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PROCESSING OF VARIABLE NUMBER AGREEMENT: EVALUATING /S/ LENITION IN COMPREHENSION

MARGARET FEATHERSTONE
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Reviewed and approved* by the following:

Carol Miller
Associate Professor of Communication Sciences and Disorders
Thesis Supervisor

Ingrid Blood
Professor of Communication Sciences and Disorders
Honors Adviser

* Signatures are on file in the Schreyer Honors College.
ABSTRACT

The number of English Language Learners (ELLs) in the United States continues to grow rapidly, almost too fast for educators and professionals to appropriately guide them to the academic services and support they require, including in language learning. As a result, challenges arise in appropriate assessment and diagnostic measures and can lead to a risk of misdiagnosis of language disorders. One way to help reduce this risk of misdiagnosis is through cultural-linguistic awareness of the dialectal differences and language variation that exists in the child’s first language. The current study examines adults’ processing of variable and consistent number-marking with implications in diagnosis, treatment and intervention strategies for ELLs.

To explore this question, we looked at listeners’ online processing of singular and plural noun phrases in Andalusian Spanish. In many varieties of Spanish, syllable-final /s/, including the plural affix, is variably lenited, meaning that the plural is sometimes marked by an alveolar fricative [s], an aspiration [h], or is omitted. Even when /s/ is omitted, the vowel laxing associated with closed syllables remains, providing a potential auditory cue to the omitted consonant. The frequency of each form varies depending on linguistic (following phoneme, morphological status) and extra-linguistic factors (speaker SES, age, speech register).

In Spanish, nouns agree in number with other elements in the determiner phrase (e.g. determiners, adjectives). This and the properties of /s/ lenition mean that there are a variety of morpho-phonological cues listeners may use to determine that a given noun phrase is plural. In addition to the variably produced plural marker, potential cues include the forms of masculine (but not feminine) plural and singular definite determiners, and laxing of the final -o in masculine plurals (but not -a in feminine plurals, as [a] has no lax counterpart). If participants are better able to take advantage of more consistent, more salient plural markers, they should
recognize masculine plurals and fully-produced forms more quickly and reliably than feminine plurals and lenited forms.

Forty-two native speakers of Andalusian Spanish from the University of Granada participated in a visual world task. On each trial they saw four pictures (e.g., 1 dog, 3 dogs, 1 pepper, 3 peppers) and heard a prompt to select one of the images (e.g., *Pincha en lo(s) perro(s)*, “Click on the PL dog.PL”). Participants heard 96 trials, evenly divided among the combinations of target plurality (singular/plural), target gender (masc/fem), and determiner (definite/otro “other”). Half of the participants heard plurals with fully pronounced /s/ and half heard dialect-appropriate lenition. Sentences were recorded by a speaker native to Granada. Results show that participants readily used the available cues to plurality: as they heard the determiner and noun they singled out the target image. Participants looked reliably more to the plural image in plural than in singular trials (definite and otro trials, *p* < .0001). However, there was no reliable main effect of target gender or condition, nor were there reliable interactions between factors.

These findings demonstrate that listeners readily use cues that are highly variable in their everyday experience in online comprehension, and that despite differences in cue saliency and consistency, they do so to similar degrees. This raises interesting questions about the nature of variable-cue processing and representation: To what extent is the ability to accurately and rapidly use sociolinguistically variable cues in comprehension honed by long familiarity with a dialect, and to what extent is it something a speaker of another dialect could acquire over short exposure? How do learners determine that these different cues all map to plurality? The current evidence provides a solid foundation for exploring these and related questions to also help professionals develop linguistically-sensitive assessment, diagnostic and intervention measures for ELLs.
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Chapter 1

Introduction

The number of people who speak a language other than English continues to grow rapidly in the United States. Specifically, it is estimated that 1 in 4 children will be Spanish-speaking in the school system by 2021 (Lopez and Barrera, 2013). As the number of Spanish-speaking students continues to grow, our awareness as teachers, educators and SLPs of the factors involved in academic success for this population is crucial. By becoming more knowledgeable about the dialectal differences that exist in Spanish, bilingualism and second language acquisition, we hope to more accurately and efficiently help these students reach their fullest potential and excel both academically and socially.

By understanding dialectal differences, we expect to more accurately distinguish language disorders versus language differences and develop assessment and instruction techniques that will best help ELLs succeed culturally and linguistically. In order to do this, we must also understand adult speakers’ language variation in comprehension and production. The current study examines adults’ processing of variable and consistent number-marking of /s/ lenition. Lenition is defined as the weakening of the consonant sometimes to the point of complete omission. Although this study is focused on adults, its implications lead to further understanding dialectal differences in Spanish and English Language Learners.

This thesis begins by discussing the importance of being prepared to serve ELLs followed by an explanation as to how the phenomenon of interest for the study does that. Chapters 2 and 3 describe the methods and results of the current study, and chapters 4 and 5
discuss the implications of the current research for the situation of ELLs in the U.S. and the conclusions bring us to suggestions on how we can improve our current practice as speech-language pathologists working with ELLs.

**Hispanic Population in the United States**

As of 2015, the Hispanic population comprised 17.6% (56.6 million) of the United States total population, and is predicted to grow to 29% of this total by 2060 (Stepler and Brown, 2016). Likewise, in the 2013-2014 school year there were 4.4 million English Language Learner students, with 3.1 million of them speaking Spanish as their first language (L1) (“Fast Facts: English Language Learners”). For the purposes of this paper, English Language Learners (ELLs) will refer to the Hispanic population, as well as other cultural populations, who are learning English as a non-native language, regardless of their maintenance or loss of usage in the language that is native to them.

Although 80% of ELL students are Hispanic, only 2.5% of teachers are culturally and linguistically qualified to teach this diverse population, meaning that they have received some level of training to recognize and accommodate to the cultural differences that may exist. Likewise, only 4% (7,029) of all American Speech and Hearing Association (ASHA) certified speech-language pathologists (SLPs) are Spanish-English bilinguals who can conduct assessment, intervention and treatment therapies for ELLs in the native language if needed (Demographic Profile, ASHA). As a result, many of these ELL students do not receive the cultural-linguistically sensitive services that are necessary to facilitate a conducive learning environment and guide their success. Furthermore, the disproportionately small number of service providers to students requires other professionals such as interpreters, or sometimes even family members, to facilitate appropriate evaluations, diagnostic and treatment plans for ELLs.
Factors Contributing to Misdiagnosis in ELLs

Historically, ELLs have been under and over-diagnosed with learning disabilities or language disorders because of their second language acquisition. In reality, many times language differences in ELLs learning the L2 are what give an impression of language-learning problems. In a language disorder, deficits in comprehension and/or expression are present in the child’s L1 and L2. In contrast, language differences occur while learning a second language where the L1 is typically developing, but more time is required for the child to succeed in the L2 as well. For example, students with a language difference are usually very competent in their native language, but to assess and teach them in a language they have not yet mastered (e.g. English) would be an unreliable and invalid method of evaluating if a language disorder or learning disability is present. Rather, targeting the L1 in which the child is more mastered would be a better representation of a child’s current linguistic abilities.

Specific language impairment (SLI), defined as an impairment of language without any identifiable impairment of nonverbal intelligence, is a good example of the difficulties associated with distinguishing a language disorder from a language difference. SLI is prevalent in 6-10% of children (monolingual or bilingual), but misdiagnosis is almost twice as common among ELLs (27.3%) as among monolingual children (14.5%) (Grimm and Schulz, 2013). SLI affects both languages of a bilingual equally with morphological and syntactic aspects of grammatical language usually being the most impaired in children with SLI, and the errors produced by L2 learners are similar to the errors produced by ELLs. In addition, diagnosing SLI in ELLs through their L2 becomes more complex because they usually cannot achieve the same proficiency and production ability in their L2 as they are in their L1, and current diagnostic measures cannot
easily distinguish whether these errors stem from language disorder or as-yet incomplete acquisition of the L2 (Paradis, et. al, 2013).

To complicate things further, dialectal differences and variability often exists within a language, and Spanish is no exception. However, today’s assessment and diagnostic measures designed to evaluate ELLs and monolinguals who may have dialectal differences do not account for variability, which can further increase the risk of a misdiagnosis. Currently, many diagnostic measures are based on Mainstream American English (MAE), and tend to use the MAE dialect as the standard for children who speak other dialects of English. This misattributes children’s non-mainstream usage and can lead to misdiagnosis for testing a child’s language abilities. For example, African American English (AAE) is a dialectal variation that tends to omit tense markers and grammatical morphemes (e.g. past tense -ed, possessive -s, third person present tense -s, etc.) in a similar way that children with language impairment do. Because of this variation, using MAE assessment to evaluate a child developing the AAE dialect does not accurately describe the child’s abilities, nor does it recognize the similarities in speech patterns that exist between AAE and children with language impairment which would lead to misdiagnosis. Likewise, similar problems are presented when ELLs with language variation in English and their native language are assessed using MAE (de Villiers, et. al, 2004).

While some action has been taken to reduce the risk of misdiagnosis among ELLs, there is more progress to be made. According to ASHA guidelines and the Free Appropriate Public Education Act (FAPE), educators are required to provide a culturally and linguistically sensitive environment for all students. For ELLs, this may include individualized instruction by a bilingual instructor, information about cultural practices that are used in the home, etc. However, oftentimes ELLs are placed in special education classrooms for reasons other than their diagnosis
such as school district budget cuts, a lack of cultural or linguistic educational resources, or insufficiently trained teachers to properly instruct them (Geva, 2000).

In addition, in 2006 the Individuals with Disabilities Education Act (IDEA) required each state to proportionally measure race/ethnicity and misdiagnosis. If significant disproportionality was found, the state was required to review and revise evaluation and assessment treatments as necessary. If the misdiagnosis was found in the child and had occurred before the age of 3, the child would receive early intervention support to help guide future success. Early intervention strategies for these misdiagnosed or at risk children has proven to be successful long-term and may include strategies to enhance vocabulary in both L1 and L2, parental involvement to encourage the use of both languages at home, assessment measures that can update progress, etc. (“Culturally and Linguistically Diverse Students,” 2017). By understanding the patterns and processes at work in language variation, we will then be able to develop the linguistically sensitive assessment measures and techniques this community deserves.

Language Processing

People process language incrementally, using various pieces of information as cues to determine what might be coming next in a sentence. These cues may be linguistic (lexical, phonological, morphological), extra-linguistic (socioeconomic status (SES), age, sex, context) and may vary depending on the dialect the speaker and listener speak. For example, in Spanish nouns agree in number (plurality) with other elements of the phrase (e.g. adjectives, verbs, etc.). As a result, people can use this cue to help determine how different parts of a sentence connect and to help them determine the speakers’ intended meaning.

When listeners hear a speaker whose dialect that is not similar to their own, they may rely on linguistic and extra linguistic cues, such as those mentioned earlier, more heavily to determine
the meaning of a sentence. The use of linguistic and extra-linguistic cues can vary depending on factors such as speech style, the geographic region and its dialectal characteristics. For example, if an American English speaker has a southern dialect, a listener who is not familiar with the dialect may use linguistic cues such as gender of the pronoun or use of plurality in the verb/noun. Likewise, knowledge that the speaker is from the south would be considered an extra-linguistic cue to help determine what the speaker is saying.

Like most languages, Spanish consists of a variety of dialects, and within the language are dialectal features that distinguish the region where one is from. These dialectal characteristics may include phoneme omission (e.g., saying “pay” instead of “play”), aspiration/omission (e.g., not pronouncing /s/ at the end of a word), or devoicing of vowels and consonants (e.g., pronouncing “could” for “good”), just to name a few. The current study is part of a line of psycholinguistic and sociolinguistic research that investigates language variation and online processing of Andalusian Spanish speakers, a region where /s/ is frequently lenited.

Sociolinguistically, previous research evaluating the production of /s/ lenition has demonstrated that it is more common in working class than middle class SES and in male adult speakers than those that are female. In addition, /s/ is more commonly aspirated or lenited when used as a plural marker in comparison to a non-morphological marker (Miller, 2014). Lenition of /s/ is a phenomenon that is widely studied in Spanish linguistics; however, to my knowledge this study is the first of its kind to evaluate the effects of /s/ lenition on processing.

**Andalusian Spanish**

Similar to other dialects of Spanish, such as those of Latin America, Andalusian Spanish is characterized by frequent /s/ lenition, or weakening of the consonant sometimes to the point of complete omission. This can occur in the word-final and syllable-final position. The production
of /s/ is used to mark morphological features in Spanish. For example, in the verb vas (you go), /s/ represents the second person singular form. Similarly, /s/ used in los gatos (the cats) signifies plurality, as in more than one cat being represented. However, when /s/ is omitted in either of these cases, the cue to number becomes variable. This is often the case of Eastern and Western Andalusian Spanish (Figure 1); thus, the listener must rely on other cues to determine number meaning of a word or sentence.

![Figure 1. Map of Andalusia](image)

Provincias orientales: Eastern Andalusia
Provincias occidentales: Western Andalusia

Vowels can be tense or lax: vowels in closed syllables (e.g. syllables ending in a consonant) are usually produced lax, while vowels in open syllables (e.g. words ending in a vowel) are usually produced tense. The tense-lax distinction can be described using formant frequencies (e.g. F1 and F2). A formant is defined as a concentration of acoustic energy around a particular frequency in the speech wave. Each formant corresponds to a resonance in the vocal tract and occurs roughly at 1000Hz intervals. Formant frequencies are determined by the positioning of the articulators in the mouth. For example, F1 is correlated with tongue height and pharyngeal space, meaning that the tongue decreases in pharyngeal space when going from a high to low vowel, and a small mouth opening will provide a low F1 with a large mouth opening.
producing a high F1. F2 is associated with changes within the oral cavity and tongue retraction where front vowels usually have a higher F2 and back vowels have a lower F2 (“F1 and F2”).

In Andalusian Spanish, omitting an /s/ can change a syllable from closed to open; this would usually mean that the vowel would be produced tense. However, research has found that formant frequency measurements of vowels are still consistent with a lax vowel. This was measured with an Andalusian Spanish speaker who was asked to read a list of sentences. Her format frequencies are shown in Figure 2, and demonstrate differences in tense versus lax vowels, with lax vowels having a higher F1 and lower F2, with the exception of /o/ and /u/ (Corbin, 2006).

With the exception of /a/ which is only produced lax, the arrows in Figure 2 show the tense vowels matched with their laxed counterparts. Vowels in the on the left are front vowels, those on the right are back vowels and top to bottom corresponds to high to low vowels. As shown in Figure 3, the difference in frequencies is slight, and our study used these findings as the foundation to ask how listeners process cues that are frequently available and consistent in meaning, but variable in form.
Figure 3. Example Formants of Spanish Tense and Lax Vowels (from Corbin, 2006)

**Research Questions**

The Hispanic-American population of those 18 and younger includes 69% Mexican, 15% Caribbean (Puerto Rico 9.2%, Cuba 3.5%, Dominican Republic 2.8%, etc.), with the remainder coming from other Latin American countries (“Statistical Portrait of Hispanics,” 2016). Lenition of word-final and syllable-final /s/ is a dialectal feature of Spanish speakers from Puerto Rico, Dominican Republic, Chile, as well as the southern region of Spain. Previous research has shown that children exposed to /s/-leniting varieties of Spanish take longer to acquire plural morphological markers (e.g. the /s/ in *dogs*) than children who do not speak /s/ leniting dialects of Spanish, but usually acquire variable /s/ production by age 3 as a result of the variable input the receive from their caretakers (Miller, 2014).

As the number of ELLs in the United States continues to grow, it is important for SLPs and all educators to understand language variability and dialectal differences that can exist within any given language. In addition, it is important to provide language assessments that can appropriately diagnosis and accurately assess these language differences and distinguish them from a language disorder. The current study evaluates processing of /s/ lenition in adults of Andalusian Spanish, and implications from the study can help educators further understand language variation and its impact in everyday use. Thus, the following two research questions further evaluate language variation of /s/ lenition in language processing: 1. Do speakers of EAS
process full and reduced forms of the plural affix differently? 2. Does the salience of the cue to plurality matter? (e.g., el vs. lo(s), la vs. la(s))? 

**Hypothesis**

To address these questions, we examined how adult native speakers of Andalusian Spanish process singular and plural noun phrases; the research questions previously mentioned emphasize the importance of vowel quality as the main cue to distinguishing plural and singular forms in language variation of Andalusian Spanish. Because /a/ does not have a tense pair, it is produced the same in the word-final position of open and closed syllable words. Using this information about the characteristics of lax /a/, participants will be able to distinguish between singular and plural noun trials if the vowel quality of /a/ is a sufficient cue to plurality. If they cannot distinguish singular and plural noun trials, /a/ could be considered ambiguous as plural or singular in feminine noun trials because of its lax nature.

Previous research indicates that /o/ is produced as tense in open-syllable words and lax in closed-syllable words. However, when /s/ is being lenited in closed-syllable words, the word becomes an open-syllable word. Therefore, if people are using vowel quality as a cue to plurality, they will be able to distinguish singular and plural noun trials, even conditions when /s/ is being lenited. However, if the vowel quality of /o/ does not serve as a cue to plurality, participants may not be able to distinguish plural and singular nouns in the reduced /s/ condition. In addition, gemination, the lengthening of the consonant of the following word, may be a result of /s/ lenition (Corbin, 2006).
Chapter 2

Methods

Participants

A total of 46 participants were recruited through advertisements via flyers that were distributed throughout the campus at the University of Granada; however, only 42 participants (29 female) are included in the results due to experimenter error (1) or because Andalusia was not their native region (3). All participants were monolingual, although some had knowledge and exposure to a second language, which was evaluated through a language history questionnaire. The task was approved by the Institutional Review Board (IRB) of Penn State and participants were compensated 10 euros per hour.

Materials

The task consisted of 96 questions, all which started with the phrase “Pincha en…” (click on) followed by one of the nouns shown in Figure 4. All nouns began with a voiceless stop; that delimiting the vowel and final /s/ in the preceding determiner was measured on Praat as part of analyzing the experimental materials.
Figure 4. Nouns Used in Experiment

Conditions were run between participants: they either heard the fully pronounced /s/ in all appropriate instances of the sentence or where /s/ was produced naturally (that is, lenited) by the Andalusian speaker. Recordings for the task were created by a female native-speaker of Spanish who was from the same local area as the participants and who was employed at Penn State University. The speaker was asked to read the sentences in her normal dialect (e.g. such as that with other speakers in the region) and to also read the sentences where /s/ was fully pronounced. Figure 5 demonstrates the manner in which questions 1 and 2 were presented.

<table>
<thead>
<tr>
<th>Feminine:</th>
<th>Masculine:</th>
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<tbody>
<tr>
<td>la (the); otra (other)</td>
<td>el (the); otro (other)</td>
</tr>
<tr>
<td>Corbata: tie</td>
<td>Pato: duck</td>
</tr>
<tr>
<td>Puerta: door</td>
<td>Trapo: cloth</td>
</tr>
<tr>
<td>Pelota: ball</td>
<td>Pimiento: pepper</td>
</tr>
<tr>
<td>Carta: letter</td>
<td>Pollo: chicken</td>
</tr>
<tr>
<td>Tortuga: turtle</td>
<td>Plato: plate</td>
</tr>
<tr>
<td>Tarjeta: credit card</td>
<td>Toro: bull</td>
</tr>
<tr>
<td>Planta: plant</td>
<td>Pajaro: bird</td>
</tr>
<tr>
<td>Pera: pear</td>
<td>Perro: dog</td>
</tr>
<tr>
<td>Cabra: goat</td>
<td>Cuadro: picture</td>
</tr>
<tr>
<td>Cama: bed</td>
<td>Piano: piano</td>
</tr>
<tr>
<td>Paloma: bird</td>
<td>Cubo: cube</td>
</tr>
<tr>
<td>Campana: bell</td>
<td>Trono: throne</td>
</tr>
</tbody>
</table>

Figure 5. Trial Types

2 Conditions: fully produced /s/ or naturally reduced /s/ by speaker
Procedure

The monolingual participants were first given a language history questionnaire (LHQ) to evaluate the extent to which another language, if any, had been learned (Li, et. al, 2014). After the LHQ was completed and verbal consent was given, participants used the chin rest to start calibration and validation to ensure accuracy in the eye movement recordings.

The task was done at the University of Granada in southern Spain using a four-picture visual world paradigm (Eyelink 2000). The Eyelink 2000 is an eye-tracking device that measures a participant’s eye gaze as a sentence unfolds, measured in milliseconds. In this experiment, using that type of technology was important to measure the exact millisecond participants switched between pictures, based on the information (e.g. linguistic cues) they were hearing at the time.

Pictures presented in the task were all similar in quality and color and edited on Gimp Software to be the same in size (350x350 pixels). The experiment was counterbalanced for target location, competitor location, target item, target plurality, gender and form (full/reduced) so that
all combinations of variables were distributed as evenly as possible. In addition to eye movement measurements during the sentence, the actual item the participant clicked on was measured. Each trial did not begin until the participant’s eye was focused on the center of the screen in order to ensure accuracy in calibration from the eye-tracker, then they heard the sentence such as “Pincha en los perros” (click on the dogs).

Data Analysis

Using Praat, we analyzed the stimuli produced by the native speaker to understand what cues were available to number when the /s/ was lenited. First, we measured the high frequency noise of the vowels /o/ and /a/ of the noun and determiner in each sentence. As seen in the differences outlined in red on the determiner “los” in Figure 7, /s/ is not completely omitted in the reduced condition, but rather is producing a level of aspiration or breathiness as a replacement as shown by the light shade.

![Figure 7. Naturally Reduced /s/ Condition](image)
Figure 8 shows the fully produced /s/ as done by our speaker. Specifically, in the red outline on the vowel of the determiner *los* (the) and noun *perros* (dogs), more black is shaded representing the /s/ being produced.

In addition, other analyses to measure cues to plurality included closure duration (Figure 9) and the duration of /s/ or /h/ (Figure 10). Closure duration is measured from the amount of time that one word ends until the second word begins (e.g. the duration between “los” and “perros”). As seen in Figure 9, closure duration was higher in the reduced plural condition.

Figure 9. Closure Duration in Nouns
Figure 10, shown above, measured the duration of /s/ or /h/ on plural determiners in both full and reduced conditions (e.g. los/las, otros/otras). Although it would be expected that the duration of /s/ or /h/ is high in the full condition, it is important to note that the reduced condition shows that the duration is not at zero but still present. This suggests that there was some aspiration in the reduced /s/ condition.
Chapter 3

Results

Results show that participants were able to use the available cues in singular and plural trials, even when /s/ was omitted. Figure 11 shows participants’ looking behavior in both conditions (full/reduced), split by determiner type, and collapsed across target number. As shown in blue, the target was easily identified in all four cells of the design: participants looked at all pictures equally until they heard their first cue, the article, followed by the noun shortly thereafter at which point they could identify the correct picture. Although the reduced condition appears to show the competitor being considered longer than in the full condition, no significant differences were found.

To further explore potential differences between the full and reduced conditions and across trial types, I examined three measures of participants’ processing: the latency of their first shift to a picture of the correct plurality, the proportion of time they spent looking to a plural picture in a 500-ms window from determiner onset, and the proportion of time they spent looking to the target picture in a 1000-ms window from noun onset. Preliminary analyses of participants’ click responses indicated that accuracy was lower in otro trials than in trials with a definite determiner. Otro and definite trials were therefore analyzed separately. Only trials that resulted in a target click were included in the eye-tracking analyses.
Figure 11. Average Proportion Looking to each image (full and reduced conditions)

Figure 12. Latency of First Shift to Target Plurality; 1500 milliseconds (ms) from determiner onset

Latency of first shift to target plurality.
Figure 12 shows the latency of participants’ first gaze-shift from a picture of the wrong plurality (e.g., a singular picture in a plural trial) to a picture of the correct plurality, measured in a 1500-ms window beginning at determiner onset. Quicker shifts indicate faster processing. Latencies were analyzed using mixed-effects models. Predictors were condition (full, reduced), plurality (singular, plural), and target gender (masculine, feminine). Separate models were fit for the definite and otro trials, and models included random intercepts by target noun and participant and the random slope of plurality by target noun. There were no reliable effects or interactions in definite determiner trials (all $\chi^2(1) < 1$). However, in otro trials there was a main effect of plurality ($\chi^2(1) = 14.47, p = .0001$), and an interaction between condition (full vs. reduced) and plurality (singular vs. plural; $\chi^2(1) = 16.10, p < .0001$).

Participants shifted faster to the target in the plural than the singular in otro trials, and this pattern was stronger in the reduced versus the full condition. It is suggested that the reduced condition (/s/-lenition) was the dialect in which participants were most familiar with it, since most of them had grown up in Eastern Andalusia. The main effect of plurality indicates that participants were quicker to shift to plural than to singular images. This might be the result of a visual bias for plural images or an indication that plural cues are more informative and easier for participants to use in comprehension (Lukyanenko and Fisher, 2014). The fact that this tendency is stronger in the reduced condition may indicate that plurals are particularly easy to process in participants’ native dialect, or conversely that singulars are particularly difficult to identify when the speaker consistently lenites /s/ in plurals.
Figure 13. Proportion Looking to Plurals; 500 ms from determiner onset

**Proportion looking to plural, 500 ms determiner window**

Figure 13, shown above, shows the proportion of time participants spent looking to plural images in a 500 ms window beginning at determiner onset. This window encompasses the determiner and the beginning of the target noun. If participants are using the information available to them during this window, they should look more to the plural in plural trials than in singular trials. As can be seen in the graph, participants tended to look more at the plural in plural than in singular trials across all trial types. This pattern was analyzed using pair of mixed-effects linear models, fit as described above. Models revealed main effects of plurality in both the definite ($\chi^2(1) = 105.63, p < .0001$) and *otro* trials ($\chi^2(1) = 12.39, p = .0004$). There were no other reliable main effects or interactions (condition in definite trials $\chi^2(1) = 1.61, p = .2$; all other $\chi^2(1) < 1.5$). This means that participants had an early tendency to look at the correct plurality, even before they had heard the entire noun, but that this did not differ reliably by condition or trial type.
Figure 14 shows the proportion of time participants spent looking to the target image in a 1000 ms window beginning at the noun onset. This was measured to analyze if participants were looking at the target noun. Mixed-effects models, fit as above, revealed a main effect of plurality in *otro* trials ($\chi^2(1) = 6.69, p = .01$), and an interaction of condition and plurality in definite trials ($\chi^2(1) = 7.05, p = .008$): there were more looks to the target in plural versus singular trials, and in definite trials this pattern was stronger in the full condition. Participants’ higher proportion of target looks in plural trials suggests either a plural bias or that plurals are stronger cues than singulars are. The fact that this pattern was stronger in the full condition than in the reduced condition in definite trials may indicate that the full-form /s/ is a particularly strong cue to plurality.
Chapter 4

Discussion

The results of this study show that monolingual Andalusian Spanish speakers were able to distinguish between singular and plural noun phrases that are often heard variably in their everyday conversation. They could do so in an equally efficient manner regardless of /s/ lenition, as no differences were found between lenited versus non-lenited conditions. Although it was originally hypothesized that feminine trials might be more ambiguous in both singular and plural for participants in the reduced /s/ condition, participants were able to find the target picture at similar rates in both the fully produced /s/ and reduced /s/ condition, and in feminine and masculine trials.

The results also suggest that a number of cues, besides vowel quality, were considered when they made their decision. As previously mentioned, these cues could have been linguistic (e.g. plurality, gender) or extra-linguistic (e.g. sex of the speaker, speech style), but this study was not designed to determine the contributions of specific cues besides vowel quality. Furthermore, this study only tested one of the many dialectal features that characterize different Spanish-speaking countries. The analyses of the stimuli show that other cues to plurality such as closure duration (representative of gemination) and duration of the /s/ or /h/ served as other available cues to plurality during the task. In addition, our hypothesis previously suggested that feminine nouns (e.g. ending in /a/) would be more ambiguous than masculine nouns because /a/ does not have a lax allophone; however, masculine trials had no processing advantage. This provides further evidence that other cues besides vowel quality were used to determine plurality.

This project serves a foundation for future investigations on /s/ lenition at the intersection of language processing and sociolinguistics, a combination that is relatively understudied.
Further investigations about variable agreement in sociolinguistic settings could evaluate how readily speakers of non-leniting /s/ dialects or Hispanic ELLs could use variable cues to plurality to distinguish between singular and plural forms. Results of these studies could serve as a resource for distinguishing between language disorders or language differences in ELL students in leniting and non-leniting varieties of Spanish. Using this knowledge as a foundational basis about language processing in adult speakers of an /s/-leniting dialect of Spanish, further research on language variation can help us understand how dialectal differences impact speech production and comprehension in both adults and children.

**The Importance of Dialectal Differences for SLPs**

Implications from this study can help SLPs and educators to develop assessment and diagnostic tests that are culturally-linguistically sensitive to these dialectal differences to reduce the risk of misdiagnosis in ELLs. It can also be highlighted the urgent need for cultural-linguistic training for SLPs and all professional educators working with children to confidently and accurately guide the ELL’s language and academic development- whether it is through English-only or bilingual language instruction. Furthermore, recognizing language variation will allow us as SLPs to conduct assessments that best evaluate a child’s current ability and future potential.

**Language Assessment**

Assessment measures must be carefully considered when evaluating ELLs who have dialectal differences and language variations of Spanish. As previously mentioned, in a variety of Hispanic regional dialects such as those of Andalusia, Chile, and Puerto Rico, /s/ is frequently lenited in the syllable-final and word-final position. Furthermore, /s/ is produced later and more variably for children in these leniting dialects compared to dialects where /s/ is not typically lenited (Miller, 2014). It is also important to note that whatever assessment measure is chosen
must also be considered valid for the child of that specific cultural population: was that specific cultural-linguistic population tested in the norming sample? For example, if a certain assessment does not specifically state that language-minORITY students were used in validity testing, it is safe to assume that they were not. Furthermore, assessment measures must be used as the foundation for treatment plans which could be goal and progress-oriented to track how the ELL’s language is developing. The following sections briefly touch on current methods to assess and accurately identify language disorders and differences in ELLs.

In addition to having assessment tests available to evaluate ELLs, knowledge in language acquisition, milestones and phonological development can help guide progress and lead to clues about a language disorder if it is present. Research suggests that ELLs can take 3-5 years to attain oral proficiency, while academic English proficiency can require 4-7 years (Hakuta, Butler and Witt, 2000), while also accounting for the child’s family environment, length and frequency of exposure to the L2, age of acquisition, and screening for any vision or hearing problems.

Phonological development is not parallel across languages in monolingual English, monolingual Spanish, or bilingual English-Spanish children. In a study of phonological development from children of Puerto Rican origin, cluster reduction (e.g. /st/ in “store” turns to “sore), final consonant deletion (e.g. /k/ in “book” turns to “boo”), and unstressed syllable deletion were still prevalent at the age of 4. In addition to understanding the dialectal differences among Hispanic ELLs, consonantal and vocalic sound differences between the two languages must be taken into account when evaluating a child’s sound production. For example, sounds such as /ʃ/ (ch), /ʝ/ (ll) and /ñ/ (n) are nonexistent in the English but ELLs may be using them as a replacement until the accurate sound is acquired (Gorman and Kester, 2001).
Conducting a bilingual phonological inventory is another method that can strengthen an SLP’s diagnosis and future services. During a bilingual phonological inventory assessment, speech samples and an independent analysis of single-words and connected speech in both of the child’s languages are necessary to evaluate the sounds that are being developed. Following the speech samples, the SLP categorizes the sounds by place, voice and manner to analyze if specific articulators are more troublesome than others (see figure 15 below). After an independent analysis is completed, a relational analysis allows the SLP to distinguish which sounds are shared in both languages, and which ones are specific to a given language. Finally, an error analysis can evaluate the extent to which sounds are being replaced or substituted for sounds in which the child has difficulty with. By performing an error analysis, the SLP should also evaluate the extent to which sounds are being substituted cross linguistically (e.g. a Spanish trill produced in English production) (Goldstein and Fabiano, 2007).

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Figure 15. Sample Spanish-English Place-Voice-Manner Chart

**Dynamic Assessment**

The majority of today’s assessment measures are considered static, measuring learned skills at one point in time, and can put ELLs at risk for a misdiagnosis because they do not factor the cultural differences that are usually present in ELLs, nor their potential for growth in this
new environment. Alternatively, dynamic assessment (DA) is one of the few direct assessment methods that has been proven to successfully distinguish language disorders versus language differences in ELLs. Rather than focusing on an ELL’s current language knowledge, DA focuses on a child’s ability to learn new information using a “test-teach-retest” model. During the test phase, the SLP will gather information to create a baseline that will be later used for comparison. During the teach phase, the SLP will provide new information to the child using strategies that are proven to help the child learn. Finally, the retest phase allows the SLP to evaluate how well the child was able to learn that new information, and the types of methods and strategies the child used to do so. This 3-phase model allows the SLP to predict future learning abilities for the child that can help identify if a language disorder is present (Peña, Gillam and Bedore, 2014).

Combining DA with phonological development is one method that can potentially reduce the risk of misdiagnosis for ELLs. For example, phonological awareness skills have been shown to predict later reading ability outcomes, but testing phonological awareness skills is often found to have a significant flooring effect. In the case of phonological awareness skills, a flooring effect means that most children have not yet developed the skills that are necessary to illustrate an accurate picture of what level a child’s phonological awareness skills are at. This is especially common in static assessment measures where phonological awareness tests are only being measured at the present level, rather than showing future potential, thus eliminating the flooring effect. For example, during the Initial Sound Fluency (ISF) test, the administrator will present the child with four pictures then ask the child to identify, verbally or by pointing, the picture that corresponds with specific sound of the administrator.

In contrast, DA assessment measures such as Dynamic Screening of Phonological Awareness (DSPA) test has been proven to reliably measure phonological awareness. During the
DSPA test, the participant is asked to delete a syllable or phoneme of a specific word, as specified by the administrator (e.g. “Say dishwasher without dish), but the administrator also provides prompts as guidance for each command. The test contains four sets of words with increasing complexity in each set, and prompts included guidance such as “Remember the word dishwasher without dish is washer, now you say it,” the administrator would stress the part of the word that was to be repeated, etc. In a study that used the DSPA and ISF test to evaluate the effectiveness and validity (e.g. extent of flooring effect) in kindergarten children, results showed that the DSPA better predicted reading achievement by the end of the academic school year, in comparison to a static version (e.g. Static Screening of Phonological Awareness) of the exact same test. The only difference between these two tests was that the latter did not receive any prompts or guidance, unlike the DSPA. Furthermore, the ISF was found to have a flooring effect that proved to be not as effective in predicting reading outcomes of these kindergarten children (Bridges and Catts, 2011).

Although DA has proven to be effective in many aspects of SLP services (e.g. novel vocabulary learning, producing phonological sounds, syntax sentence structure, etc.), many SLPs report that they have not been trained to conduct DA in treatment, and further lack adequate time to do so. Despite these challenges, DA can improve language abilities with a small amount of instruction and can also be useful in distinguishing typically developing and high-risk language impairment bilingual/ELL children (Peña, Gillam and Bedore, 2014). These are important assessment measures for ELLs, especially those who have dialectal differences such as /s/ lenition, because direction instruction such as the methods used in DA is an accurate predictor of how well the child is able to learn new information and what kind of potential he/she has, regardless of the current skill level.
The Importance of Cultural-Linguistic Sensitivity When Working with ELLs

The field of cultural-linguistic awareness and bilingualism has come a long way since the “English-only” movement back in the 1980s where it was believed that two languages hindered a child’s ability to succeed in other subjects. On the contrary, today we know that bilingualism actually enhances all areas of academic performance and can delay the onset of age-related diseases such as Alzheimer’s. In addition, a bilingual person uses both language structures together to create a linguistic foundation that can strengthen language acquisition. However, many topics in this field are still underdeveloped and have not been investigated such as dialectally-fair diagnostic testing methods, oral and academic language acquisition, and cultural inclusivity training techniques for SLPs and other professional educators. By gaining more information in these areas and training professionals to do so as well, we hope to accurately guide language development of ELLs to the best of our abilities.

Cultural and linguistic competence is one aspect to successful diagnostic, treatment and intervention plans of a child. This includes training behaviors, skills and awareness for culturally diverse students such as the child’s family environment, cultural traditions, as well as conducting interviews, assessments and evaluations in the child’s native language (“Issues in Ethics,” 2013). By doing so, professionals can work effectively and efficiently with the culturally diverse population they are treating and hopefully gain further analysis in distinguishing language disorders versus language differences. Current literature on assessment measures for ELLs is broad and offers a variety of options for SLPs, most importantly in gathering information about the child’s oral and academic language proficiency, an extensive case history, cultural norms, length of residency in the United States, language spoken at home, etc.
Chapter 5

Conclusion

This eye-tracking experiment was written as a thesis to analyze language processing of variable forms, specifically /s/ lenition in Andalusian Spanish. In our study about online processing of dialectal variation, our results showed that Andalusian Spanish speakers were able to equally distinguish between singular and plural noun phrases in both lenited and non-lenited speech. Although we hypothesized that participants would use the vowel quality as a cue to distinguish plural and singular noun forms in the reduced /s/ condition, our results suggest that other cues, besides vowel quality were used. Participants were able to quickly identify singular and plural trials in masculine and feminine form.

This study provides a solid foundation for future work to evaluate the influences of dialectal variation which can then be applied to assessment and instruction methods for ELLs who come from various countries with dialectal differences that exist within a specific language. Furthermore, we hope to reduce the misdiagnosis that frequently occurs in ELLs and other minority groups due to their language variation. In addition, creating cultural-linguistic training opportunities for SLPs and all educators to work with ELLs will help us reach these goals.
BIBLIOGRAPHY


MARGARET FEATHERSTONE  
Margaretr. featherstone@gmail.com | 267-307-7941

VOLUNTEER SERVICE EXPERIENCE

The Nazareth Fund  
September 2015 – Present
- Collaborate with other board members to find new fundraising opportunities that will support Nazareth Academy High School in advancing its educational and innovative resources for current students

Mid-State Literacy Council Tutor  
September 2014 – April 2016
- Provided individualized tutoring sessions with a low-level English Language Learner student to help improve speech and comprehension of the English language by preparing reading comprehension exercises, conversational worksheets, and vocabulary lessons

Spring Break Travel- Haiti  
Spring Break 2014 - 2017
- Travel to Haiti over to deliver donations collected from fundraisers, teach English language lessons, and work on projects that will improve infrastructure at Maison Fortunate Orphanage

RELEVANT EMPLOYMENT EXPERIENCE

Research Assistant, Language Acquisition Lab  
September 2016 – May 2017
- Code and analyze a variety of data collections from Dr. Karen Miller during her summers in Chile (2007 – 2008) with plans to upload them to CLAN for use of other researchers

Lake Naomi Club, Special Events Coordinator  
Summer 2015 – Summer 2016
- Oversaw and directed a staff of 60 members in providing creative recreational activities for the members of the community
- Planned and lead large-scale events such as family carnival, holiday celebrations, which involved detailed preparation and communication with other departments, working 50 hours per week

Lake Naomi Club, Group Leader  
Summer 2014
- Trained camp counselors to properly interact with campers and their parents in order to help improve professionalism and creativity within the camp environment
- Worked individually with a non-verbal Autistic camper through integration in the camp environment while communicating through an AAC system as the mode for communication

FLUENCY IN A SECOND LANGUAGE

Bachelor of Science in Spanish, Applied Option  
May 2017
- Double majored in Spanish and CSD in order to strengthen my Spanish speaking abilities and comprehension levels to work with the Hispanic population after attaining a Master’s degree

Study Abroad  
Summer 2015
- Improved Spanish-speaking skills through participation in an academic course setting and cultural experiences with Native speakers

LEADERSHIP POSITIONS

Project Haiti President  
Fall 2016 – Present
- Lead the officer board and general body in weekly meetings and events to support our partners in Haiti which include Maison Fortune Orphanage, the rural village of Jaksonville and Midwives for Haiti
- Organize flights, itinerary and all accommodations for a group of 20 individuals to travel to Haiti where we deliver donations collected throughout the year, teach English language lessons, provide manual labor, and participate in their culture
**Project Haiti Vice President, Fundraising Chair**  
*Fall 2014 – Spring 2016*

- Assisted the President with general management and organization of the club by providing analytical input regarding important decisions and finding methods to improve overall efficiency as a club
- Communicated with a local elementary school to educate its students on the disparities that exist in Haiti while also collaborating on various fundraisers to support our mission
- Lead 35 club members in the logistical planning and fundraising of over $15,000 for our partners in Haiti, including Maison Fortune Orphanage which houses over 200 children that were affected by the 2010 earthquake, and a rural village in the town of Jacksonville

**Women’s Leadership Initiative**  
*Fall 2015 – Spring 2016*

- Selected as one of thirty students in the College of Health and Human Development to participate in a program that emphasizes leadership skills and development through a variety of self-awareness assessments, workshops, special guest lectures, and field trips

**HONORS AND AWARDS**

**Schreyer Honors College**  
*Spring 2015 – Spring 2017*

- Received admittance to the Schreyer Honors College to complete 14 honors course credit and write a thesis under the supervision of my research adviser

**Research Abroad**  
*Summer 2016*

- Received an NSF research grant to independently plan and conduct an eye-tracking experiment about the effects of /s/ lenition on comprehension with Andalusian speakers at the University of Granada, Spain
- This research abroad was part of the Partner for International Research Experience (PIRE) program in the Center for Language Science at Penn State

**OTHER**

**PSUxLing3 conference and poster presentation**  
*October, 2016*

- Presented the research I conducted in Spain during summer 2016 focusing on /s/ lenition and its effects on comprehension and online sentence processing in poster form
- Presented this project at a lecture to the Center for Language Science and to Penn State University President Eric Barron

**PSUxLing2 conference and poster presentation**  
*October, 2015*

- Presented a corpus study on copula verb agreement in child-directed speech in a poster presentation to Penn State faculty

**CUNY 2017 conference and poster presentation on Human Sentence Processing**  
*March, 2017*