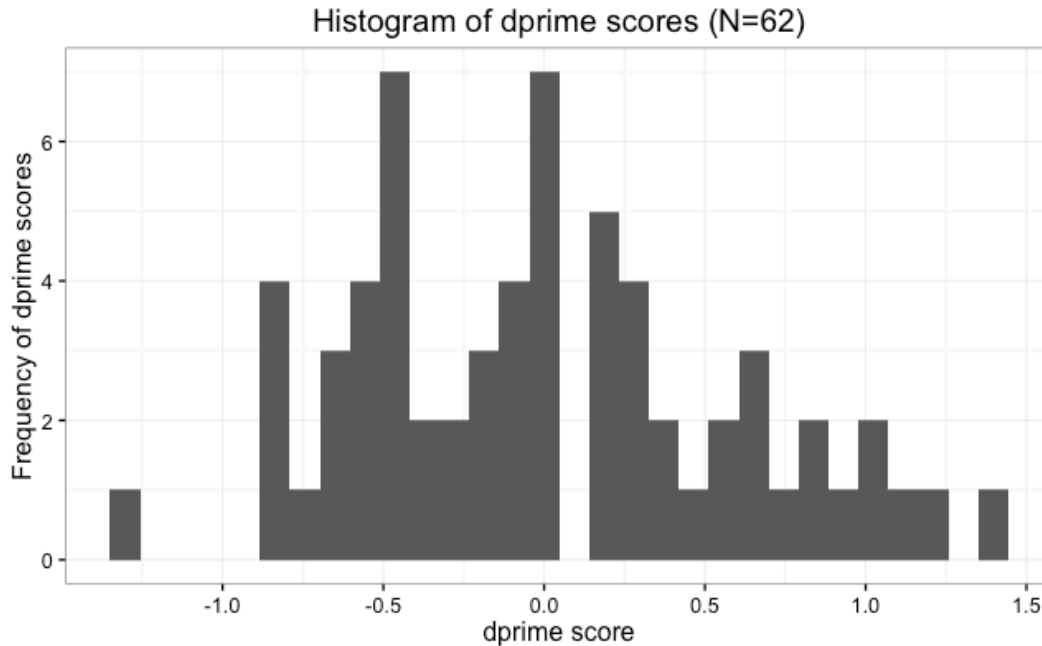


Figure 46. Histogram of d-prime scores for 62 participants

To ensure that all of the data were normally distributed, I excluded three participants' data whose d-prime score fell outside of two standard deviations from the mean d-prime score of .009 (participant LP.f.3.04 had a d-prime score under -1.19 (-1.30), and participants LP.f.2.03 and V.m.1.09 had d-prime scores over 1.19 (1.25 and 1.40, respectively). Table 22 below shows the demographic information of the included 59 participants.

Table 22. Demographics of participants included in the perception task (N=59)

	SES: Low		SES: High	
	Females	Males	Females	Males
Age: Young	5	5	6	6
Age: Middle	4	5	5	5
Age: Older	4	5	4	5

In addition to exploring the continuous acoustic cues that each demographic group used to identify a stimulus as plural, I was interested to see whether there were differences in participants' sensitivity to the task according to their demographics. Therefore, the plots below show participants' d-prime scores according to listener SES, age, and gender.

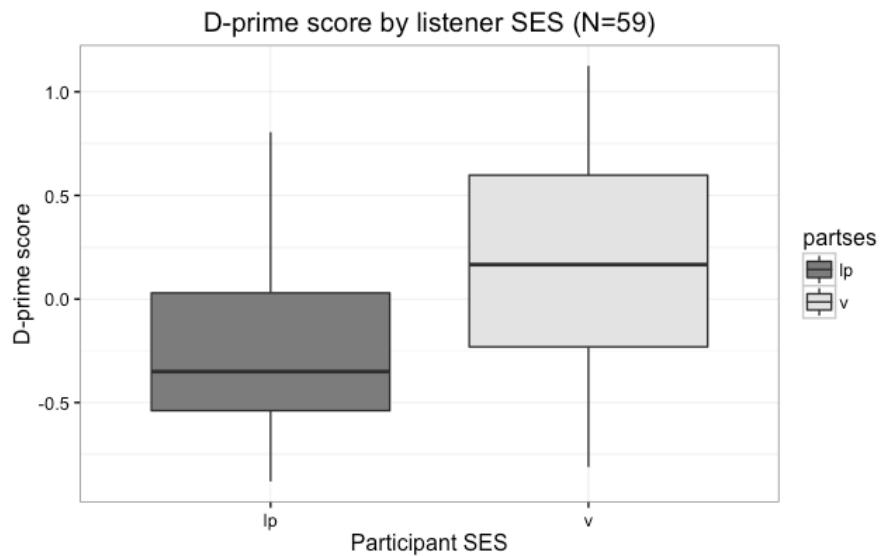


Figure 47. D-prime score by participant SES (N=59)

According to Figure 47, participants in the high SES, Vitacura neighborhood appear to be more sensitive to the experimental paradigm, though the low D-prime scores overall reveal that participants are not very sensitive to the paradigm.

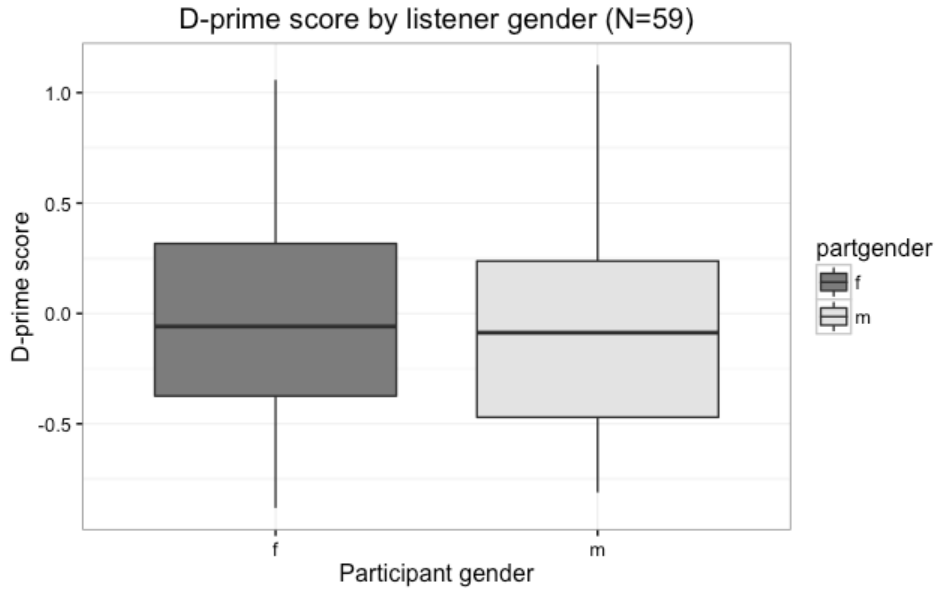


Figure 48. D-prime score by listener gender (N=59)

Additionally, according to Figure 48, listeners' sensitivity does not appear to be affected by their gender. However, I then plotted participant SES by participant gender, and discovered that the interaction between these two groups may have contributed to the apparent lack of effect in Figure 48. In Figure 49 below, I show the interaction between participant SES and participant gender on d-prime scores.

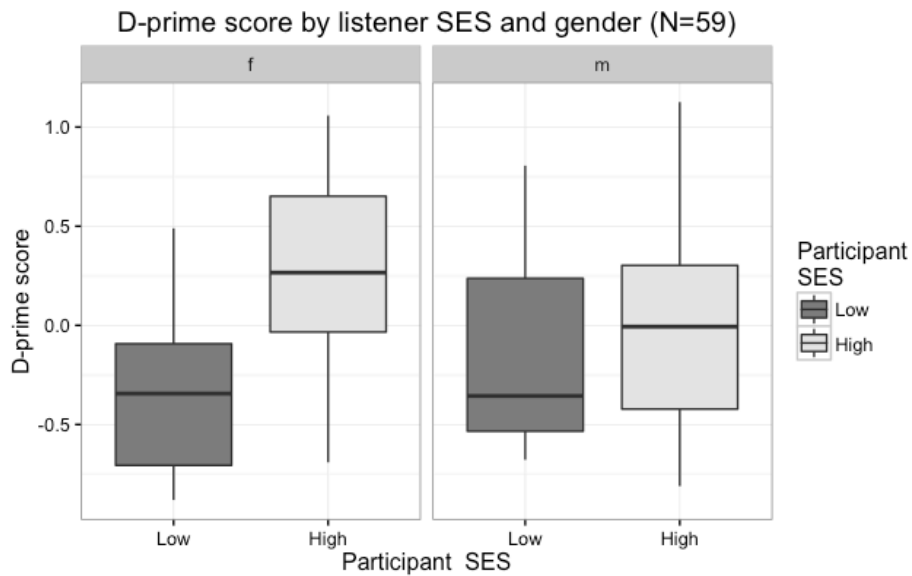


Figure 49. D-prime score by listener SES and gender

In Figure 49, we can observe a significant difference in d-prime scores according to participant SES for female listeners, while there is more overlap between male listeners' d-prime scores. Based on this observation, I include an interaction between participant SES and participant gender in the model.

Finally, I also interacted participant SES by participant age to see whether there would be any age-related effects within SES groups, shown in Figure 50 below.

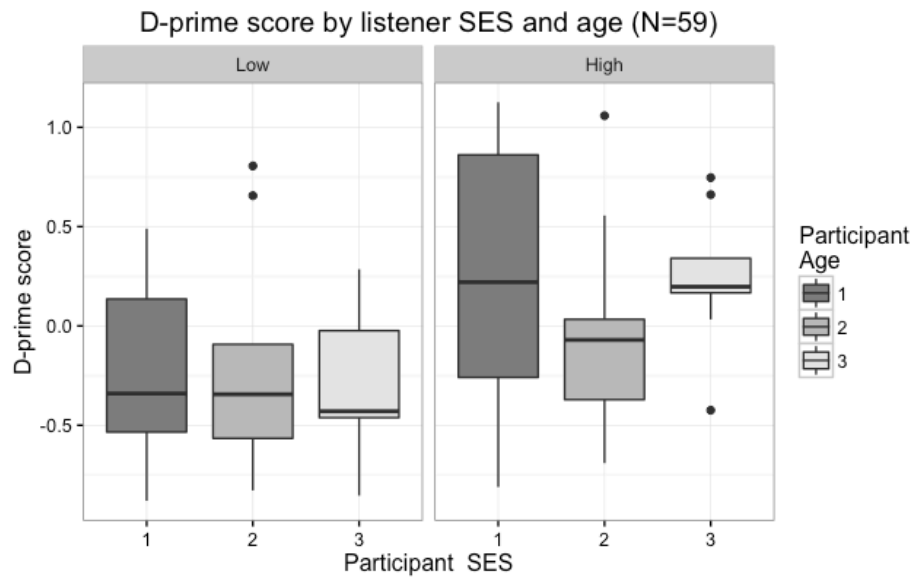


Figure 50. D-prime score by listener age and SES

From this figure, we can observe that in the low SES group, there are no observable differences across age groups, but that in the high SES group, there is a curious effect of the middle age group being less sensitive than the younger or older ages. For this reason, I include an interaction of participant SES by participant age in the model below, to explore the effects of age and SES on d-prime scores.

I then ran a linear mixed effects regression with d-prime score as the continuous dependent variable, using participant as a random effect, to examine the effects of participant age by participant SES, and participant gender interacted with participant SES on listener sensitivity to the task. The code for the model is included below in Example 16, and results of this analysis are shown in Table 23 below.

```
Example 16.
dp1<-lme(fixed=dprime~
partage*partseslh+
partseslh*partgender, random=~1 | part, data=dprimeupd)
```

Table 23. Results of linear regression analysis of d-prime values

	Linear regression: D-prime values			
	β (coefficient)	Standard Error	t value	p value
Intercept	.44	.14	3.07	.00**
Participant age				
Young	Ref	-	-	-
Middle	-.20	.18	-1.15	.26
Older	-.29	.18	-1.62	.11
Participant SES				
Low	Ref	-	-	-
High	.46	.19	2.37	.02*
Participant gender				
Female	Ref	-	-	-
Male	.28	.15	1.92	.06
Participant age by participant SES				
Middle age x high SES	.26	.24	1.05	.30
Older age x high SES	.19	.25	.78	.44
Participant SES by participant gender				
High SES x male	-.41	.20	-2.04	.05*

The analysis revealed a simple main effect for participant SES. Since participant SES is interacted with both participant gender and participant age, the effect above for “Participant SES: High” shows the effect for the reference groups. That is, according to this model, young females in the higher SES have significantly higher d-prime scores than young females in the lower SES ($p<.05$). This effect can also be observed in Figure 50.

Additionally, the model revealed a significant interaction effect for participant SES and participant gender. To determine whether there is an SES effect for male listeners, I relevelled the 'Participant gender' factor in the model above so that the reference value was 'male.' The output of the relevelled model showed that there was no difference between SES group for males ($\beta=.05$, $SE=.15$, $p=.81$). That is, males in the low SES group are approximately as sensitive as males in the high SES group to the experimental paradigm.

Finally, there were no significant effects for age in either of the SES groups. In sum, females in the higher SES group are more sensitive than females in the lower SES group, while males in each group are not significantly different from one another. Overall, high SES females are the most sensitive listeners to the paradigm.

5.5. Perception experiment results: Cue sensitivity analysis

In spite of the lack of robust differences between the stimuli types used in the experiment, the production results from the previous chapter reveal that speakers do use a variety of acoustic strategies to mark a distinction in singular vs. plural words, and this perception experiment might reveal that participants pay attention to cues that are relevant for or present in their daily lives.

In Figure 51 below, I show an aggregate of the different stimulus response types for all 59 participants.

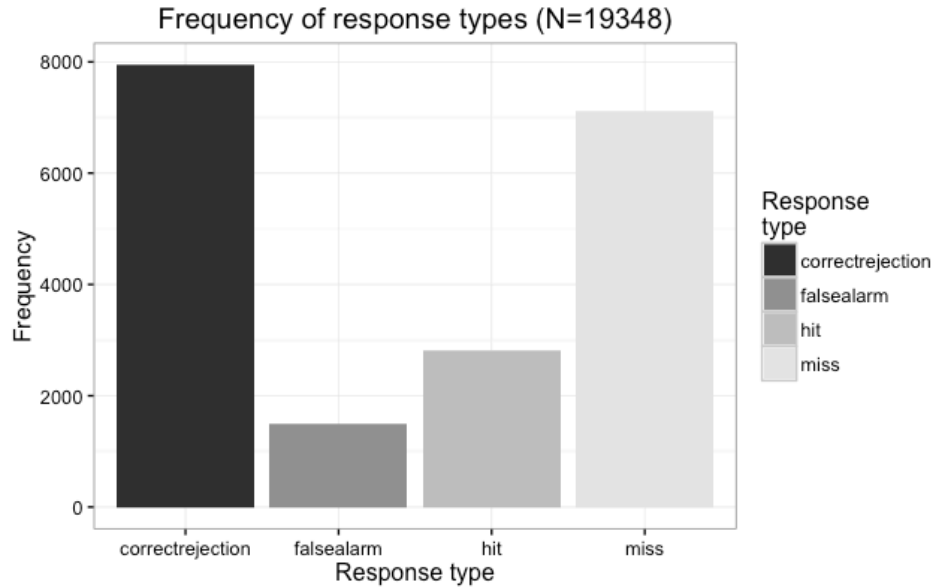


Figure 51. Frequency of response types

Participants' overall accuracy rate, as a combination of the 'correct rejection' responses (N=7947) and the 'hit' responses (N=2803), is 55.5%, slightly above chance. The reader will note that in general, listeners were biased toward selection of a singular response (that is, both 'correct rejections' and 'misses' in the figure above), aligned with the findings of previous studies. In spite of this bias, I examined the data further to determine whether there were any observable differences in response as singular or plural based on continuous acoustic cues of the stimuli and the social characteristics of the listener. In order to account for all the possible combinations, I take participants' identification of the stimulus as the binary dependent variable, and the acoustic factors of H1*-H2*, F1, and duration interacted with listener age, listener SES group, and listener gender. Duration was also interacted with utterance position due to possible utterance-final lengthening effects. In Example 17 below I present the R code used to construct this model, and Table 24 below shows its output.

```
Example 17. perclpf1<-glmer(plukey ~
  h1h2z*partses+
  h1h2z*partage+
  h1h2z*partgender+
  flz*partses+
  flz*partage+
  flz*partgender+
  durz*partses*utterance+
  durz*partage*utterance+
  durz*partgender*utterance+ (1 | part), data = picdata,
  family = binomial, control =glmerControl(optimizer = "bobyqa",
  optCtrl=list(maxfun=2e8)))
```

Table 24. Output of binary logistic regression analysis of perception experiment

Logistic regression: Effects of acoustic cues and participant demographics on a plural response				
	β (coefficient)	Standard Error	<i>t</i> value	<i>p</i> value
Intercept	-1.34	.31	-4.27	.00***
H1*-H2*z	.07	.05	1.55	.12
Participant SES				
Low	Ref	-	-	-
High	-.74	.28	-2.63	.01**
Participant age				
Young	Ref	-	-	-
Middle	-.04	.34	.11	.91
Older	.91	.34	2.66	.01**
Participant gender				
Female	Ref	-	-	-
Male	-.81	.28	-2.88	.00**
F1z	.11	.05	2.29	.02*
Duration z	.10	.07	1.41	.16
Utterance position: medial	.20	.11	1.75	.08
Interaction: H1*-H2* by participant SES				
H1*-H2* x high SES	.06	.04	1.56	.12
Interaction: H1*-H2* by participant age				
H1*-H2* x Middle age	-.02	.05	-.43	.67
H1*-H2* x Older age	-.19	.05	-1.92	.06
Interaction: H1*-H2* by participant gender				
H1*-H2* x Male	.02	.04	.49	.63
Interaction: F1z by participant SES				
F1z x high SES	.05	.04	1.08	.28
Interaction: F1z by participant age				
F1z x Middle age	-.08	.05	-1.47	.14
F1z x Older age	-.11	.05	-2.2	.03*
Interaction: F1z by participant gender				
F1z x male	.18	.04	4.30	.00***
Interaction: Duration by participant SES				
Duration x High SES	-.06	.06	-.92	.36
Interaction: Duration by utterance position				
Duration x utterance medial	.02	.13	.16	.88

Interaction: participant SES by utterance position				
High SES x utterance medial	.34	.10	3.44	.00***
Interaction: Duration by participant age				
Duration x Middle age	.09	.08	1.05	.30
Duration x Older age	.04	.08	.47	.64
Interaction: Utterance position by participant age				
Middle age x utterance medial	-.18	.13	-1.43	.15
Older age x utterance medial	-.12	.12	-1.06	.29
Interaction: Duration by participant gender				
Duration x Male	-.16	.06	-2.54	.01*
Interaction: Participant gender by utterance position				
Male x utterance medial	.18	.09	1.86	.06
Interaction: Participant SES by duration by utterance position				
High SES x duration x utterance medial	.01	.12	.05	.96
Interaction: Participant age by duration by utterance position				
Middle age x duration x utterance medial	-.50	.15	3.329	.00***
Older age x duration x utterance medial	-.31	.14	-2.27	.02*
Interaction: Participant gender by duration by utterance medial				
Male x duration x utterance medial	.15	.12	1.34	.18

Since all of the continuous predictors are interacted with categorical predictors, the effects and *p*-values above for the continuous predictors are only for one particular group. That is, for instance, the model above shows effects for standardized H1*-H2*, standardized duration, and standardized F1 values when each of the categorical predictors is at its reference level: low SES, age group 1, female gender, and utterance-final position. According to this model, then, this demographic group relies on a vowel's F1 value when identifying a stimulus as plural. The degree to which they rely on F1 can be determined using the coefficient (β) value in the model above. This coefficient is the effect for one unit of change in the predictor variable (or, an

increase in one standard deviation of F1) while holding other predictors in the model constant (i.e. H1*-H2* and duration are at zero), for this particular reference group. Since this is a logistic model, the coefficient is the log odds for the outcome ‘plural.’ These logs odds can be transformed into an easier-to-understand probability using the following equation, taken from Johnson (2008:160):

Example 18. Formula to calculate probabilities from logits
Probability of $x = \frac{\exp(\beta)}{1 + \exp(\beta)}$

Therefore, to examine the effect of a one-unit increase in F1, we can apply this formula using the coefficient of F1 given in the model above.

$$\begin{aligned} \text{Prob(plural selection)}_{F1} &= \frac{\exp(.11)}{1 + \exp(.11)} \\ \text{Prob(plural selection)}_{F1} &= .527 \end{aligned}$$

In other words, as the F1 value of a stimulus increases by one standard deviation, young female listeners in the low SES group are 53% more likely to identify the stimulus as plural, and this difference is significant at the .05 level. In other words, overall, an increase in F1 (or a lowering of the vowel) makes young, female, working-class listeners more likely to identify a stimulus as plural.

Additionally, the significant simple main effect for SES:High in the model above represents the effect for a change in SES group from SES:Low to SES:High when all the continuous predictors are at 0 (their means), over an average of all categorical predictors. In other words, after controlling for all other variables, there is a significant effect of SES: members of the high SES are significantly less likely to identify a stimulus as plural ($p < .01$) according to the equation below. For this calculation, I have again taken the coefficient of the predictor of interest (SES:High), and since the coefficient is negative, this means that this group is more likely to select a singular response. In other words, they’re less likely to identify a stimulus as

plural. Specifically, participants in the high SES group are approximately 32% less likely to identify a stimulus as plural.

$$\text{Prob(plural selection)}_{\text{HighSES}} = (\exp(-.74)) / (1 + \exp(-.74))$$

$$\text{Prob(plural selection)}_{\text{HighSES}} = .32$$

This effect can be visualized in Figure 52 below.

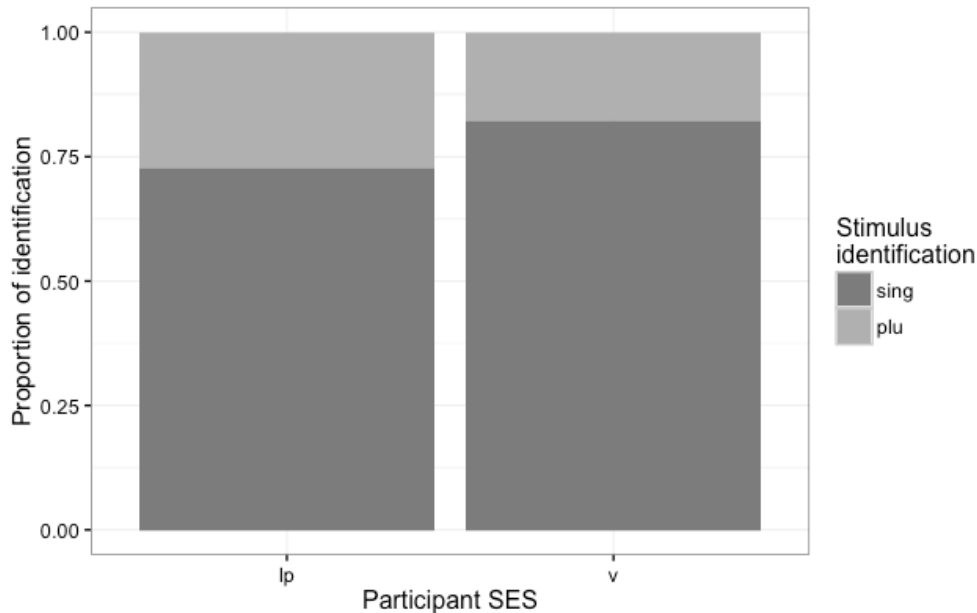


Figure 52. Stimulus identification by listener SES group

As can be observed, members of the high SES group ('v') are significantly less likely to identify a stimulus as plural, by approximately 33%.

Similarly, the significant simple main effect for Age:Older in the model above represents a significant difference between Age:Young and Age:Older after controlling for the other predictors. Specifically, as the equation below shows, older listeners are 71% more likely to identify a stimulus as plural than younger listeners ($p < .01$), which can also be visualized in Figure 53 below.

$$\text{Prob(plural selection)}_{\text{Age:Older}} = (\exp(.91)) / (1 + \exp(.91))$$

$$\text{Prob(plural selection)}_{\text{Age:Older}} = .71$$

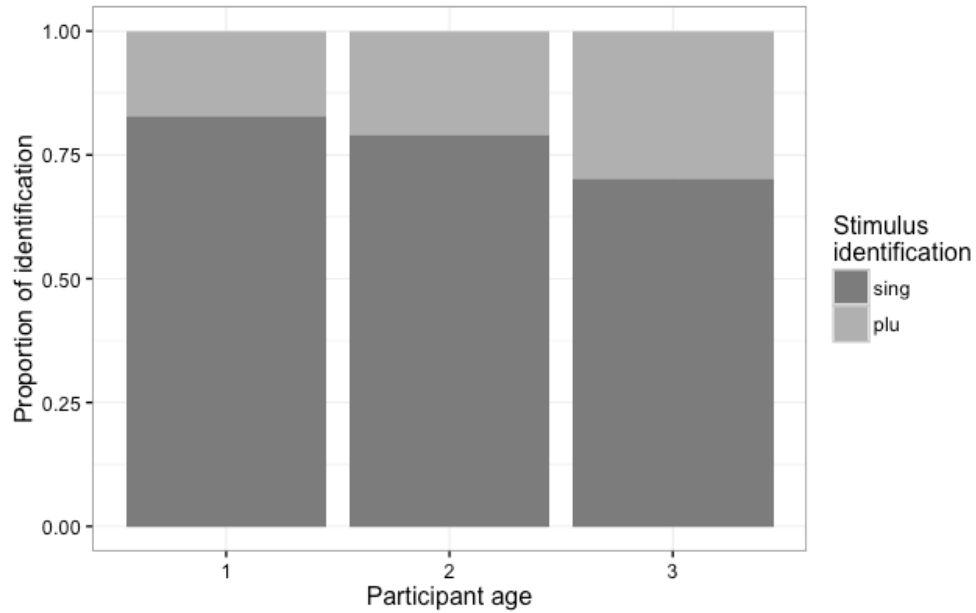


Figure 53. Stimulus identification by participant age group

Finally, the significant simple main effect for gender demonstrates a comparison between male and female listeners controlling for all other predictors. According to the equation below, males are 31% less likely to identify a stimulus as plural, as compared to females, and this difference between gender responses is significant ($p < 0.01$).

$$\text{Prob(plural selection)}_{\text{Sex:M}} = \frac{\exp(-.81)}{1 + \exp(-.81)}$$

$$\text{Prob(plural selection)}_{\text{Sex:M}} = .31$$

This effect can be visualized in Figure 54 below.

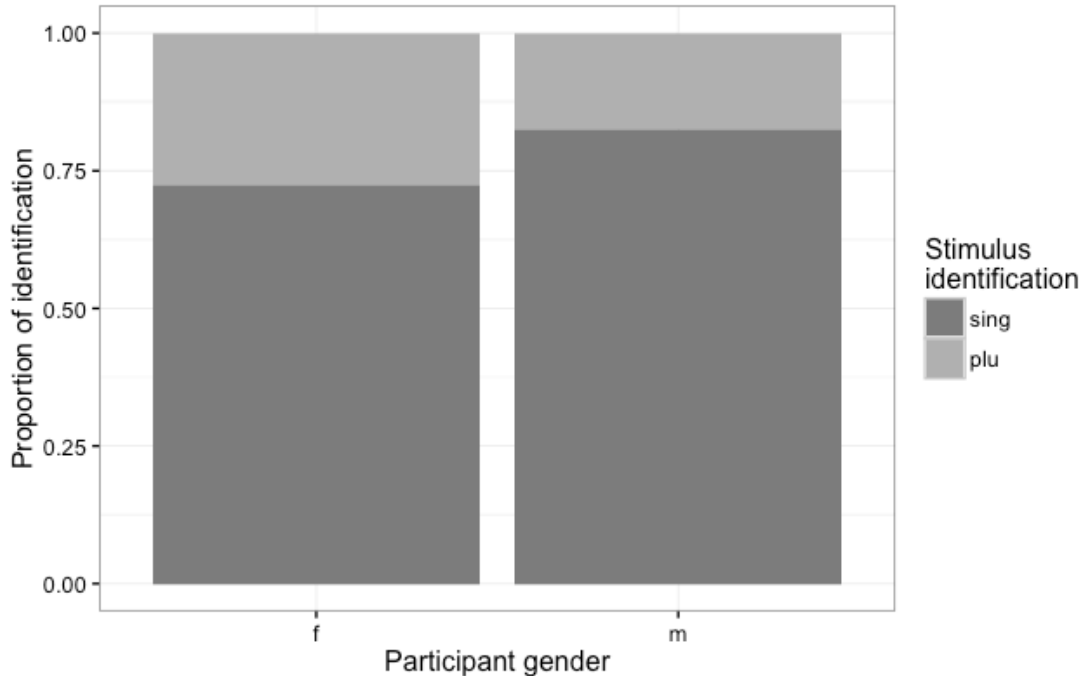


Figure 54. Stimulus identification by participant gender

Regarding duration, lengthening of a final vowel (in utterance-final position) does not contribute to these young, female participants' identification of a stimulus as plural ($p=.16$), and in order to determine whether lengthening of a final vowel in utterance-*medial* position contributes to identification of a stimulus as plural by these participants, there are three options available. The first is to use the `relevel` function in the model above, and `relevel` to utterance position=`medial`, as in Example 19 below. Then, the effect for the duration variable is the effect of duration in utterance-medial position.

```
Example 19. perclpf2<-glmer(plukey ~
h1h2z*partses+
h1h2z*partage+
h1h2z*partgender+
flz*partses+
flz*partage+
flz*partgender+
durz*partses*relevel(utterance, 'medial')+
durz*partage*relevel(utterance, 'medial')+
durz*partgender*relevel(utterance, 'medial'))
```

```
(1 | part), data = picdata, family = binomial, control = glmerControl(optimizer =
"bobyqa", optCtrl=list(maxfun=2e8)))
```

According to this model, the coefficient for duration with a reference level of utterance medial is .12 (SE=.11, p=.29).

Another strategy for arriving at this same value is to add up the relevant coefficients in the complete model in Table 24. That is, to determine the effect of duration in utterance-medial position, I take the coefficient of duration in utterance-final position (.10) and add to it the coefficient for the interaction of duration x utterance medial (.02). The sum of these coefficients (.12) is the same as given above (.12).

Yet a third technique is to use a simple effects analysis as described in Bretz et al. (2011: 108–11) using the `glht` function in the `multcomp` package (Hothorn et al. 2008). The `glht` function, according to Bretz et al. (46) takes a fitted response model (in this case, the original ‘`perclpf1`’ model shown in Table 24 and performs a comparison at a given value). Therefore, if we are interested in the effect of duration in utterance-medial position on the reference group’s selection of a plural response, we would input the following in R, essentially adding up the coefficients by hand as in the first strategy presented here. I created a new item in Example 20 below, used the ‘`glht`’ function, and the terms in Example 20 include the model name and the argument ‘`linfct`’ whose components specify the matrix of coefficients to be tested (Hothorn et al. 2008:13). Specifically, I take the base coefficient of ‘`durz`’, and add to it the interaction between ‘`durz:utterancemedial`’, and compare that to a null model (“`==0`”). Therefore, to find the effect for utterance-medial position for the low SES, female, young age group, I use the following formula:

```
Example 20.
medlpf1<-glht(perclpf1, linfct=c("durz+durz:utterancemedial==0"))
```

The output of Example 20 is shown in Example 21 below.

Example 21.

Linear Hypotheses:

	Estimate	Std. Error	z value	Pr(> z)
durz + durz:utterancemedial == 0	0.1245	0.1135	1.097	0.273

As the reader will note, this equation also has the same coefficient (estimate) value as calculated by hand using the second strategy described above. This equation and process will also serve the next level of hypothesis testing. Specifically, the model above only accounts for the reference level of each categorical variable (i.e. young, female speakers in the lower SES group). However, as reflected by my research question exploring whether different demographic groups rely on different cues to identify the plurality of a stimulus, I am interested in knowing the effects of the continuous variables on plural identification in each of the demographic groups, and whether these are significant predictors of plural selection. Therefore, I performed a simple effects analysis as described in Bretz et al. (2011: 108–11) using the multcomp package (Hothorn et al. 2008) for each of the 12 demographic groups (2 levels of SES, 2 genders, and 3 age groups; 2x2x3). For instance, in Example 22 below, I show the R code used to find the main effect for F1z when the reference group is high SES, older, male participants (or, the V.m.3 group).

```
Example 22. vm3f<-glht(perclpf1,  
  linfct=c("f1z+partage3:f1z+partgenderm:f1z+partsesv:f1z==00"))
```

In Example 22, I add up the coefficients relevant to the predictor I am interested in (F1z), and the effects of F1z that interact with the group I am interested in (when those diverge from the reference group). In this case, the group of interest (V.m.3) diverges from the original reference group (LP.f.1) according to all three categorical predictors of age, gender, and SES, so I include these three terms.

5.5.1. Summary: Cue Sensitivity by Demographic Groups

In the tables below, I present the main effect coefficients for each of the continuous predictors organized by demographic group. I used the `glht` function as described above to determine the main effects for each of the categorical predictors (H1*-H2*, F1, and duration in both utterance positions) for each of the 12 demographic groups.

Table 25. Logistic regression: Effects of acoustic values on plural selection; main effects for low SES females (LP.f)

Group	Young			Middle			Older		
	β	St. Error	p-value	β	St. Error	p-value	β	St. Error	p-value
H1*-H2*	0.07	0.05	0.12	0.05	0.04	0.22	-0.02	0.04	0.64
F1	0.11	0.05	0.02*	0.03	0.04	0.46	0.00	0.04	0.98
Duration: Utterance- medial	0.12	0.11	0.27	-0.28	0.11	0.01**	-0.15	0.10	0.15
Duration: Utterance-final	0.10	0.07	0.16	0.19	0.06	0.00**	0.14	0.06	0.03*

Table 26. Logistic regression: Effects of acoustic values on plural selection; main effects for low SES males (LP.m)

Group	Young			Middle			Older		
	β	St. Error	p-value	β	St. Error	p-value	β	St. Error	p-value
H1*-H2*	0.09	0.05	0.05	0.07	0.05	0.13	0.00	0.04	0.99
F1	0.29	0.05	0.00***	0.21	0.05	0.00***	0.18	0.04	.00***
Duration: Utterance- medial	0.12	0.11	0.30	-0.29	0.12	0.01*	-0.16	0.10	0.13
Duration: Utterance- final	-0.06	0.08	0.45	0.03	0.07	0.69	-0.02	0.07	0.75

Table 27. Logistic regression: Effects of acoustic values on plural selection; main effects for high SES females (V.f)

Group	Young			Middle			Older		
	β	St. Error	p-value	β	St. Error	p-value	β	St. Error	p-value
H1*-H2*	0.13	0.04	0.00**	0.11	0.05	0.02*	0.04	0.04	0.32
F1	0.16	0.05	0.00***	0.08	0.05	0.11	0.05	0.04	0.30
Duration: Utterance- medial	0.07	0.10	0.49	-0.34	0.12	.00**	-0.20	0.11	0.06
Duration: Utterance- final	0.05	0.07	0.52	0.13	0.13	0.08	0.08	0.07	0.24

Table 28. Logistic regression: Effects of acoustic values on plural selection; main effects for high SES males (V.m)

Group	Young			Middle			Older		
	β	St. Error	p-value	β	St. Error	p-value	β	St. Error	p-value
H1*-H2*	0.15	0.04	.00***	0.13	0.05	.01**	0.06	0.04	0.15
F1	0.34	0.05	.00***	0.26	0.05	.00***	0.23	0.05	0.00***
Duration: Utterance- medial	0.06	0.10	0.54	-0.34	0.13	.01**	-0.21	0.11	0.05
Duration: Utterance- final	-0.11	0.07	0.12	-0.03	0.08	0.72	-0.08	0.07	0.26

Using the tables above, I then created Table 29 below to summarize the main effects for each demographic group. According to this table, participants are more likely to identify stimuli as plural in the following cases.

Table 29. Summary of significant cues for plurality according to demographic

Demographic group	H1*-H2*	F1	Duration	
			Utterance-medial	Utterance-final
Young working class females (LP.f.1)		More likely to identify stimuli with higher F1 as plural ($p < .01$)		
Middle working class females (LP.f.2)			More likely to identify significantly <i>shorter</i> stimuli as plural ($p < .01$)	More likely to identify significantly longer stimuli as plural ($p < .01$)
Older working class females (LP.f.3)				More likely to identify significantly longer stimuli as plural ($p < .05$)
Young working class males (LP.m.1)		More likely to identify stimuli with higher F1 as plural ($p < .001$)		
Middle working class males (LP.m.2)		More likely to identify stimuli with higher F1 as plural ($p < .01$)	More likely to identify significantly <i>shorter</i> stimuli as plural ($p < .01$)	
Older working class males (LP.m.3)		More likely to identify stimuli with higher F1 as plural ($p < .01$)		
Young professional class females (V.f.1)	More likely to identify breathier stimuli as plural ($p < .01$)	More likely to identify stimuli with higher F1 as plural ($p < .001$)		
Middle professional class females (V.f.2)	More likely to identify breathier stimuli as plural ($p < .05$)		More likely to identify significantly <i>shorter</i> stimuli as plural ($p < .01$)	
Older professional class females (V.f.3)				

Young professional class males (V.m.1)	More likely to identify breathier stimuli as plural ($p < .001$)	More likely to identify stimuli with higher F1 as plural ($p < .001$)		
Middle professional class males (V.m.2)	More likely to identify breathier stimuli as plural ($p < .01$)	More likely to identify stimuli with higher F1 as plural ($p < .001$)	More likely to identify significantly <i>shorter</i> stimuli as plural ($p < .01$)	
Older professional class males (V.m.3)		More likely to identify stimuli with higher F1 as plural ($p < .01$)		

As can be observed, each group of speakers relies on a unique configuration of strategies to determine plurality in this task. Here, I examine the cues that each demographic group relied on in order to identify plurality in this experiment.

Young, female speakers in the low SES group rely on F1 lowering to assign a plural response, a cue also relied on by all males in the low SES group. Middle and older age group females in this low SES group are both more likely to identify stimuli as plural if they are lengthened in utterance-final position, and they are the only demographic group to attend to this cue.

Interestingly, only middle age group members, across both SES groups and both genders, are sensitive to utterance-medial vowel shortening as a plural marking strategy. That is, 26-41 year olds are the only listeners to identify shorter utterance-medial vowels as plural.

All males in the working class rely on F1 lowering to identify vowels as belonging to plural words, and this is the only cue used by the youngest and oldest males. As mentioned, it is also the only cue used by the young females in this SES group.

In the higher SES group, young females use both vowel breathiness (higher H1*-H2*) and vowel lowering to identify a stimulus as plural. Middle age group females identify breathier vowels as belonging to plural words, and are more likely to identify shorter stimuli as plural in

utterance-medial position. The older females in this higher SES group do not use any cues to identify plural words. That is, there were no significant differences in their responses as singular or plural based on continuous values of the stimuli.

All of the high SES males relied on vowel lowering to identify plurality, and young and middle-age group males also relied on breathiness. Additionally, only middle age group listeners identified shorter stimuli as plural when in utterance-medial position.

In sum, F1 lowering is used by all males and young females of both SES groups to identify a vowel as plural. Vowel shortening is used by only middle age group members across genders and SES groups, and breathiness is relied upon by only the young and middle-aged listeners in the higher SES group.

Figure 55 below demonstrates the number of cues used to perceive a plural word according to age, gender, and SES of the participant. Note that males and females in the low SES group use the same number of cues to perceive plurality, while males in the high SES group use more cues than the older and middle-aged females, and young males and young females use the same number of cues.

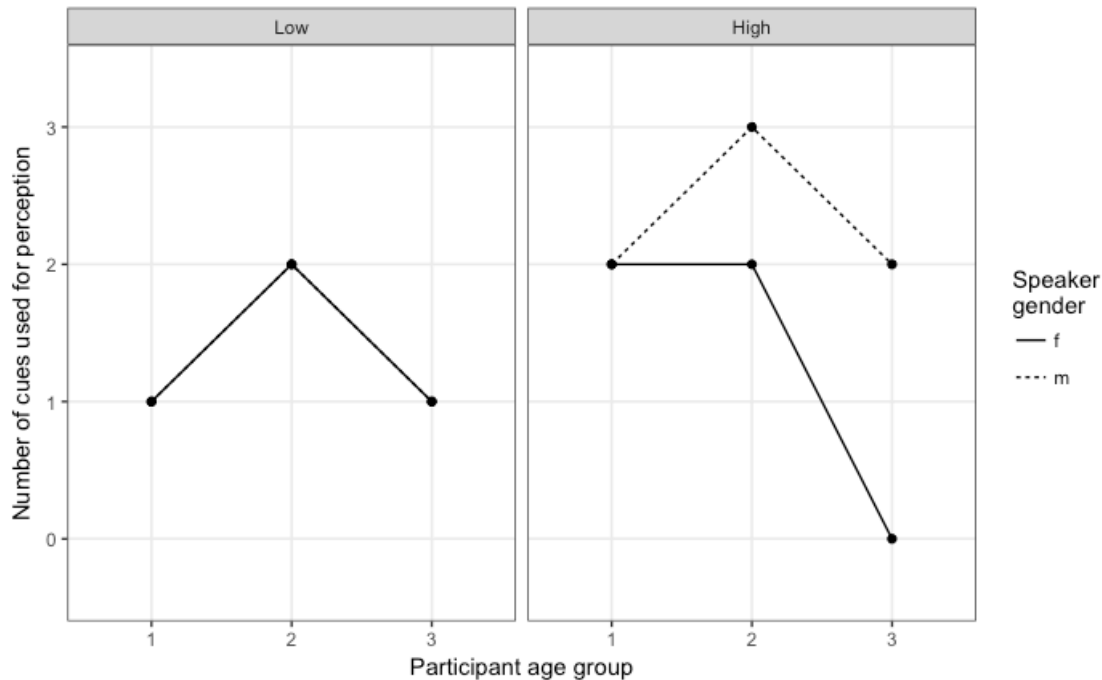


Figure 55. Number of cues used to identify plural vowels

5.6. Visual prime analysis

Following Hay, Warren, & Drager (2006), I hypothesized that the demographics represented in the visual prime images would have an effect on plural selection. Before running a model testing whether participants' responses varied based on the perceived demographics in the visual prime images, I explored the data, and determined that I needed to include an interaction between participant age and the gender of the visual prime. All other predictors, including demographics of both participant and visual prime, were included as simple terms.

To explore the effects of the visual prime demographics on the likelihood that participants would identify a stimulus as plural, I ran a logistic regression in R with plural identification as the binary dependent variable, and 'participant' included as a random effect. In Example 23 below, I show the R code used to obtain the output presented in Table 30 below.

```

Example 23. piceffectf<-glmer(plukey ~
partage*picgender+
partses+
relevel(picses, 'low')+
relevel(picage, 'young')+
partgender+
(1 | part), data = picdata, family = binomial, control = glmerControl(optimizer =
"bobyqa", optCtrl=list(maxfun=2e8)))

```

Table 30. Logistic regression results: Effects of visual prime and participant demographics on plural identification

	Logistic regression: Effects of picture demographics on a plural response			
	β (coefficient)	Standard Error	<i>t</i> value	<i>p</i> value
Intercept	-1.22	.30	-4.04	.00***
Participant age				
Young	Ref	-	-	-
Middle	-.11	.33	-.33	.74
Old	.97	.34	2.87	.00**
Picture gender				
Female	Ref	-	-	-
Male	-.00	.06	-.01	.99
Participant SES				
Low	Ref	-	-	-
High	-.44	.27	-1.60	.11
Picture SES				
Low	Ref	-	-	-
High	-.03	.04	-.72	.47
Picture age				
Young	Ref	-	-	-
Older	.01	.04	.39	.70
Participant gender				
Female	Ref	-	-	-
Male	-.72	.27	-2.62	.00**
Interaction: Participant age by picture gender				
Participant age 2 x Male	.22	.09	2.38	.02*
Participant age 3 x Male	-.12	.09	-1.4	.16

This model reveals a significant main effect for participant gender. That is, males are significantly less likely to identify a stimulus as plural ($p < .05$), regardless of its underlying plurality and regardless of the visual prime with which they are presented.

Additionally, a simple main effect obtained for the ‘participant age’ predictor. When primed with a visual image of a female, young and middle age group listeners do not differ in their identification of a stimulus as plural. However, older participants are significantly more likely to identify a stimulus as plural when presented with a visual prime of a female. When I relevelled the ‘picture gender’ factor to test the effect of the male visual prime on responses according to the different age groups of the listeners, I determined a similar pattern: older participants are significantly more likely to identify a stimulus as plural when presented with a male visual prime ($\beta=.85$, $S.E.=.34$, $p<.05$) as compared to young and middle age group speakers. Therefore, it appears that older listeners are more likely to identify a stimulus as plural regardless of the gender of the visual prime. Additionally, middle age group speakers respond significantly differently according to the gender of the visual prime: middle age group participants are significantly less likely to identify a stimulus as plural when they are presented with a female picture ($\beta=-.22$, $S.E.=.07$, $p<.001$). These relationships can be visualized in Figure 56 below.

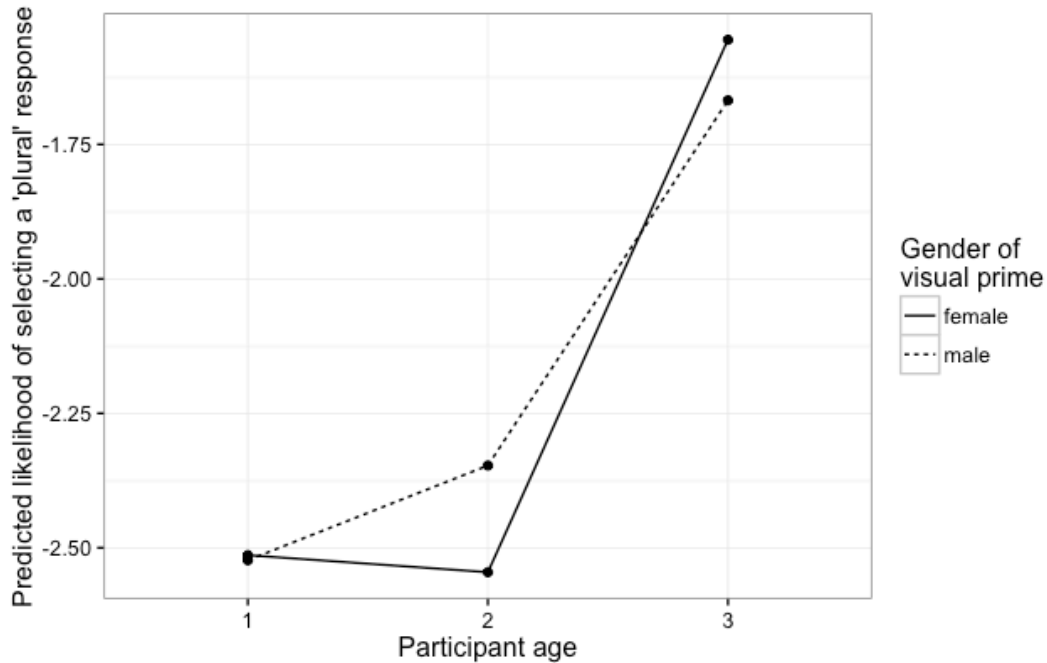


Figure 56. Interaction effect of participant age and visual prime gender

In sum, according to these results, younger and middle-aged participants are overall *less* likely to identify a stimulus as plural, older participants are overall *more* likely to identify a stimulus as plural, and participants belonging to the middle age group are *less* likely to identify a stimulus as plural when presented with a female visual prime. In other words, members of the middle age group are more likely to believe that a female speaker is producing a singular word, providing initial evidence for a gender-based difference in perception.

No other effects obtained for the demographics of the visual prime, in contrast with what previous work regarding exemplar theory would predict. That is, the perceived SES of the visual prime did not affect participants' responses as singular or plural, nor did the perceived age of the visual prime.

5.7. Reaction time analysis

Finally, I was interested to see whether participant demographics or visual prime demographics caused any differences in response times. Drager (2005) found that listeners' reaction times and responses to the perceived boundary of a vowel shift were significantly conditioned by both the social class represented by the visual prime and the social class of the participant themselves. Specifically, she found that working-class participants were faster to respond to voices associated with working-class photos than middle-class photos, and that the opposite effect was found for middle-class listeners. She interprets this finding through exemplar theory, arguing that if a group is familiar to you, exemplars from that group will be more activated (and thus contribute to a faster response time).

For this analysis, I included only correct responses (that is, 'hits' and 'correct rejections'), for a total N of 11,003. Reaction times were measured from the offset of the stimulus so that I could ensure that participants heard the whole word (including the test item at the end of the word) before providing a response. I follow Luce (1986), who states that genuine reaction times will be at least 100 milliseconds long, due to the time it takes for a response to be processed and a motor reaction to be carried out, in excluding any reaction times faster than 100 milliseconds (N=14). According to Whelan (2008), it is difficult to establish an exclusionary cutoff for slower responses. Additionally, given the right-skewedness of the data, I followed the recommendation of Levshina (2015:59) in using a normalization method based on median scores rather than means, using Median Absolute Deviation scores (MAD-scores). I centered and standardized the reaction times using the data.Normalization function in the clusterSim package (Walesiak and Dudek 2017), using method "n2", which standardizes the data based on subtracting the median of the variable from each observation, and dividing that value by the MAD score. The median

reaction time score prior to this transformation was 1.07 seconds, while the mean was 1.285. Following the standardization by MAD score, I eliminated any observations slower than 2 standard deviations above the MAD score (N=1406) and any observations faster than 2 standard deviations below the MAD score (N=10), leaving 9573 observations for analysis. A histogram of these remaining observations is shown below.

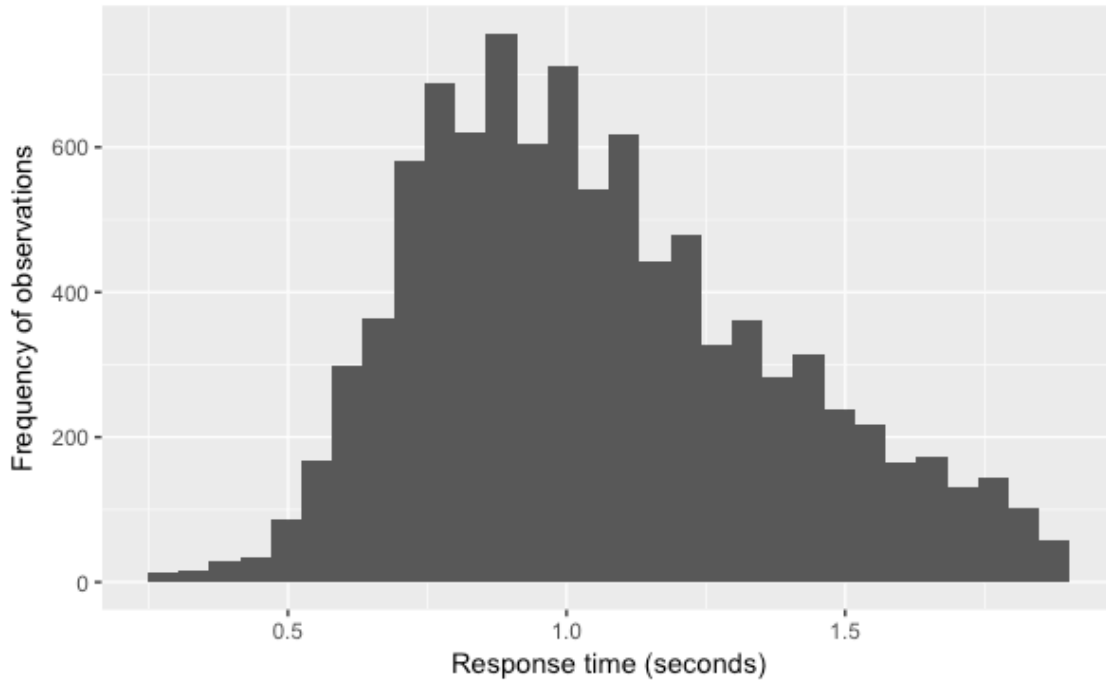


Figure 57. Histogram of response times (N=9573)

In the analysis, I wanted to test whether there were effects of either participant demographics or visual prime demographics on participants' reaction times. Prior to fitting the model, I explored the data visually to determine whether I should include any interactions, and determined that an interaction between participant SES and picture SES should be included. I therefore fit a mixed-effects model with normalized reaction time as the continuous dependent variable, and predicted whether this reaction time would change based on participant age,

gender, or SES interacted with picture SES, and simple terms of picture age and gender. The results of the model are as follows.

Table 31. Results of linear regression examining predictors of response times

Linear regression: Effects of demographic predictors on reaction times			
	β (coefficient)	Standard Error	<i>p</i> value
Intercept	.03	.11	.78
Participant gender			
Female	Ref	-	-
Male	-.09	.10	.95
Participant age			
Young	Ref	-	-
Middle	-.02	.12	.87
Older	.46	.12	.00***
Participant SES			
Low	Ref	-	-
High	-.12	.10	.24
Picture gender			
Female	Ref	-	-
Male	-.04	.01	.01**
Picture age			
Younger	Ref	-	-
Older	-.00	.01	.84
Picture SES			
Low	Ref	-	-
High	-.04	.01	.12
Interaction: Participant SES by Picture SES			
High participant SES x High picture SES	.02	.03	.53

As the results demonstrate, older participants were significantly more likely to respond more slowly to the stimuli. It is impossible to know, however, whether this is due to a motor issue related to more advanced age, or whether this latency is due to confusion or mismatch between the auditory and visual stimuli.

The model also revealed that participants were overall significantly faster to respond when presented with a male picture, and data visualization showed that this effect held across

both male and female participants. That is, both males and females are faster to respond to male stimuli. The model did not reveal any other main or interaction effects.

5.7.1. Limitations of Reaction Time Analysis

This task was participant-paced. In other words, the program would not move to the next item until participants had pressed one of the two response keys. During the instructional phase, if participants asked, I told them each item required an answer, so they had to push something, and reiterated that if they weren't sure what to press, that they should just rely on their intuition. Once they provided a response by pressing a key, the program waited 1.5 seconds before presenting the next set of stimuli.

Therefore, timing for completion of the task varied greatly. Younger participants tended to be faster, and could complete the task in approximately 15-20 minutes. This is likely due to their familiarity with current forms of technology. Older participants tended to take longer, which could be attributed to either motor issues or perhaps a lack of familiarity with technology. Additionally, older participants were more likely to perform an unsolicited type of monitoring: as they listened, they would at times speak (their perception of) the words aloud.

Participant fatigue in the visual prime task was certainly an issue. There were a total of 360 items presented, and several participants asked questions such as “falta mucho?” (*Is there much left?*) or “cuánto dura?” (*how long does this take?*) usually near the end. Following the perception task, all participants were asked what they thought of it. Specifically, I asked the open-ended question of “¿Qué le/te pareció?” (*what did you think?*) Responses to this question provided a rich body of qualitative results.

5.8. Anecdotal feedback regarding perception test and success of guises

As mentioned above, following the perception task, participants were asked what they thought of it. Some participants offered feedback about the lexical items themselves, anecdotally confirming my selection of these items. For instance, one participant (LP.m.2.01) said “fueron cosas diarias, como *casa y amigos*, cosas que podrías escuchar todos los días” (*they were daily things, like house and friends, things you could hear every day*). Similarly, LP.m.1.03 said the words were “very Chilean” (*fueron muy chilenas las palabras*) and that he thought the items had been selected from a political discourse.

Many individuals commented on the visual prime guises and associated them with the auditory stimuli. For instance, V.f.3.01 said “había algunos que hablaban super bien” (*some spoke super well*). When I asked her to elaborate on which ones spoken better, she specified that both the professional males spoke well, while “[she] didn’t understand anything the [male] construction worker said.” Recall that the auditory stimuli were all the same; the participants were primed with different images but heard the same speaker saying the same word each time. Female participant V.f.2.02 said that social class was clearly and appropriately marked in the pictures. When I asked her to elaborate she said, “socialmente hablando. O sea, por los rasgos físicos y también su entorno. Obviamente el joven cuico está en la nieve, la señora gordita trabajadora, y el obrero” (*socially speaking. Or, because of their physical features and also the environment. Obviously the young cuico is up skiing, the older chubby working lady, and the construction worker*). Additionally, LP.m.2.02 commented that “hay fotos que te causan rechazo, como la del flaite” (*there are some pictures that cause a sense of rejection, like that of the flaite*).

In true Chilean slang style, when asked what he thought of the task, V.m.2.04 said “hay weas que en verdad no cacho lo que dicen” (*there’s some shit that I truly had no idea what they*

were saying). Indeed, several participants stated that they had trouble understanding some of the items, saying things like ‘no lo escuché’ (*I didn’t hear it*). For instance, LP.f.3.04 said the following phrases out loud throughout the task: “No escuché nada de lo que dijo ella; ya me confundí ya; no se entiende” (*I didn’t hear anything of what she said; I’m already confused; you can’t understand it*). Future studies of this style should select stimuli below a particular speech rate threshold in order to ensure that participants have not only morpho-phonological but lexical access to the word.

Finally, and of interest to the present study, following the perception experiment many participants mentioned final /s/ explicitly, often commenting that Chileans ‘eat’ the /s/. When I asked them to expand on that, and specifically, whether the lack of overt /s/ made the task more challenging, some said yes. Others said that when they encounter this issue, they listen for the ‘entonación’ (*intonation*) of the final vowel, or its length.

For instance, LP.f.2.03 reported following the perception task that “me di cuenta que hablamos mal. Tenían que ser plurales pero no se entendía la s” (*I realized that we speak badly. [These words] had to have been plural but you couldn’t understand the ‘s’*). I followed up with this comment, asking how this participant knew which button to push if there was no explicit [s], and she said “hay un alargue de la última letra, como momentos, pocas, es como la clave, yo también la uso” (*there’s a lengthening of the last letter, like momentos, pocas, it’s like the key, I use it too*). Male participant V.m.1.02 stated “Aquí la gente se come las letras” (*here people eat their letters*). When I followed up to ask him, “Entonces cómo te das cuenta de la cantidad de cosas?” (*how do you know the quantity of things*), he responded “por la entonación, o se alargan las palabras; da la sensación que están hablando en plural” (*because of the intonation, or the words are lengthened; you get the feeling that they’re speaking in the plural*). Older male

participant V.m.3.01 said something similar: “es muy difícil darse cuenta si están hablando en singular o plural, sobre todo cuando es una palabra suelta, aislada, mal pronunciada. Los chilenos se comen las eses, y hay un cambio de todo no más, alarga la ‘a’ final si ya es plural” (*it’s really difficult to realize whether people are speaking in singular or plural, especially when it’s a single, isolated, poorly pronounced word. Chileans eat their eses, and there’s a complete change, they lengthen the final ‘a’ if the words is plural*).

Male participant V.m.1.05 said that Chilean *females* commonly use this lengthening strategy: “en vez de pronunciar las cosas, con *ese*, se pronuncian con la vocal... o sea se alargan... las mujeres hablan como que con más flojera” (*instead of pronouncing things, with s, they pronounce them with the vowel... I mean they’re lengthened... women speak with more like laziness*). This particular participant’s observation was actually correct, in that young women do lengthen utterance-final vowels to mark a plural, though not in his own demographic group. Additionally, his group of young, high SES males was not overall sensitive to that utterance-final plural lengthening.

Finally, male participant V.m.2.05 associated /s/ deletion with *social status*, saying “de repente gente de otros estratos igual la cortan” (*sometimes people from other social strata cut it off too*).

In summary, participants made overt mention of several key components of the experiment, such as matching versus occasional mismatch of visual guise and auditory stimuli, and lengthening of final vowels. Overall, participants found the task challenging, likely due to the nature of the stimuli selected. Several potential changes could be made to future studies like this one, including ensuring that selected stimuli are produced slowly enough to ensure comprehension, while still attempting to mirror a normal speaking rate. Studies including both

males and females may also need to ensure that pitch (especially for the female speaker) is within a less variable range.

Future studies could also test for pitch (F0) effects across singular vs. plural words, to examine this intuition that several participants mentioned regarding the intonation of plural words, especially the hypothesis that this strategy is indexed with a female identity.

5.9. Discussion of Perception Results

5.9.1. D-prime Scores

As presented above, young females in the high SES group were significantly more sensitive to the paradigm than their low SES counterparts. This does not necessarily mean that they perceived more cues, but that they were not only more likely to identify plural items as plural, but also refrain from identifying singular items as plural. They were not, however, more sensitive than their male or older counterparts in the high SES group. Similar to the argument in Chapter 4, I posit that female members of the low SES are less likely to be exposed to speakers outside their demographic, and therefore may have a limited amount of sensitivity to stimuli that originated in a higher SES group.

5.9.2. Cue Sensitivity

As mentioned above, breathier vowels were identified as plural by younger and middle-aged males and females in the high SES group, while no members of the low SES group were sensitive to this measure. Recall that the stimuli themselves did not differ along this dimension, so the sensitivity of these speaker-listeners implies that this cue is somehow relevant for them in their daily lives.

Higher vowels (that is, vowels with a lower F1) were identified as plural by *all* of the male listeners, as well as young female listeners. This association of vowel lowering with plurality on the part of all male speakers is particularly interesting given the more disparate F1 findings in production, which will be discussed in the next chapter. A potential limitation of this finding is that, as in the previous chapter, F1 values were normalized based only on speaker sex, so there may be some inherent variation in the vowel quality of the stimuli used. However, again, this robust finding demonstrates that a lowered vowel as a cue for plurality may be meaningful in the broader listening and processing experiences of these participants.

Only middle age group listeners perceived shortened utterance-medial vowels as plural, across both SES groups and genders. Interestingly, this demonstrates that these listeners are sensitive to the prosodic features of the stimuli. That is, listeners were presented with isolated stimuli and asked to identify its plurality, and these listeners all perceived shortened vowels as plural in utterance-medial position, while no such effect obtained in utterance-final position. Christophe et al. (1994) demonstrated that French infants are sensitive to word boundaries in French, and Christophe et al. (2001) demonstrated that French infants are also sensitive to word boundaries in Spanish. The authors posit that this may be due to both higher pitch, higher intensity and longer delays between vowel onset to vowel onset in the boundary vs. non-boundary condition. These may therefore be useful cues to test in the future for this contrast, but for now, the results of this experiment have demonstrated that adult listeners are sensitive to utterance-medial shortening on plural vowels.

Finally, as described above, only the middle- and older-age females in the low SES group were sensitive to utterance final lengthening, and were more likely to identify longer utterance-final vowels as plurals. No other demographic groups perceived this contrast, and the fact that

the younger listeners did not perceive this difference calls into question its salience and reliability.

5.9.3. Visual Guises

Unlike what I had predicted, there were no differences in responses based on the visual primes. I posit that this is due to the gender mismatch as described above, given the female speaker's broader pitch range, as well as the potentially imprecise assignment of visual guise images to the paradigm.

5.9.4. Reaction Times

Regarding the findings of the reaction time analysis, as mentioned, older participants were more likely overall to take longer to respond to the stimuli. This may be due to a motor issue related to their more advanced age, or it could be due to a mismatch between the stimuli and the visual prime. That is, if these listeners expected to hear an apparently 'older' speaker using a particular configuration of cues, and did not hear the cues they expected, this might cause a delay in their response time.

Additionally, the findings above reveal that participants are faster to respond to male guises across the board. There are a few possible interpretations of this finding. First, as demonstrated via the stimuli analysis above, only the male stimuli speaker differentiated his vowels via a lowering of the plural vowels, while there were no differences in the female's stimuli. Perhaps this mismatch between what listeners expected to hear given the visual prime and what they actually heard differed enough to cause a longer reaction time. In other words, perhaps they found the male speaker's stimuli more reliable, which therefore facilitated a faster response. An alternative possibility is based on some anecdotal feedback collected from participants following the task. Specifically, some speakers such as V.f.1.02 claimed that

“entendía mejor a los hombres” (*I understood the male speakers better*). Male V.m.2.02 said that “a few of the photos had nothing to do with the word he heard.” When I asked him to elaborate, he said “no sé, una foto de una chica y habló un hombre” (*I don’t know, a photo of a girl and a male speaking*). The female speaker did have a broader pitch range, and particularly at the end of an utterance, would use a lower-pitched (and at times creaky) voice; perhaps it was this to which he was referring. Again, this apparent mismatch may have caused a lengthier response time.

5.10. Summary

In this chapter, I have determined what acoustic cues listeners attend to in order to identify a stimulus as plural, and whether the cues attended to varied according to who the listener was, and who the speaker was perceived to be. According to the analyses presented in this chapter, overall, participants are biased toward identifying items with no overt /s/ as singular, though young females in the high SES group proved to be more sensitive than females in the lower SES to the paradigm. The analyses also revealed that different groups relied upon different cues to identify plurality, and that in general, members of the high SES used more cues to differentiate singular from plural words. Additionally, in general, older listeners were slower to provide correct responses, while all listeners provided a correct response more quickly when presented with a visual prime of a male. In the next chapter, I examine the results from chapters 4 and 5 in conjunction with one another, to examine the connections between production and perception of the singular~plural contrast in Chilean Spanish.

Chapter 6. Discussion and Conclusions

In this dissertation, I have aimed to provide evidence for several research questions regarding the production and perception of plural vowels in Santiago Spanish. The first questions related to whether and how speakers distinguish between singular and plural vowels in production according to previous impressionistic hypotheses. I showed that different demographic groups used different acoustic and prosodic cues to differentiate their singular from their plural vowels using acoustic analysis over the final third of final vowels of words extracted from naturalistic sociolinguistic interviews. Additionally, I demonstrated that these same stratified groups of listeners relied on different acoustic cues to identify the plurality of isolated words. These words had been extracted from sociolinguistic interviews and presented to listeners in a forced-choice perception experiment in which each auditory stimulus was preceded by the presentation of a visual prime differing by perceived age, gender, and socioeconomic status. In the remainder of this chapter, I present a synthesis of the cues used for both production and perception, and argue that mismatches between production and perception of the different acoustic cues signal instability in the marking of this contrast.

6.1. Production and Perception Considered Together

Traditional linguistic accounts posited that speech production and perception would be closely matched or aligned, or that changes in production would be accompanied by changes in perception (such as proponents of Motor Theory, cf. Liberman et al. 1967; Liberman and Mattingly 1985; Fowler 1981, 1986). The existence of categorical perception, or listeners being able to consistently identify a boundary between scalar representations of sounds such as /ba/ and /pa/ provide some evidence for the existence of the theoretical entities most often described as

phonemes (though listeners are often unable to reliably discriminate between two members of the same category, cf. Casserly and Pisoni 2010). However, some studies have shown that this link is not as precise as previously believed. For instance, Evans and Iverson (2007) demonstrate through a long-term study of British university students that subjects changed their accent after attending university, but there were no reliable changes in listener perceptions of exemplars overall. However, they did find a link between individual subjects' overall production and perception. Several other recent studies incorporating variation have demonstrated that the link between production and perception is not quite as precise as previously believed (Beddor 2009; Beddor et al. 2013; Harrington, Kleber, & Reubold 2008; Kleber, Harrington, & Reubold 2012).

For instance, Kleber et al. (2012) examine lax /ʊ/ fronting in Standard British English, and find that /ʊ/ is fronted in both production and perception by younger speaker-listeners. According to these authors, perceptual compensation for coarticulation occurs before productive compensation for articulation, showing that perception and production of coarticulation may be misaligned with respect to each other for some speaker-listeners participating in a sound change in progress. This line of argumentation follows Ohala's (1993), who claims that sound change is initiated when listeners reanalyze coarticulatory effects in the input. In Kuang and Cui's (2016) study, they find that cue weights are not aligned between production and perception of the tense~lax contrast in Southern Yi. That is, they find that rather than phonation, F1 is the dominant cue for all age groups used in the identification of stimuli. This mirrors Kuang's (2011) findings that show that younger speakers tend to use vowel quality differences to distinguish tense /e/ from lax /e/ in this dialect. Kuang and Cui (2016) claim that in their data, formant cues have become more dominant in perception before a similar shift occurs in production, aligning with Ohala's findings.

Along this same line of research, Beddor (2015) explores the nature of the link between a speaker-listener's articulatory and perceptual repertoires or grammars, with an added element of understanding for variation across individuals. Her main question is whether listeners who produce more innovative variants also weight the innovative property more heavily in perception. She provides evidence from two ongoing projects, both of nasal production and perception in American English, and a change in progress in obstruent voicing in Afrikaans. In American English, she finds that coarticulatory nasalization in production is variable but stable for female American English speakers, and that there are some individual outliers. She also finds some differences in how these speakers perceived nasalization using an eye-tracking study, revealing that listeners differed systematically in their moment-by-moment processing of coarticulation. She also describes a change in progress in Afrikaans (cf. Coetzee, Beddor, and Wissing 2014). In these data, phonologically voiced stops often lack prevoicing, particularly among younger speakers. For these stops that lack prevoicing, the voicing contrast is not neutralized, but rather maintained through the use of the F₀ contour of the post-stop vowel. The authors determined F₀ was stable in production and relied upon in perception, and that use of VOT was dependent on participant age: older listeners are more likely to produce prevoiced /b/, and also are more influenced by this cue than younger listeners in a perception task. In sum, Beddor (2015) discusses the trading relations of the multiple cues that may signal a contrast, under the assumption that the perceptual weights that listeners assign to the covarying phonetic properties for a phonological contrast will be manifested in those individuals' production of that contrast. In other words, Beddor claims that individuals whose production and perception match are to be expected. She claims that we may also expect to find individuals who are inconsistent

producers of a contrast, but who are reliable perceivers. Unexpected, though, would be reliable producers who are insensitive perceivers.

This distribution is similar to that described in Labov et al. (1991). These authors describe testing for vowel mergers using a minimal pair test, and provide the following schema to conceptualize an individual’s production and perception of phonological contrasts, particularly in the case of American English vowels undergoing shifts.

		Spoken	
		Same	Different
Judged	Same	A	B
	Different	C	D

Figure 58. Schema for production and perception of vowel merger, replicated from Labov et al. (1991:37)

According to Labov et al. (1991), we would expect entries to occur in cells A and D, where production and perception are matched according to a categorical view. In my data, this is the case for the utterance-medial duration cue: middle-age group speakers are the only groups to produce their plural utterance-medial vowels as consistently shorter than their singular utterance-medial vowels, and these middle-age group participants are also the only listeners who identify this shortening as a salient cue for plurality in perception. I posit that this is further evidence for this particular dimension to be considered stable, age-graded variation: it is a reliable cue across middle-age group speakers and listeners.

Additionally, Labov argued that items in cell C could be understood as words that are spoken as the same by the speaker but heard as different (he gives the examples of *latter* and *ladder*, or *which* and *witch*). For Beddor (2015), these are the inconsistent producers but reliable perceivers, as in Figure 59 below.

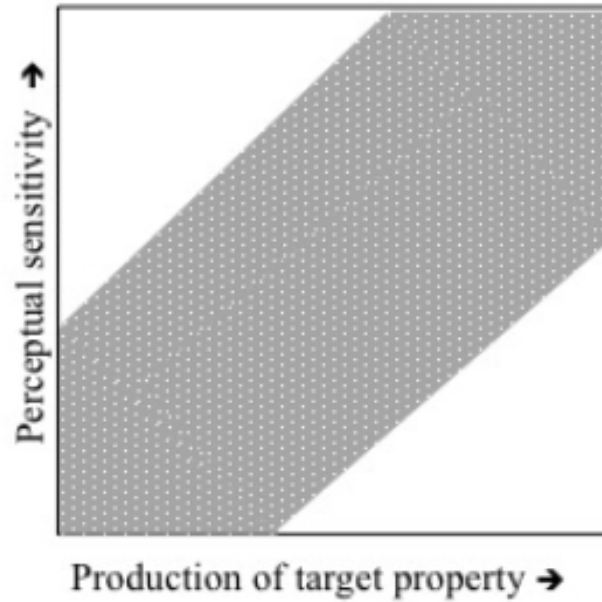


Figure 59. Schematic representations of relations between production and perception (replicated from Beddor 2015:7, originally Figure 7). Non-shaded, lower-right region: reliable producers but insensitive perceivers. Non-shaded, upper-left region: weak or inconsistent producers but attentive perceivers.

In my data, there are several instances representative of the upper-left region, in which individuals do not necessarily produce a contrast along a particular dimension, but do perceive one. I provide Table 32 below in order to help the reader visualize the different groups and their distributions of cues.

Table 32. Cues in production and perception by demographic group

Demographic group		H1*-H2*	F1	Duration	
				Utterance-medial	Utterance-final
Young working class females (LP.f.1)	Production	Plurals breathier			Plurals longer
	Perception		Plurals lower		
Middle	Production		Plurals <i>higher</i>	Plurals <i>shorter</i>	

working class females (LP.f.2)	Perception			Plurals <i>shorter</i>	Plurals longer
Older working class females (LP.f.3)	Production		Plurals <i>higher</i>		
	Perception				Plurals longer
Young working class males (LP.m.1)	Production	Plurals breathier			
	Perception		Plurals lower		
Middle working class males (LP.m.2)	Production			Plurals <i>shorter</i>	
	Perception		Plurals lower	Plurals <i>shorter</i>	
Older working class males (LP.m.3)	Production	Plurals breathier	Plurals <i>higher</i>		
	Perception		Plurals lower		
Young professional class females (V.f.1)	Production	Plurals breathier			
	Perception	Plurals breathier	Plurals lower		
Middle professional class females (V.f.2)	Production			Plurals <i>shorter</i>	
	Perception	Plurals breathier		Plurals <i>shorter</i>	
Older professional class females (V.f.3)	Production	Plurals breathier			
	Perception				
Young professional class males (V.m.1)	Production	Plurals breathier	Plurals lower		
	Perception	Plurals breathier	Plurals lower		
Middle professional class males (V.m.2)	Production	Plurals breathier		Plurals <i>shorter</i>	
	Perception	Plurals breathier	Plurals lower	Plurals <i>shorter</i>	
Older professional class males (V.m.3)	Production	Plurals breathier			
	Perception		Plurals lower		

Instances of mismatch between a cue perceived but not produced include the following. In the case of breathiness, middle age group high SES perceived but did not produce plurals as

significantly breathier. However, as evidenced, this is a cue used by all of the other individuals in the higher SES, so it is clearly a reliable cue and a perception pattern that can be explained via their exposure to the other people in their own neighborhood and demographics. Additionally, there are many instances of mismatch in the production and perception of the F1 cue. Only the young male high SES speakers lower their plural vowels, while all males and young females in both SES groups perceived lowered vowels to be plural. The magnitude of this mismatch, i.e. that so many groups would perceive this difference while not producing it, leads me to posit that its production may be more widespread than that shown here, which will require further verification via future production studies. The final instances of mismatch occur regarding the utterance-final lengthening cue, which is perceived by middle-age group and older age group females in the lower SES, but not produced by them. In fact, the only group that reliably differentiates these vowels is the young females in this same demographic group.

Returning to Figure 58, Cell B in which individuals produce a difference but do not perceive one was previously theorized to be empty, because “speakers could hardly learn to make a difference without perceiving it” (Labov, Karen, & Miller 1991, 38). However, several studies, including some of Labov’s own work, have found that in fact, speakers do produce items as phonologically contrastive but perceive them to be the same, and Labov, Yaeger, and Steiner (1972) termed this *near-merger*. Near-merger has now been attested in several dialects of English (including the vowels in *source* and *sauce* in New York City (Labov, Yaeger, and Steiner 1972, 1:Ch. 6); *fool* and *full* in Salt Lake City (Di Paolo 1988); *meat* and *mate* in Belfast (Harris 1985), *caught* and *cot* in San Francisco (Hall-Lew 2013), and *Ellen* and *Alan* in New Zealand English (Hay, Drager, and Thomas 2013). Janson and Schulman (1983) also reported evidence for near-merger in Swedish vowels, and find that residents of the city of Lycksele

produce a four-way vocalic distinction while Stockholm residents produce a three-way distinction, but both groups perceive only a three-way contrast. Yu (2007) has also provided evidence for near-merger of morphological tone in Cantonese, advocating an exemplar-based representation of the speech-processing system.

In my data, there are several instances in which speakers produce singular and plural items using different acoustic measures, but do not perceive them as different according to the same cues (representing the lower-right region in Figure 59). For instance, low SES middle-aged and older female speakers raise their plural vowels (lowering the vowels' F1), as do older male speakers in this working-class neighborhood. However, these participants are not likely to identify words with a lowered F1 as plural, and in fact, the male participants are likely to identify words with a *raised* F1 as plural. Additionally, as discussed in chapter 4, neither younger males nor younger females in this low SES group differentiate their singular and plural vowels using F1 (using *either* raising or lowering). The lack of use of F1 alternation by the younger generation, as well as the cue mismatch on the part of these older speakers causes me to posit that plural vowel raising is losing ground in both production and perception, and is therefore in a current state of near-merger, as it moves toward merger of singular and plural vowels along the F1 dimension. However, this narrative would be incomplete without also considering that vowel lowering may be on the rise given that all of the males and some of the females were more likely to identify lower vowels as plural. Thus, the mismatch in cues may also be signaling *instability* as the saliency of the cue and its reliability is in flux.

Similarly, young females and younger and older males in the low SES group produce their plural vowels as breathier, but do not perceive breathier vowels as plural. I posit that for these speakers, the mismatch of this cue signals instability rather than near-merger, as some

young speakers are beginning to adopt this feature indexed with prestige or high status. That is, these younger speakers are beginning to adopt a feature of speech in high SES individuals, without necessarily being aware of this feature. However, this runs counter to the previously made argument that this is a change from above, since changes from above are characterized by an adoption of an overtly prestigious feature. Beddor (2015), however, posits that “otherwise expected links between a language user’s production and perception could substantially change if the target phonetic property were socially stratified [sic]” (7). She points to her and her collaborators’ work in Afrikaans, in which anticipatory vowel nasalization is a socially indexed property, in that speakers from different ethnic groups produce systematically different nasalization patterns (8), and is in the process of being verified perceptually. That is, as I have posited above, these low SES groups are beginning to adopt a feature that is indexed with high status, so its usage patterns are currently in flux, evidenced by a mismatch between production and perception. I predict that in the future, this change may continue to progress, and eventually become a salient perceptual identifier of plurality for these speakers. The near-merger argument, then, does not apply to this particular dimension of the singular~plural contrast.

Finally, regarding utterance-final lengthening, young females from the low SES group are the only group to lengthen their utterance-final plural vowels. However, they do not perceive this difference. Middle- and older- age group females in this SES group, however, are more likely to identify a lengthened, utterance-final vowel as plural, but do not produce it. I therefore posit that this is a change in progress, begun by these young working-class women, that is already becoming salient for middle- and older speakers, though these older speakers themselves have not adopted this differentiation in production, and may or may not in the future. Again, here, the production~perception mismatch is indicative of instability and nascent change (toward

differentiation of singular and plural vowels along a durational continuum), rather than in the direction of merger.

6.2. Summary and Conclusions

In this dissertation, I have examined production and perceptual cues of the singular~plural contrast in Santiago Spanish along multiple continuous dimensions. I have shown that these multiple dimensions are used in different ways by these diverse speakers.

For instance, utterance-medial shortening is a cue for plurality, produced and perceived by only members of the middle age groups across genders and SES groups demonstrating age grading and overall community stability. This stability is particularly striking given the differences between these speakers and these neighborhoods discussed in Chapter 3, as well as their geographical distance from one another.

Additionally, breathiness is a cue for plurality produced and perceived reliably by high SES speaker-listeners. Several members of the lower SES also produce their plural vowels as breathier, but do not perceive breathier vowels as plural. This mismatch signals the instability of the nascent change, which may attenuate the perceivers' attention (cf. Beddor 2015:7). This adoption of breathier plural vowels by members of the lower SES (particularly the younger members) leads me to posit that this is a change from above, in which speakers begin to use a phonetic cue indexed with high prestige or status.

Utterance-final lengthening is produced by not perceived by young females in the low SES, while middle- and older age group females in this neighborhood perceive breathier vowels as plural but do not produce them as such. Again, I posit that this mismatch signals instability of this cue as it is begun as a change from below by these low SES female speakers.

Finally, plural vowel lowering is produced only by young males in the high SES group, but is perceived by all males and young females in both SES groups. It is therefore a perceptually robust but seemingly unreliable cue, signaling some type of instability. Plural vowel raising, on the other hand, is produced by middle- and older age group speakers in the lower SES, but not perceived by any groups. I therefore posit that plural raising is moving toward loss, as younger speakers in the low SES do not produce their singular and plural vowels with any F1 differences.

Evidence for mismatch of production and perception has been found in several subfields of acoustic phonetics, most notably sociophonetics, and further instances of this mismatch may continue to be found as more researchers utilize perceptual studies in the pursuit of understanding how production and perception are aligned in the mind/brain. This dissertation aligns with accounts that index social features to acoustic measures, positing shifts along multiple acoustic dimensions signaling one morpho-phonemic contrast. I argue that mismatch of cues used in production and perception signals instability and change in progress, rather than near-merger.

6.3. Limitations and Future Directions

In this dissertation, I have provided an analysis of cues used in production and perception to signal plurality at one particular moment in time using an apparent-time approach. Future research is required to verify the several shifting cues I have posited here, ideally with some or all of the same individuals whose data are included here. For instance, will utterance-medial shortening continue to be associated with middle age groups, or is it indicative of a broader community shift across time? Will other low SES groups adopt plural breathiness due to its prestigious social value, and will breathiness become overtly indexed with prestige in perceptual studies? Will other groups adopt utterance-final lengthening? In what directions will the F1 cue

move, and will listeners continue to use it to identify plurality if it is no longer used in production? This study has examined two socially disparate groups, but how are other communities in Santiago producing and perceiving plurality? Finally, future explorations of this same phenomenon in other dialects of Spanish would permit me to determine whether use and perception of these vocalic strategies may be language specific (i.e. happen throughout dialects of Spanish) or dialect specific (i.e. whether they only appear in /s/ weakening dialects).

Additionally, previous research has posited that acoustic cues used to signal contrasts may shift and trade saliency with other cues that may already be included in the signal. Given the multiple dimensions and posited directions of the cues examined here, future studies should take into account the potential for cue weighting and trading relations that speakers may be using.

As mentioned above, the visual primes used in the perception study did not influence listeners' identification of the stimuli, and this may be due to incorrect calibration of these visual primes, or the guises not indexing the precise social and demographic values that I had originally believed they would. Therefore, a more precise account of the social indices of the multiple cues for this contrast is required.

Future explorations could also account for potential lexical effects. No corpus of spoken Chilean Spanish currently exists, but future studies could provide some sort of frequency coefficient for each word or root based on the words' appearance throughout the sociolinguistic interviews.

Additionally, according to a functionalist approach, the phonological system is based on two principles, which are at times in opposition to one another: minimize the speaker's effort, and also minimize the probability of confusion on the part of the interlocutor (Hayes 1996; Flemming 2004). Therefore, a functionalist outcome of vocalic merger between singular and

plural word types would be some other sort of compensatory mechanism. Poplack (1980b) states that in her Puerto Rican Spanish data there were no cases in which the *notion* of the plural was entirely absent, whether due to overt /s/ expression early in the NP, or due to other disambiguating factors (65). However, I have come across several cases of utterances that are completely ambiguous in terms of their plurality, in both my sociolinguistic interviews (at least one in most 60 sociolinguistic interviews, and some speakers had more than one) as well as overheard examples, such as the following:

Example 24. Overheard example of confusion

A: ¿Y tu[Ø] papá[Ø]?

B: ¿Mi papá?

A: O sea, ¿tu mamá y tu papá?

In this example, speaker A asks “And your parents?”, using the word *papás* meaning ‘parents’ in the plural but ‘father’ in the singular. Speaker B appears to misunderstand, asking a clarifying question, and speaker A repairs using circumlocution to confirm that he means “your mother and your father.” Perhaps, if merger of singular and plural vowels continues to progress, speakers will begin to use other discursive strategies to disambiguate situations like this one.

I aim to continue to monitor the progress of each of these shifts, as well as explore other cues that speaker-listeners may be using to distinguish between singular and plural NP constituents. The fundamental frequency (F0), perceived as pitch, may be another salient cue for plurality, on which several speakers provided some metalinguistic commentary. For instance, when I asked a young male speaker from the high SES how he could tell the difference between singular and plural, he said “por la entonación,” (*by the intonation*), or the young male speaker from the lower SES who said that “los chilenos reemplazamos la ‘s’ por el tono” (*we Chileans replace the ‘s’ with tone/pitch*).

Future examinations of the acoustic cues marking this morpho-phonological contrast, in tandem with the social factors to which they might be indexed, may serve as a fruitful exploration into how production and perception are related to one another and how they may be mediated by both phonetic and non-phonetic factors.

Appendix 1. Demographic questionnaire applied to all participants

Información demográfica

Primer nombre:

Sexo:

Fecha de nacimiento & edad:

Comuna en donde vive, y a partir de qué fecha:

Comuna en donde nació:

Con quién(es) vive:

En dónde trabaja (título del puesto y comuna):

Por favor, dibuje un círculo alrededor de su nivel educacional:

Sin estudios

Básica incompleta

Básica completa

Media incompleta

Media completa

Técnico incompleto (1-3 años)

Universitaria incompleta o técnico completo

Universitaria completa o más

En dónde se criaron sus padres (comuna, ciudad):

Madre:

Padre:

En qué trabajaban sus padres (título del puesto, comuna):

Madre:

Padre:

¿Qué nivel de estudios tienen sus padres?

Madre:

Padre:

¿Tiene hermanos? ¿A qué se dedica(n)?

¿Está casado/a? ¿Dónde se crió su pareja? ¿A qué se dedica?

Dibuje un círculo alrededor de los bienes que hay en su casa:

Ducha
TV color
Refrigerador
Lavadora
Calefón
Microondas
Automóvil (auto, camioneta, jeep, van)
TV cable o satelital
PC
Internet

¿Arriendan o son dueños de casa?

¿En algún momento ha viajado fuera de Chile? ¿Adónde ha ido, y por cuánto tiempo?

¿Habla otro idioma? ¿Cuál?

Nombre, comuna de origen:

¿Estaría dispuesto/a a volver a participar en un estudio similar dentro de unos años?

Sí No

Si ha contestado que sí, por favor, proporcione sus datos personales (número de teléfono, dirección, correo electrónico)

Si se cambia de casa, de número de teléfono, o dirección de correo electrónico, por favor, avísenos! ☺ EstudioChile2015@gmail.com

Appendix 2. Questionnaire regarding perceptions of the images used as visual primes

Cuestionario

ID:



1. ¿Conoces a esta persona? **Sí**

No

2. ¿En qué rango de edad crees que está esta persona?

a. 18-25

b. 26-35

c. 36-45

d. 46-55

e. 56-65

f. 66+

3. Esta persona da la impresión de ser:

Para nada

Mucho

Responsable	1	2	3	4	5	6
Ambiciosa	1	2	3	4	5	6
Chistosa	1	2	3	4	5	6
Amable	1	2	3	4	5	6

4. ¿Qué estudios crees que tiene esta persona?

a. básico

b. medio

c. técnico

d. título universitario

e. título de posgrado

5. Yo supongo que esta persona trabaja en un ambiente más similar a:

a. trabajador temporal (por ejemplo: vendedor de flores o frutas en la feria)

b. trabajador no especializado (por ejemplo: empleado en McDonalds)

c. trabajador especializado (por ejemplo: operador de máquinas)

d. Oficinista (por ejemplo: secretario/a)

e. Profesional (por ejemplo: hombre de negocios)

f. Profesional con posgrado (por ejemplo: doctor)



1. ¿Conoces a esta persona? **Sí** **No**

2. ¿En qué rango de edad crees que está esta persona?
 - a. 18-25 b. 26-35 c. 36-45 d. 46-55 e. 56-65 f. 66+

3. Esta persona da la impresión de ser:

	Para nada					Mucho
Responsable	1	2	3	4	5	6
Ambiciosa	1	2	3	4	5	6
Chistosa	1	2	3	4	5	6
Amable	1	2	3	4	5	6

4. ¿Qué estudios crees que tiene esta persona?
 - a. básico
 - b. medio
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2. ¿En qué rango de edad crees que está esta persona?

- a. 18-25 b. 26-35 c. 36-45 d. 46-55 e. 56-65 f. 66+

3. Esta persona da la impresión de ser:

	Para nada					Mucho
Responsable	1	2	3	4	5	6
Ambiciosa	1	2	3	4	5	6
Chistosa	1	2	3	4	5	6
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