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Acquisition of L2 Phonology: An Acoustic Analysis of the Centralization of L2 Spanish /a/ in Adult L1 English-Speaking Learners

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ABSTRACT

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Although many studies have been carried out regarding the acquisition of Spanish as a second language, very few have focused on the acquisition of Spanish vowels. Studies that have compared the L2 production of Spanish vowels in learners who have spent an extensive time living abroad versus at home learners are scarce at best. The present study hopes to add to the literature by comparing the L2 pronunciation of the Spanish /a/ in these two groups using an acoustic analysis with the aid of speech-signal processing software and the inclusion of a native group for comparison. In addition, it hopes to provide insight into how these groups vary in their pronunciation of the Spanish /a/ in different tasks. Three tasks were administered—an oral interview, the reading of a short story, and the reading of a word list—whose range varied by less formal to more formal, respectively. The tokens were analyzed using Praat to find the F1 and F2 value at the midpoint of each. The results indicate that those who lived in a Spanish-speaking country for an extensive period of time (RM) demonstrated a significant difference ($p<0.05$) between their production of the Spanish stressed /á/ and the unstressed /a/ in the oral interview and short story tasks, but did not show a significant difference in the more formal word list task. The at-home (AH) group, who had spent no more than three weeks in a Spanish-speaking country, displayed a significant difference ($p<0.05$) between the two tokens in all three tasks. It was found that the RM group displayed a significant difference ($p<0.05$) in F2 values between it and the native speaker (NS) group in one of the tasks, indicating that language transfer was present in both its stressed and unstressed tokens of the Spanish /a/. Interestingly, the native Spanish-speaking group also displayed a significant difference ($p<0.05$) between its production of the stressed /á/ and the unstressed /a/ in the short story task.

Keywords: Spanish, second language acquisition, vowel acquisition, centralization, schwa, task type, Spanish centralization

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1. INTRODUCTION**.** The acquisition of L2 phonology is an increasingly present topic in today's literature dealing with second language acquisition (SLA). Among this literature, Spanish stands out as a dominant theme due to the ever more influential Spanish-speaking world and the language's consequent popularity as a subject in secondary and university education in the United States. Although many SLA studies have been carried out that deal with the acquisition of L2 Spanish phonology, many of these studies have focused on the acquisition of consonantal segments, not as much attention has been given to L2 Spanish vowel acquisition. Therefore, adding to this particular area of research would be beneficial to the field of SLA to help provide a greater understanding of the problems that learners face while attempting to acquire the L2 vowel system of Spanish.

The research that does exist on L2 acquisition of Spanish vowels does not address the impact that spending an extensive period of time living abroad may have on L2 Spanish vowel acquisition, such as will be the focus of this study, or how experience with the language may determine production accuracy over a variety of tasks. Moreover, much of the previous research used impressionistic techniques rather than using speech-signal processing software to measure the accuracy of the target vowel. For example, although Menke and Face (2010) studied the L2 production of the Spanish vowel system in advanced learners using speech signal-processing software, they did so with just one oral task in which participants read a short story. Furthermore, said study compared learners from various levels of experience and instruction rather than focusing specifically on learners with experience living abroad in a foreign country. On the other hand, Simões (1996) studied beginning and intermediate learners and their overall improvement after going on a short, 4-week study abroad, but he used impressionistic techniques to describe their L2 vowel production. The few investigations that have been carried out demonstrate the

need to add more literature to this topic in order to provide a better understanding of L2 vowel acquisition by L1 English speakers in regards to how the experience of living in a foreign country affects production accuracy throughout a variety of task types.

This study aims to fill this void in the literature by studying two main L1 English-speaking groups and then comparing their vowel production to that of an L1 Spanish-speaking control group. One of the L1 English-speaking groups spent about two years living in a Spanish-speaking foreign country, while those from the other group spent no more than three weeks in a Spanish-speaking country. Both groups were enrolled in the same third-year advanced Spanish grammar course at the time of the interviews. While the few studies that do exist on L2 Spanish acquisition of vowels have focused on the entire Spanish vowel system, this thesis will focus solely on the Spanish /a/ in light of three observations: (a) the little attention given to the low central Spanish vowel /a/ in research and when the Spanish vowel system is discussed in general (see Hualde 2005, Skelton 1969, Stockwell & Bowen 1965, Whitley 2002), (b) my own interest and observations that many L1 English speakers struggle pronouncing L2 Spanish /a/ correctly, and (c) the inherent limitations posed by a master's thesis (e.g. time constraints) that prevent further research into the acquisition of anterior and posterior vowels. Nonetheless, this study was guided by the following research questions:

(1) Do native English-speaking adult learners who have spent an extended period of time in a Spanish-speaking country and native English-speaking adult learners who have very little experience living in a Spanish-speaking country centralize the Spanish low central vowel /a/?

(2) If these populations do centralize their L2 Spanish /a/, does their centralization vary by task type? Does one group centralize more than another in different tasks?

2. REVIEW OF THE LITERATURE.

2.1 BRIEF COMPARISON OF THE ENGLISH AND SPANISH VOWEL SYSTEMS. Vowels can be described using many criteria, such as height, frontness and backness, and as being either a simple vowel or a diphthong. Height refers to how high the dorsum of the tongue is located in relation to the roof of the mouth. The Spanish vowels /i/ and /u/, for example, are considered high vowels because the dorsum elevates higher in the cavity of the mouth, toward the palate (Quilis 1999), while /e/ and /o/ are mid, and /a/ is low. Frontness and backness refers to how forward or back the body of the tongue is. Therefore, the Spanish /i/ is a fronted, or anterior, vowel because the tongue shifts closer to the front of the mouth, /u/ is a backed, or posterior, vowel because the tongue rises toward the back, and /a/ is central. Simple vowels do not change in quality during production, while diphthongs do demonstrate change in articulation (O'Grady 2010:34). The diphthong /ej/ in the English word *bait* (/bejt/), for example, begins articulation with /e/ and ends with /j/. Taking this information into account, the Spanish /a/, for example, is a low central simple vowel.

The English vowel system is complex and contains many phonemes. In total, it consists of the following vowel phonemes: /i, ɪ, ej, ɛ, æ, aj, ʌ, aw, ɑ, ɔ, ɔj, ow, ʊ, u/, including the vowel-glide combinations and diphthongs. English diphthongs, although phonetically complex in nature, are considered simple vowels phonologically (O'Grady 2010:35) and have a distinctive role in English (Delattre 1964). English vowels generally maintain their vowel quality in a stressed syllable. Although "all English vowels can occur in unstressed syllables" (Ladefoged 1975:72), they commonly centralize to the English schwa [ə] within polysyllabic words in unstressed environments (Whitley 2002:28). Thus, centralization of English vowels would bring the production in from the peripheral toward the center of the cavity of the mouth.

The schwa [ə] is illustrated by O'Grady (2010:37) as a mid, central vowel, as displayed in Figure 1. Delattre (1964:82) points out that, "about 90 percent of unstressed vowels turn to some schwa (neutral vowel)."

As seen in Figure 1, the English vowel system has a large inventory. Compared to the single low vowel in the Spanish vowel system, English has two phonetically simple and two phonetically complex low phonemes: /æ, aj, aw, ɑ/. The phoneme /æ/ is fronted and has one single point of articulation, such as in the word *bat*. The phonemes /aj/ and /aw/, on the other hand, are more central and are diphthongal in nature, and represent the sounds found in the English words *bite* and *loud*, respectively. The English phoneme /ɑ/, however, is a backed vowel that is represented in the English word *lock*.

	Anterior	Central	Posterior
High	i		u
	ɪ		ʊ
Mid	ej	ə	ow
	ɛ	ʌ	ɔj ɔ
Low	æ aj	aw	ɑ

FIGURE 1. English vowel system.

On the other hand, the vowel system of Spanish is much simpler than that of English. There are a total of five Spanish vowel phonemes: two high vowels (/i/ and /u/), two mid (/e/ and /o/), and one low (/a/). Unlike in English, there is no significant difference between their production in stressed and unstressed environments (Hualde 2005). Additionally, Spanish simple vowels are short in duration, are considered to be very tense, and do not diphthongize; that is they do not change in quality or articulation (Lansing 2002). In Figure 2 we see that the Spanish

/a/ is both low and central, as opposed to the English simple vowels /æ, ɑ/. Additionally, Hualde (2010:125) states that the Spanish low vowel /a/ is closer in quality to the English /ɑ/ than any other vowel, although no true equivalents exist between the Spanish and English vowel systems (see Hualde 2005, Stevens 2011).

	Anterior	Central	Posterior
High (Closed)	i		u
Mid	e		o
Low (Open)		a	

FIGURE 2. Spanish vowel system.

Technology facilitates the observation of the differences between the Spanish and English vowel systems using a spectrogram to view the sound frequencies of vowels. Speech signal-processing software, such as the computer program Praat (Boersma and Weenink 2014) that was used in this study, provides a visual representation of vowel formants, which are defined as a "concentration of acoustic energy at a certain frequency range" (Hualde 2005:297). Of special interest in this study is the relationship that formant 1 (F1) and formant 2 (F2) have in the Spanish vowel system. The higher the F2 value, the more forward the tongue is located in the oral cavity and consequently the more anterior the vowel. That is, the /i/ vowel has a higher F2 value than that of /e/, and so forth. Conversely, a low F1 indicates a high, or closed, vowel (/i/), and a higher F1 indicates a low vowel (/a/) (Quilis 1999:164-166).

The complex nature of the English vowel system versus that of Spanish can cause problems for L1 English speakers when producing L2 Spanish. Flege's (1995:239) speech

learning model (SLM) explains that the more dissimilar two languages are phonetically, the easier it will be for foreign language learners to differentiate the L2 sounds from those of their L1. Flege (1995:239) also states:

> Category formation for an L2 sound may be blocked by the mechanism of equivalence classification. When this happens, a single phonetic category will be used to process perceptually linked L1 and L2 sounds (diaphones). Eventually, the diaphones will resemble one another in production.

That is, language learners categorize L2 sounds as similar or dissimilar, or may even consider an L2 sound as equivalent to that of an L1 sound. These two similar sounds become fused conceptually as one in the speaker's mind, and thus the L1 and L2 sounds are produced similarly in speech. Therefore, English speakers may perceive L2 Spanish vowels as very similar to their own, but the contrast they make in speech production is not the actual contrast between the L1 and L2 phonemes. Thus L1 English speakers, unless trained otherwise, do not easily distinguish the contrasts between the two vowel systems, and their L2 speech production may mimic that of their L1 (Flege 1995).

The similarities that native English speakers perceive between English and Spanish can cause them to transfer their vowel system to L2 Spanish production (Stockwell & Bowen 1965). Thus, it is likely that L2 Spanish speakers will produce a vowel closer to that of their native language in quality, such as the /æ/ or /ɑ/, these being the simple low vowels in English in stressed syllables and a schwa [ə] in unstressed syllables. However, it is important that L2 Spanish learners understand that transferring vowel systems can cause a marked foreign accent, and can "change the meaning of words or create incomprehensible utterances" (Brown 1990:1159), and consequently cause misunderstanding when communicating with native

Spanish speakers (Stockwell & Bowen 1965). Therefore, L2 Spanish speakers should "keep their Spanish vowels short and tense in both stressed and unstressed syllables and avoid the English phonological process that … centralizes unstressed vowels to [schwa]" (Stevens 2011:78).

Some examples of problems that can occur when L1 English speakers transfer their vowel system to their L2 Spanish include the neutralizing of "gender distinctions in nouns and adjectives and person distinctions in verbs" (Stevens 2011:78). Thus, hearing the word *amigo* pronounced *[ə.mí.gə], for example, may cause misunderstanding depending on context because the gender of the noun has been neutralized and it isn't clear if the speaker is referencing a male or a female (Stevens 2011). Furthermore, language transfer causes the diphthongization of Spanish simple vowels word internally or in word-final position (Stockwell & Bowen 1965). For example, a Spanish learner may pronounce the Spanish word *comemos* as *[ko.méi̯.mos], thus displaying a foreign accent. Problems can also arise in minimal pairs in which a Spanish diphthong and Spanish simple vowel contrast, such as in *reno* and *reino* (Whitley 2002). Pairs of English and Spanish words that are similar both in their phonetic make up and meaning, such as *afirmar* and *affirm* or *aspirar* and *aspire*, for example, also contribute greatly to the problems that L2 Spanish speakers experience (Stockwell & Bowen 1965).

2.2 VOWEL ACQUISITION IN L2 SPANISH. Little research has been done regarding the acquisition of L2 Spanish vowels. The few previous studies focusing on L2 Spanish vowel acquisition have mostly focused on beginner or intermediate learners (Elliott 1995b, Elliott 1997, Simões 1996, Stevens 2011). An exception to this is Menke and Face (2010), who studied the vowel production of L2 Spanish learners at an advanced level of proficiency (graduating Spanish majors and Phd students). Moreover, much of the previous research was done using

impressionistic analysis techniques (Elliott 1997, Hammerly 1982, Simões 1996), rather than basing the results on an acoustic analysis performed with the aid of computer software to create spectrograms of the data, as was employed in this study.

Some of these same studies that compared learning between at-home learners (AH) and study-abroad (SA) learners focused on SA learners who spent very little time in a Spanish-speaking country (just four weeks in Stevens 2011 or five weeks in Simões 1996). Nonetheless, Stevens (2011) found that the 11 SA students in his study improved their Spanish pronunciation of vowels, while the 11 AH students did not. Simões (1996), on the other hand, found that only two of five SA informants improved their Spanish vowel pronunciation.

In sum, although some research has been published regarding L2 Spanish vowel acquisition, the research either focused on beginner or intermediate learners who spent relatively little time living in a Spanish-speaking country, or the analysis techniques were impressionistic in nature. Very little research, if any, has been conducted regarding the L2 Spanish vowel acquisition of advanced students who have spent extensive time living abroad, and this study hopes to contribute to this topic by using an acoustic analysis to provide empirical evidence of their L2 Spanish production.

2.3 TASK TYPE. In addition to time spent abroad, target-like pronunciation can also be affected by the style—that is, the level of attention learners pay to their speech (Tarone 1979:181)—in which the L2 speech is produced. Major (1987:192-197) summarizes a great amount of previous research on stylistic variation in L2 and states that "variation due to style or register is universal in human language. Accordingly, such variation should be expected in second language learning as well." Tarone (1979) also supports this theory, and evidence of it is becoming more prominent

in the literature. Major (2004:170), again reviewing previous SLA research regarding acquisition of style, states, “In general, it has been found that the more formal the style, the less L1 transfer and the greater the frequency of targetlike forms.” The study presented in the same article found that native Spanish speakers produced significant differences in style in their L2 English when comparing their production from a less formal task with that of a more formal task.

On the other hand, some research has shown that L2 speech production is actually more target like during less formal tasks, such as an oral interview, for example (Diaz-Campos 2006, Major 1987, Zampini 1994). This is possibly because the learners had more native input in informal settings, and therefore their L2 speech production is more likely to be target like in informal contexts (Diaz-Campos, 2006). This study aims to add to the literature by researching what difference, if any, exists between L2 vowel production in formal and informal tasks among AH learners and those learners who have spent an extensive time living abroad.

The previously mentioned studies that focused on L2 Spanish vowel acquisition (Elliott 1995b, Elliott 1997, Menke & Face 2010, Simões 1996, Stevens 2011) did not address whether or not there is any difference in L2 Spanish vowel production in different styles, and often included only one task in the study. For example, Stevens (2011) performed a formal task in which learners read from a randomized list of sentences, while Menke and Face (2010) had informants read an authentic short story. On the other hand, Simões (1996) was seeking spontaneous speech in an informal task and thus performed oral interviews with the informants. This study aims to add to the literature by studying L2 Spanish vowel production across increasingly formal tasks, including an oral interview modeled after ACTFL’s OPI, the reading of a short story, and the reading of a word list.

2.4 SUMMARY. The research published on the comparison of advanced AH students and those who have spent an extensive time living in a Spanish-speaking country, using precise analysis techniques, offers an incomplete image of L2 Spanish vowel acquisition. This project aims to contribute to the field of SLA by using precise analysis techniques to study the impact that spending an extensive time living abroad, or about two years, has on L2 Spanish vowel acquisition in different tasks when compared to AH learners who have very little experience living in a Spanish-speaking country.

3. METHODOLOGY

3.1 PARTICIPANTS. This project consists of 24 informants who are divided into three groups: the AH group (n=9), the group of learners who had lived for an extensive period of time in a Spanish-speaking country (n=10), and a group of native Spanish (NS) speakers (n=5). Although similar in many aspects to a traditional SA learner, the group of learners from this study who spent an extensive time abroad differs from the traditional SA learner due to the nature of their living experience in their respective Spanish-speaking countries, and thus their background merits a detailed explanation. At the time of the study, they had recently returned from a religious volunteer missionary experience while living abroad in a Spanish-speaking country for about two years, during which time they were not considered students. For this reason, they will be referred to as the return-missionary group (RM). However, before arriving in their assigned countries, they spent approximately nine weeks at the Missionary Training Center (MTC), an intensive language-study program that revolves around religious study and preparation, where basic Spanish grammar and vocabulary were taught by college-aged instructors who had also learned Spanish through the same type of experience (see Fletcher Stack 2013, Kron 2012,

NPR Staff 2014). The quality of the Spanish instruction during their stay at the MTC is unknown.

Throughout their extensive time spent in a Spanish-speaking country, they were paired with either an L1 Spanish-speaking companion or an L1 English-speaking companion for a minimum period of six weeks, although their assignment as a companionship could have lasted nine months or longer. They spent the great majority of their time speaking with native Spanish-speakers on the streets, in religious meetings and seminars, and in people's homes. Essentially, they spent 22 months living and working with native Spanish speakers on a daily basis, during which time they didn't return to the United States. Due to this unique experience, these study participants had very intense contact with, and input from, native Spanish-speakers for an extensive period of time. However, the actual amount of contact with native Spanish speakers is unknown.

There has been some research published on the L2 Spanish acquisition of these RM learners (Alvord & Christiansen 2012, Bean 2013, Dewey & Clifford 2012, Schwaller & Miller 2012, Tanner 2012), although of these, only two researched L2 Spanish phonological acquisition (Alvord & Christiansen 2012, Bean 2013), and neither studied L2 Spanish vowel acquisition.

In regards to the AH group, none of the informants has ever spent more than three weeks abroad cumulatively while visiting a Spanish-speaking country, but rather has learned Spanish at school in the classroom. Additionally, none of the AH informants has ever taken a Spanish phonetics class, and all heritage speakers were excluded from the study. One of the informants from the AH group reported having studied in a Spanish immersion program.

The 19 informants that speak American English as their native language range in age from 17 to 23 and were enrolled in a third-year Spanish grammar course at their university at the time of the study.[1] Their background information including gender, age, and place of origin is found in Table 1. Their background information concerning their time spent living in a Spanish-speaking country and their experience with formal Spanish education is found in Table 2. These two tables were divided for the convenience of the reader.

Speaker	Group	Gender	Age	Place of origin
1	AH	M	18	Florida, USA
2	AH	F	20	UT, USA
3	AH	F	17	CO, USA
4	AH	F	19	CA, USA
5	AH	F	21	WI, USA
6	AH	F	21	D.C., USA
7	AH	F	19	MI, USA
8	AH	F	19	UT, USA
9	AH	F	19	UT, USA
10	RM	M	21	OR, USA
11	RM	M	21	UT, USA
12	RM	M	23	CA, USA
13	RM	M	22	UT, USA
14	RM	M	22	CA, USA
15	RM	M	21	UT, USA
16	RM	M	21	UT, USA
17	RM	M	21	CA, USA
18	RM	M	21	WI, USA
19	RM	M	21	CA, USA

TABLE 1. Participant background information, including gender, age, and place of origin.

Speaker	Group	Time spent in Spanish-speaking country	Country visited	Time home (in months)	Formal instruction (in years)	
					High School	College
1	AH	n/a	n/a	n/a	4	1
2	AH	n/a	n/a	n/a	0	5
3	AH	n/a	n/a	n/a	4	1
4	AH	~3 wks	Puerto Rico, Ecuador, Perú	n/a	Spanish Immersion	2
5	AH	n/a	n/a	n/a	4	4
6	AH	n/a	n/a	n/a	4	5
7	AH	n/a	n/a	n/a	4	1
8	AH	3 wks	Ecuador	n/a	4	2
9	AH	2 wks	Guatemala	n/a	2	2
10	RM	~2 yrs	Argentina	8	2	1
11	RM	~2 yrs	Argentina	5	2	1
12	RM	~2 yrs	Argentina	6	3	1
13	RM	~2 yrs	Argentina	5	3	1
14	RM	~2 yrs	Paraguay	9	0	1
15	RM	~2 yrs	Chile	4	2	1
16	RM	~2 yrs	Peru	6	2	2
17	RM	~2 yrs	Spain	4	2	1
18	RM	~2 yrs	DR	3	4	1
19	RM	~2 yrs	Mexico	2	3	1

TABLE 2. Informant background information including time spent living abroad and formal Spanish education.

In regards to gender, the AH group consists of eight females and one male, while the RM group consists of ten males. Although there is some debate as to whether or not gender plays a role in the acquisition of L2 phonology, several studies have shown that the difference between male and female L2 phonological acquisition does not yield a significant result (Elliott 1995a; Piske, MacKay & Flege 2001; Shively 2008; Stevens 2011; Tahta, Wood & Loewenthal 1981). As Piske and colleagues (2001:199-200) said, “Previous research has provided divergent

findings concerning the influence of gender on degree of L2 foreign accent … [and] do not lead to any strong conclusions." As seen in other studies dealing with second language acquisition, this difference in gender between the two groups should not pose a significant impact on the results of this study.

One possible reason that there is such little variation in gender among the two groups is likely due to their nature: Those who had the missionary experience unique to the RM group tend to be male, as in that religion it is seen as an expectation that males give such volunteer service around the age of 19, while such an expectation is not set for females. Likewise, there are more females in the AH group because of the same reason: The males during this age period are often away serving as missionaries, while the females are at the university studying (although many females also go on such volunteer religious experiences). Therefore, it is generally more likely that those who meet the criteria for the AH group be female because they did not serve as a missionary and/or have not yet gone on a study abroad, and those of the RM group be male because they did serve as a missionary. Additionally, five native speakers were also included as a control group for comparison.

Table 3 presents the background information of the NS group, including gender, age, and country of origin. These participants are native Spanish speakers who came to the U.S. as adults to pursue university studies, and their proficiency in English is unknown.

Speaker	Group	Gender	Age	Place of origin
20	NATIVE	F	27	Columbia
21	NATIVE	F	26	Paraguay
22	NATIVE	F	29	Chile
23	NATIVE	M	27	Mexico
24	NATIVE	M	27	Mexico

TABLE 3. Native group's background information.

Although informants from all groups either lived in or are from many different Spanish-speaking countries, the literature regarding vowel production among native Spanish speakers across different dialects suggests that dialectal variation in vowel quality, as observed in the English vowel system, does not exist in Spanish. Hualde (2005:127-128) states:

> Vowel qualities are remarkably stable among Spanish dialects. There is nothing in Spanish like the differences in vowel quality that we find across geographical and social varieties of English. This is no doubt in part due to the simplicity and symmetry of the system. Speakers with a low educational level may show some departures from the norm … but these nonstandard forms are only sporadic developments and are generally shunned by educated speakers.

Quilis (1999:151) agrees with Hualde and adds, "En el sistema vocálico español apenas si es posible hablar de *vocales relajadas*. Se realiza de este modo la que se encuentra en posición final del grupo fónico, cuando precede a una pausa, y aún así, suele conservar netamente su timbre característico."

3.2 PROCEDURES AND INSTRUMENTS. All the informants first completed a background questionnaire and a survey of motivational intensity (see Appendix A and B), and then were

recorded reading a short story and a word list. These two tasks were done consecutively on the same audio track. The short story was titled *Rita la fabulosa* and contained approximately 400 words, followed by seven short questions. This short story had been edited to include specific key words and segments. Before reading the short story, the participants were told that there would be a series of questions that they would have to answer afterward. This was done so that they would focus more on the content while reading than on their pronunciation (see Appendix C). The word list consisted of 52 words taken from the short story, and the informants were told to do their best to pronounce each one carefully (see Appendix D).

The informants later participated in an interview that lasted between five and 10 minutes modeled after the Oral Proficiency Interview established by ACTFL.[2] There was not a specific theme established for the interview, but rather a variety of topics dealing with everyday life were discussed. The tasks were designed with the aim of providing a scale of formality in style—the oral interview being the least formal, the reading of the short story as intermediate, and the reading of the word list being the most formal. The audio in all the tasks was recorded digitally.

The speech samples were evaluated using Praat speech-signaling software. Twenty stressed and unstressed tokens of the Spanish /a/ for each informant were taken from each task (the oral interview, the reading of the short story, and the word list): Ten of the 20 tokens collected from each task came from stressed syllables, and 10 from unstressed syllables, for a total of 60 tokens per informant. Collectively, a sum of 1,440 tokens, including those taken from the data collected from the native Spanish speakers, was analyzed in this project.

The vowel boundaries of each token were marked using Praat, after which the values of the F1 and F2 formants were measured at the midpoint of the token using a formant-checking algorithm script. For the oral interview task, the first 10 stressed and unstressed tokens that

occurred after the two-minute mark were included, while for the reading of the short story the first 10 stressed and unstressed tokens that occurred after the one-minute mark were included (the recordings of the short story are shorter than the conversations, in general). The first 10 stressed and unstressed tokens that occurred in the word list were included, which was recorded immediately after the short story on the same audio track. The vowel boundaries marked on Praat were checked a second time for each token included in the study by this researcher. Tokens were excluded from the analysis if they became diphthongized due to synalepha or metathesis. The term diphthong is used in this paper as a grouping of two consecutive vowels that form a single syllable within a word (e.g. *Mario*), whereas synalepha is used as a grouping of two consecutive vowels that form a diphthong between two consecutive words (e.g. *su amiga*). Metathesis is used to describe the shifting of a vowel from one position within a word to another (e.g. *cascarrabias* pronounced [kas.ka.ɾjá.bas]). Figure 3 is an example of a normal stressed and unstressed token not affected by diphthongization, whereas Figures 4 and 5 are examples of diphthongization caused by metathesis and synalepha, respectively. The arrows in Figures 4 and 5 show the occurrence of the referenced phenomenon. Although not all informants or groups displayed metathesis or synalepha, the sonograms in Figures 3, 4, and 5 are examples of these phenomena among the RM group and were taken from the data collected and used in this thesis.

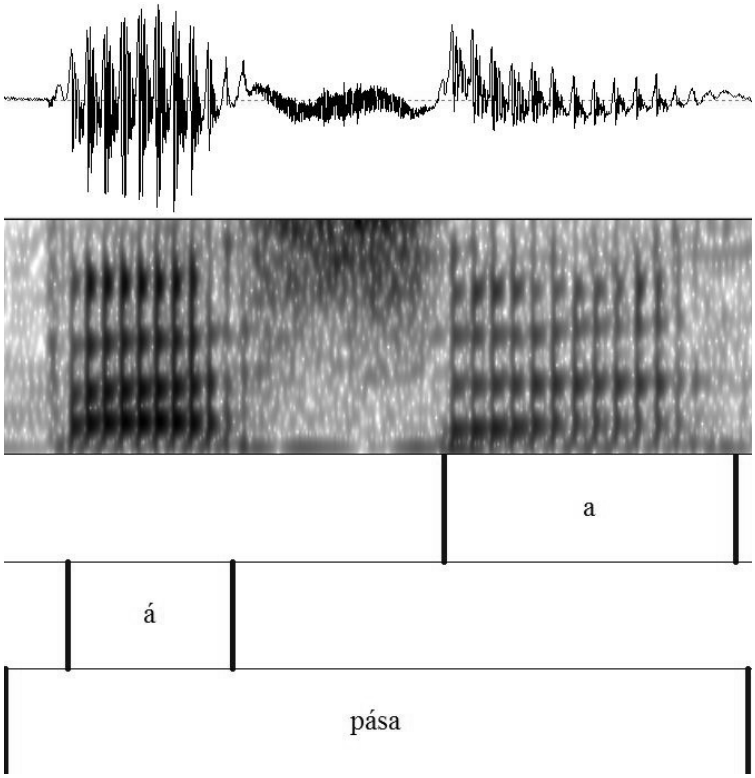

FIGURE 3. Spectrogram of stressed and unstressed /a/ from RM group.

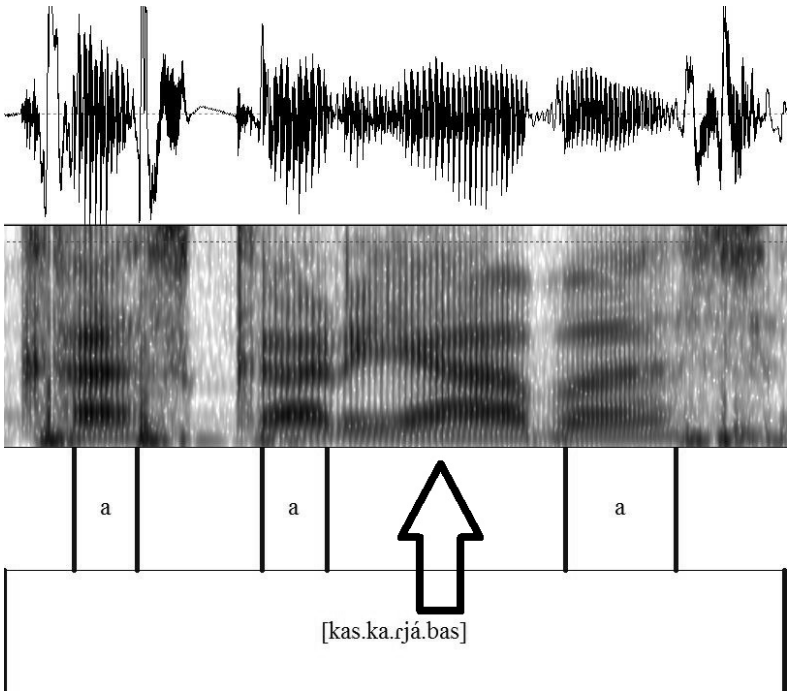

FIGURE 4. Spectrogram of metathesis: *Cascarrabias* pronounced [kas.ka.ɾjá.bas] from RM group.

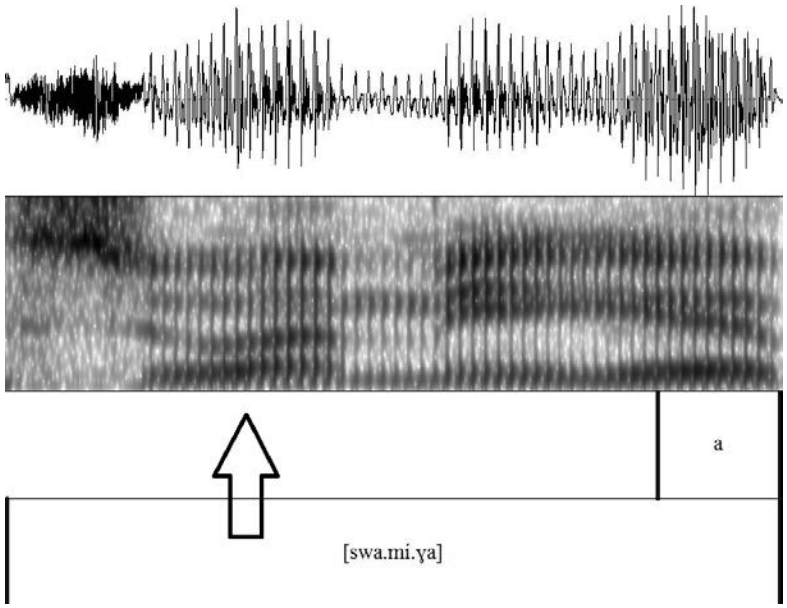

FIGURE 5. Spectrogram of synalepha: *su amiga* pronounced [swa.mí.ɣa] from RM group.

After the data were extracted by running an algorithm script in Praat, the formant values for F1 and F2 were then normalized using the Bark method described by Thomas and Kendall (2007). This vowel-intrinsic method was chosen because it best suits the needs of the project as it does not require the introduction of the entire vowel system of the informants to be analyzed as part of the data. One example that presents the need to normalize data is Delattre (1964), in which he compared the vowel systems of English, Spanish, German, and French by graphing the formant values of English, and then imposing them onto those of Spanish (and the other languages). His results seemed to show that the English vowel system is lower, more closed, and more central than that of Spanish. However, this information cannot be relied on because Delattre did not normalize his data, and thus did not take into account the physiological differences that existed between the groups of informants he investigated.

Following normalization, the data underwent a mixed-design analysis of variance using comprehensive data analysis software called SAS (version 9.3) to account for the many variables

and to perform the repeated measures, comparing the means from three groups against each other, at each task, and according to stress. The probability level (p-value) for significance for all the statistical tests was set at <0.05.

It is important to point out how centralization was measured in this study. In order to determine how much each group centralized their unstressed Spanish /a/, the Pythagorean Theorem ($a^2+b^2=c^2$) was used to determine the distance in Bark between the stressed /á/ and the unstressed /a/ when plotted on a grid (i.e. the hypotenuse). By subtracting the unstressed F1 value from the stressed F1 value, the length of the vertical side of the triangle (a) was determined. Likewise, the length of the horizontal side of the triangle (b) was found by subtracting the stressed F2 value from the unstressed F2 value. These values were then used to find the hypotenuse of the triangle, whose value is also the distance between the stressed and unstressed production of the /a/, which is considered the level of centralization for the purposes of this paper. Later, the centralization values were run through a post-hoc analysis using the same software as mentioned earlier to determine statistical significance. While the slope of each group's centralization may differ, as will be seen in the results, height, rather than frontness and backness, was the greatest factor in the centralization that was produced by the groups. The process of finding the centralization value is exemplified in Figure 6.

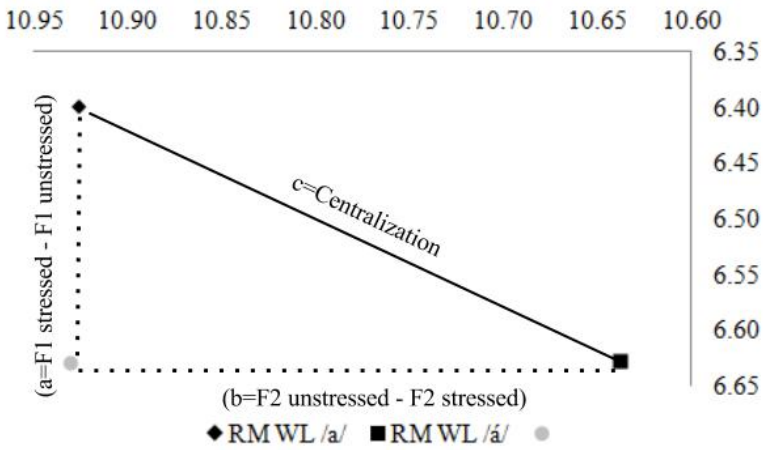

FIGURE 6. Exemplification of the process of determining the centralization value.

4. RESULTS. All the informants in this investigation participated in three tasks: an oral interview (OI), the reading of a short story (SS), and the reading of a word list (WL). Of the three tasks included in the project, the OI was the least formal and was designed to elicit speech production to which the informant paid little attention. On the other hand, the SS and the WL were more formal tasks. All the informants were told that there would be a series of questions to answer after reading the short story in hopes that they would focus more on the content than on their pronunciation. Finally, the word list contained a list of words for the informants to read. For the purposes of this study, the OI is considered an informal task, and the SS and WL increasingly formal tasks, with the WL the most formal of the three.

As will be discussed, the results were mixed. It seems as though there are two very interesting phenomena present in the data. One is that each group, including the native group, displayed some degree of movement between the stressed /á/ and the unstressed /a/, meaning that each group centralized its production of /a/ in unstressed environments. The AH group significantly centralized ($p<0.05$) its production of L2 Spanish /a/ in all three tasks while the RM group centralized ($p<0.05$) in only the OI and the SS task. Throughout all three tasks, the RM

group's production of both the stressed /á/ and unstressed /a/ was consistently more backed compared to that of the AH group, whose production was closer in proximity to that of the native group. The second phenomenon, on the other hand, occurred in a stressed environment: The RM and the AH groups produced a stressed /á/ that was more backed and, in the case of the RM group, higher than that of the NS group. It was also observed that the style of the task played a role in the degree of centralization by each group. The statistical analysis will be given for each phenomenon in each task in the following subsection.

It is helpful to remember that the numbers represented in all the tables and figures referencing F1 or F2 values have been converted to the Bark scale, and therefore are no longer in Hz. Moreover, the F1 values are inversely related to height; that is, a lower F1 value represents a higher production of /a/. Likewise, the F2 values are related to the frontness and backness of the segment; that is, a higher F2 value represents a more fronted production, while a lower F2 value represents a more backed production.

4.1 THE ORAL INTERVIEW TASK. The OI task, as mentioned previously, was the least formal of the tasks. Table 4 displays the overall means of the stressed and unstressed F1 and F2 values produced by each group for this task. The stressed and unstressed F1 means of the RM group were 6.26 and 5.50, respectively, and the F2 stressed and unstressed means of the RM group were 10.48 and 10.92. The stressed and unstressed F1 means of the AH group were 7.19 and 6.66, while the F2 stressed and unstressed means of the AH group were 11.23 and 11.41. The NS group produced a mean F1 stressed and unstressed value of 6.74 and 6.45, respectively, while their mean stressed and unstressed F2 values were 11.55 and 11.89.

The centralization values for the OI task are given in Table 4. It is evident that there was some degree of movement produced by each group between the stressed /á/ and the unstressed /a/. The RM group centralized its L2 Spanish /a/ more than the AH group, producing a centralization value of 0.88, while the AH group produced a value of 0.56. The AH group was closer to the NS group than was the RM group, whose centralization was nearly twice as much as that of the NS group.

Task	Group	Token	F1	F2	Centralization
OPI	RM	/á/	6.26	10.48	0.88
OPI	RM	/a/	5.50	10.92	
OPI	AH	/á/	7.19	11.23	0.56
OPI	AH	/a/	6.66	11.41	
OPI	NS	/á/	6.74	11.55	0.45
OPI	NS	/a/	6.45	11.89	

TABLE 4. Bark scale means for stressed and unstressed F1 and F2 for each group in OI task.

As seen in Table 5, both the RM and AH groups exhibited a significant difference ($p<0.05$) between their production of a stressed /á/ and an unstressed /a/ when considering the F1 value, and only the RM group portrayed a significant difference ($p<0.05$) in F2 values between stressed /á/ and unstressed /a/. Thus, the results indicate that the RM group's unstressed /a/ was significantly different ($p<0.05$) in both height and frontness from its stressed /á/, while the AH group's unstressed /a/ was only significantly different ($p<0.05$) in frontness from its stressed /á/. On the other hand, there was no significant difference found between the F1 stressed and unstressed or the F2 stressed and unstressed in the NS group's production of /a/, indicating that, although there was some movement between this group's production of the two, this movement was not significant. Table 6 displays the p-values for the comparison of each group's

centralization, none of which was found to be significant. That is, the difference between the AH group's centralization and that of the RM group, and so on, was not significant.

Task	Group	Comparison	p-value
OI	RM	F1 /á/ vs. F1 /a/	<0.05
OI	RM	F2 /á/ vs. F2 /a/	<0.05
OI	AH	F1 /á/ vs. F1 /a/	<0.05
OI	AH	F2 /á/ vs. F2 /a/	N.S.
OI	NS	F1 /á/ vs. F1 /a/	N.S.
OI	NS	F2 /á/ vs. F2 /a/	N.S.

TABLE 5. P-values of the comparison of each group's stressed and unstressed F1 and F2 production in OI task.

Task	Centralization Comparison		p-value
OI	RM	AH	N.S.
OI	RM	NS	N.S.
OI	AH	NS	N.S.

TABLE 6. P-values of the comparison of each group's centralization in the OI task.

In Figure 7 a plot graph is given of the mean stressed and unstressed F1 and F2 values of the three groups in the OI task. The RM group is displayed by a triangle, the AH group is displayed by a square, and the NS group by a circle. The stressed /á/ is displayed in black and the unstressed /a/ is displayed in gray. As noted in the plot graph, the groups displayed interesting behavior in the OI task. First of all, and as noted in the previous tables, each group centralized the Spanish /a/ to some degree. The AH and the RM groups' production of both the stressed /á/ and the unstressed /a/ were more backed than the native group.

FIGURE 7. Plot of each group's stressed and unstressed F1 and F2 values in the OI task.

In regards to the stressed tokens of /á/, it was found that there was a significant difference ($p<0.05$) in F2 values between the RM group and the native group in this task, which is displayed in Table 6. This indicates that the RM group's production of the stressed /á/ was significantly more backed ($p<0.05$) than that of the native group, suggesting that the RM group may have transferred its English vowel system to the stressed tokens, as well. However, this was the only interaction found to be significant ($p<0.05$) in regards to stressed F1 or F2 values in any of the tasks. This phenomenon will be addressed at greater length in the discussion section.

Formant	Group Comparison		p-value
F1	AH	RM	N.S.
F1	AH	NATIVE	N.S.
F1	RM	NATIVE	N.S.
F2	AH	RM	N.S.
F2	AH	NATIVE	N.S.
F2	RM	NATIVE	<0.05

TABLE 7. P-values of each group's stressed F1 and F2 in the OI task.

In sum, it is clear from the data presented in this subsection that the RM group centralized its L2 Spanish /a/ more than any other group in the OI task. The AH group, on the other hand, produced an unstressed /a/ that was closer to that of the NS group. The latter did not exhibit a significant difference ($p<0.05$) in stressed /á/ and unstressed /a/ production.

4.2 THE SHORT STORY TASK. The SS task was intended to be in-between the OI and the WL tasks in regards to formality. As mentioned previously, the informants were told that they would be answering a series of questions regarding the SS afterward in hopes that they would pay closer attention to content than form. The stressed and unstressed F1 and F2 means produced by the different groups in the SS task are represented in Table 8. The NS group produced stressed and unstressed F1 means of 6.81 and 6.11, respectively, and produced stressed and unstressed F2 means of 11.50 and 11.55. On the other hand, the stressed and unstressed F1 means for the RM group are 6.17 and 5.74, respectively, while its stressed and unstressed F2 means are 10.67 and 10.91. The AH group, much like the OI task, was closer to the native group than was the RM group, with stressed and unstressed F1 means of 7.04 and 6.33, respectively, while its stressed and unstressed F2 means were 11.45 and 11.51.

The level of centralization by each group in the SS task is also given in Table 8. The difference between the RM group's production of the stressed /á/ and that of the unstressed /a/ was 0.49, while that of the AH and NS groups was 0.71 and 0.70, respectively. It is insightful to point out that the RM group centralized far less in the SS task than in the OI task (RM OI centralization = 0.88) whereas both the AH and the NS groups centralized more (AH OI centralization = 0.56, NS OI centralization = 0.45). These results seem to suggest that, although

the SS task was designed to be more formal than the OI task, the informants paid less attention to their speech production in the SS task than in the OI task.

Task	Group	Token	F1	F2	Centralization
SS	RM	/á/	6.17	10.67	0.49
SS	RM	/a/	5.74	10.91	
SS	AH	/á/	7.04	11.45	0.71
SS	AH	/a/	6.33	11.51	
SS	NS	/á/	6.81	11.50	0.70
SS	NS	/a/	6.11	11.55	

TABLE 8. Bark scale means of stressed and unstressed F1 and F2 for each group in SS task.

Table 9 displays the p-values for the difference in stressed and unstressed F1 and F2 values from the SS task among the three groups. All three groups produced a significantly different ($p<0.05$) unstressed /a/ than that of their stressed /á/, including the NS group, indicating that the level of centralization for all groups was meaningful ($p<0.05$). On the other hand, none of the groups received a significant p-value for the difference between their stressed and unstressed F2 production of the Spanish /a/. Additionally, Table 10 displays the p-values for the comparison of each group's centralization, none of which was found to be significant. That is, the difference between the AH group's centralization and that of the RM group, and so on, was not significant, similar to the OI task. In regards to the significance of the production of the stressed /á/ in the SS task, none of the groups produced a stressed F1 or F2 value that was significantly different from another.

Task	Group	Comparison	p-value
SS	RM	F1 /á/ vs. F1 /a/	<0.05
SS	RM	F2 /á/ vs. F2 /a/	N.S.
SS	AH	F1 /á/ vs. F1 /a/	<0.05
SS	AH	F2 /á/ vs. F2 /a/	N.S.
SS	NS	F1 /á/ vs. F1 /a/	<0.05
SS	NS	F2 /á/ vs. F2 /a/	N.S.

TABLE 9. P-values of the comparison of each group's stressed and unstressed F1 and F2 production in the SS task.

Task	Centralization Comparison		p-value
SS	RM	AH	N.S.
SS	RM	NS	N.S.
SS	AH	NS	N.S.

TABLE 10. P-values of the comparison of each group's centralization in the SS task.

Figure 8 displays these interactions on a plot graph. The RM group is represented by a triangle, the AH group by a square, and the NS group by a circle. As seen in Figure 8, once more the AH group seemed to follow the pattern of the NS group, whereas the RM group exhibited distinct behavior. The RM group, whose stressed /á/ production started farther back than the other groups, produced a centralized /a/ that was more fronted compared to its stressed /á/ than was that of the other groups. That is, the AH and the NS groups' production of the stressed /á/ was low and central, as was their production of the unstressed /a/, while the stressed /á/ of the RM group was backed and its unstressed /a/ was mid and centralized.

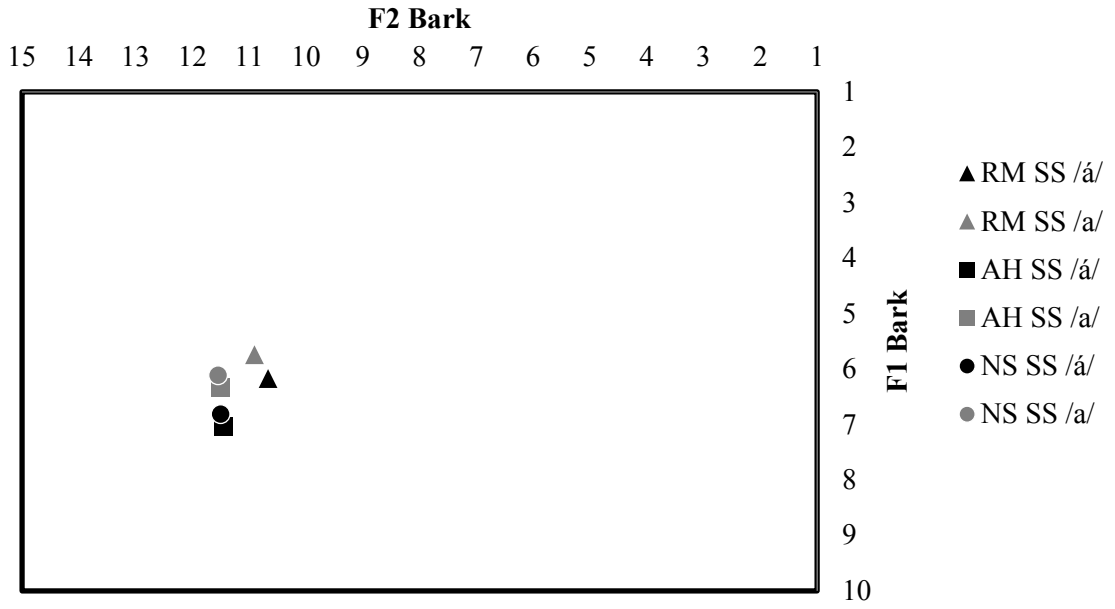

FIGURE 8. Plot of each group's stressed and unstressed F1 and F2 values in the SS task.

In sum, all three groups exhibited some level of centralization in the SS task, and all three groups produced an unstressed /a/ that was significantly different ($p<0.05$) from the stressed /á/ in height. The level of centralization produced by the RM group reduced when compared to that of the OI task, whereas the centralization produced by both the AH and NS groups increased in the SS task compared to the OI task.

4.3 THE WORD LIST TASK. As mentioned previously, the word list task was intended to be the most formal of the three. The stressed and unstressed F1 and F2 means produced by the different groups are found in Table 11. The stressed and unstressed F1 means for the RM group for the WL task were 6.63 and 6.40, respectively, while its stressed and unstressed F2 means were 10.64 and 10.93. The AH group produced stressed and unstressed F1 means of 7.37 and 6.80 and stressed and unstressed F2 means of 11.39 and 11.48. The NS group's stressed and unstressed F1

means were 7.51 and 7.15 with stressed and unstressed F2 means of 11.55 and 11.65, respectively. The difference between the RM group's stressed /á/ and unstressed /a/ was 0.37, which was very similar to that of the NS group, whose difference between stressed /á/ and unstressed /a/ was 0.38. This same difference for the AH group was 0.58. It is insightful to point out that the RM group centralized less in this task than in any of the preceding tasks (RM OI centralization = 0.88, RM SS centralization = 0.49). The NS group produced a centralization value that was lower than both of the previous tasks (NS OI centralization = 0.45, NS SS centralization = 0.70), as well. The AH group, on the other hand, produced a centralization value that was less than the preceding SS task, but nearly equivalent to that of the OI task (AH OI centralization = 0.56, AH SS centralization = 0.71).

Task	Group	Token	F1	F2	Centralization
WL	RM	/á/	6.63	10.64	0.37
WL	RM	/a/	6.40	10.93	
WL	AH	/á/	7.37	11.39	0.58
WL	AH	/a/	6.80	11.48	
WL	NS	/á/	7.51	11.55	0.38
WL	NS	/a/	7.15	11.65	

TABLE 11. Bark scale means of the stressed and unstressed F1 and F2 for each group in the WL task.

In Table 12 the p-values for the interactions produced in the WL task are given. Unlike the other tasks, only one interaction was found to be significant ($p<0.05$) in this task: the difference between the AH group's stressed and unstressed F1 means. The fact that so few interactions were found to be significant may suggest that the formality of the task did play a role in the amount of attention that the learners paid to their speech production. Additionally, Table 13 displays the p-values for the comparison of each group's centralization, none of which was found to be significant. That is, the difference between the AH group's centralization and that of

the RM group, and so on, was not significant, similar to the other two tasks. In regards to the significance of the production of the stressed /á/ in the WL task, none of the groups produced a stressed F1 or F2 value that was significantly different from another, much like the SS task.

Task	Group	Comparison	p-value
WL	RM	F1 /á/ vs. F1 /a/	N.S.
WL	RM	F2 /á/ vs. F2 /a/	N.S.
WL	AH	F1 /á/ vs. F1 /a/	<0.05
WL	AH	F2 /á/ vs. F2 /a/	N.S.
WL	NS	F1 /á/ vs. F1 /a/	N.S.
WL	NS	F2 /á/ vs. F2 /a/	N.S.

TABLE 12. P-values of the comparison of each group's stressed and unstressed F1 and F2 production in the WL task.

Task	Centralization Comparison		p-value
WL	RM	AH	N.S.
WL	RM	NS	N.S.
WL	AH	NS	N.S.

TABLE 13. P-values of the comparison of each group's centralization in the WL task.

Figure 9 provides insightful information on the production of the stressed /á/ and the unstressed /a/ in the WL task by the different groups. The RM group is represented by a triangle, the AH group by a square, and the NS group by a circle. Unlike the other two tasks, the AH group produced both a stressed /á/ and an unstressed /a/ that were higher than the corresponding values produced by the NS group. However, the AH group maintained a more central vowel production overall when compared to the RM group, who once again produced a backed /a/ that was slightly higher than that of the native group. Meanwhile, the RM group followed the same trend as with the other two tasks, producing an /a/ that is higher and more backed than that of the AH and the NS groups.

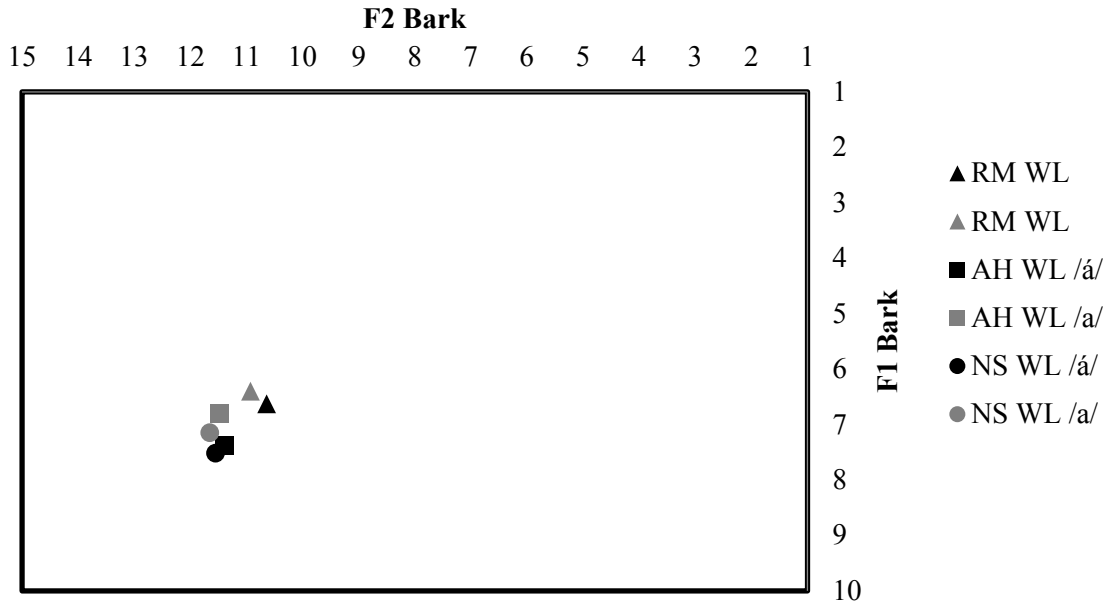

FIGURE 9. Plot of each group's stressed and unstressed F1 and F2 values in the WL task.

4.4 SUMMARY. This section is provided for the convenience of the reader to facilitate the viewing of the results for all groups in all tasks in a combined fashion. Figure 10 provides a visual of the displacement of each group's stressed /á/ and unstressed /a/ across the three tasks. The RM group is represented by a triangle, the AH group by a square, and the NS group by a circle. The WL task is represented by a solid black line, the SS task by a gray broken line, and the OI task is represented by a light grey dotted line. Each lower shape on the x-axis is the stressed /á/, which is connected to its higher and often more central unstressed /a/ counterpart. It must be said, as seen in Table 14, that none of the groups presented a significant difference in their centralization across different tasks (i.e. the RM group did not significantly centralize more in any one task than another, and so on for each group). Also, as mentioned earlier, there was no significant difference between the centralization by each group in each task (i.e. the RM group did not centralize more than the AH group in the OI task, and so on for each task).

Comparison		p-value
RM OI	RM SS	N.S.
RM SS	RM WL	N.S.
RM OI	RM WL	N.S.
AH OI	AH SS	N.S.
AH SS	AH WL	N.S.
AH OI	AH WL	N.S.
NS OI	NS SS	N.S.
NS SS	NS WL	N.S.
NS OI	NS WL	N.S.

TABLE 14. Comparison of the centralization of each group against itself across all tasks.

Nevertheless, Figure 10 makes it evident that the RM group produced both stressed and unstressed tokens of /a/ that were higher and more backed than those of the AH or NS groups. The AH group, on the other hand, consistently produced a more mid stressed /á/ and unstressed /a/, similar to that of the NS group. If one is to consider the stressed /á/ produced by the native group as central, then it is also evident that each group in each task produced some level of movement between the stressed /á/ and the unstressed /a/, creating a vector that tended to display upward and forward movement towards the center of the cavity of the mouth. Finally, in regard to the production of the stressed /á/ alone, it must also be said that none of the groups displayed significant movement between their F1 or F2 production of stressed /á/ between any of the tasks, although there was a significant difference ($p<0.05$) found between the RM and NS group's F2 values in the OI task, as mentioned earlier.

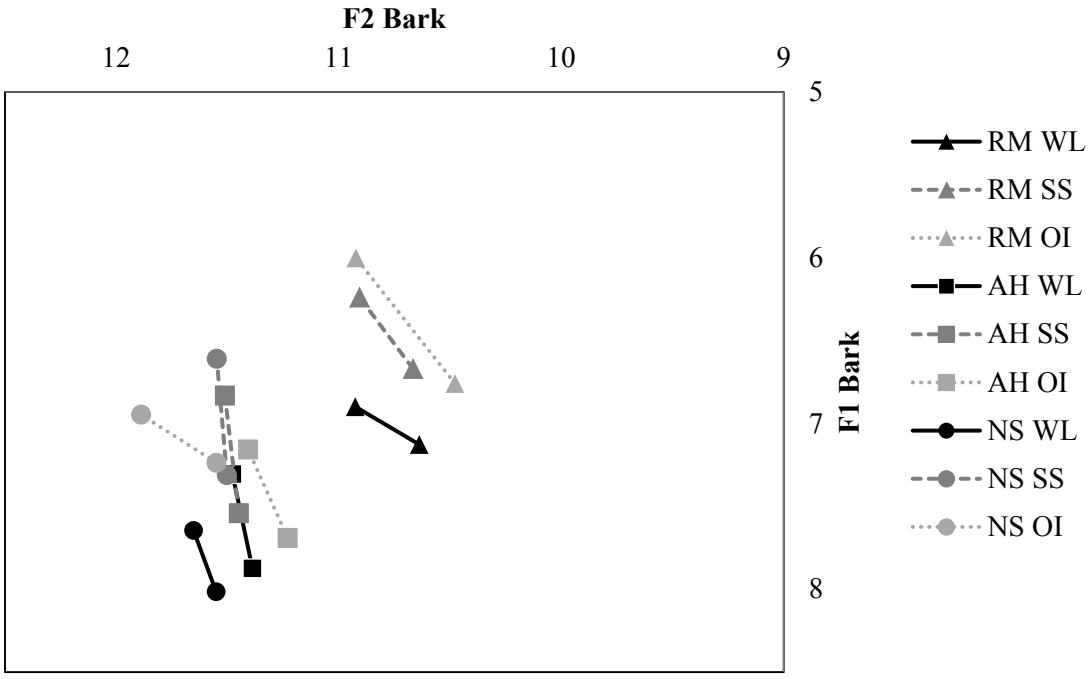

FIGURE 10. Plot of each group's stressed and unstressed F1 and F2 values in all tasks.

Figure 11 provides a display indicating if one group centralized more or less in each of the three tasks. From this figure it is evident that the RM group centralized less as the formality of the task increased. On the other hand, both the AH and NS groups displayed distinct behavior: They centralized more in the SS task than in the OI task. Furthermore, the AH group centralized nearly as much in the WL task as in the OI task, whereas the NS group centralized slightly less in the WL task than in the OI task. Nevertheless, none of these interactions were found to be significant. That is, there was no significant difference between the RM group's centralization in the OI and SS task, the SS and WL task, or the OI and WL task, and so on for each group.

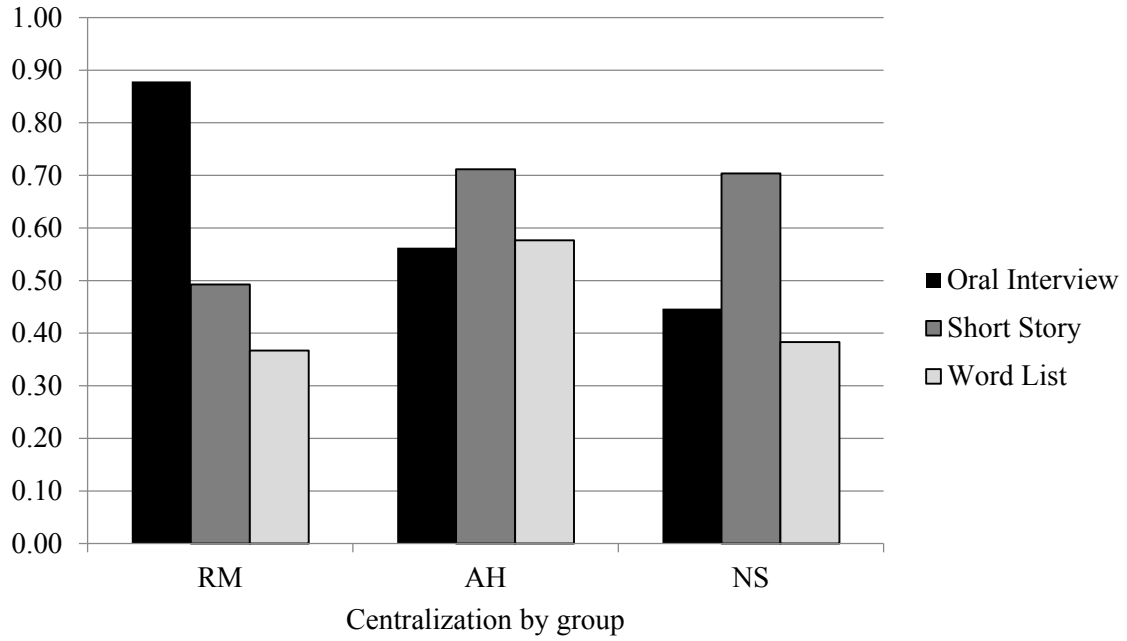

FIGURE 11. Graph of centralization by group.

In Figure 12 one can see which group centralized more in each task. The RM group centralized far more than the other two groups in the OI task. The AH group, on the other hand, centralized more than the OI and NS groups in both the SS and WL tasks. It is interesting to note, however, that the AH group consistently followed a similar pattern as that of the NS group in that it centralized to a degree in the OI task, then much more in the SS task, and once again less in the WL task, whereas the RM group steadily decreased its level of centralization as the formality of the task increased. A table containing a list of the combined values for the stressed and unstressed F1 and F2 values from each group in each task, along with the amount of centralization produced by each group in each task, are provided in Appendix E. A table containing a combined list of the p-values of the differences in F1 and F2 values for each group in each task, in addition to the p-values of the group centralization interactions in each task is provided in Appendix F.

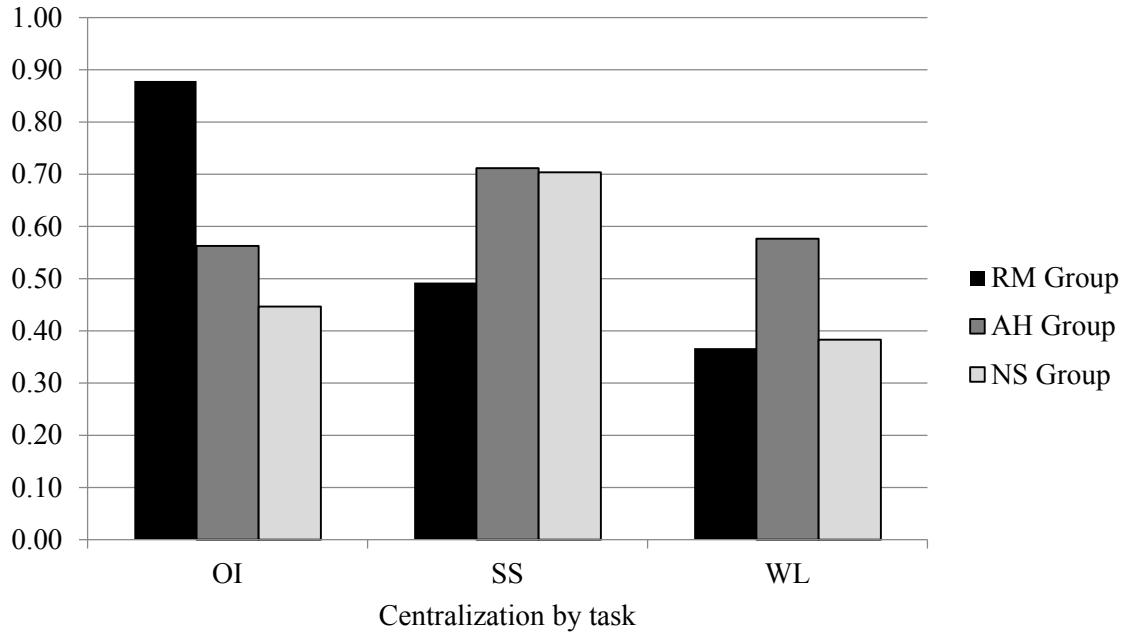

FIGURE 12. Graph of centralization by task.

5. DISCUSSION.

5.1 RESEARCH QUESTION #1. The first research question guiding this project was the following: Do native English-speaking adult learners who have spent an extended period of time in a Spanish-speaking country and native English-speaking adult learners who have very little experience living in a Spanish-speaking country centralize the Spanish low central vowel /a/? If one were to consider centralization as significant difference ($p<0.05$) between the stressed /á/ and unstressed /a/ with regard to movement either upward or forward toward a mid central production of the Spanish /a/, then according to the results, both the RM and the AH group significantly centralized ($p<0.05$) their production of the Spanish /a/ in at least one of the three tasks: The AH group significantly centralized ($p<0.05$) in all three tasks whereas the RM group significantly centralized ($p<0.05$) only in the OI and SS tasks. Additionally, it appears that the greatest factor in the centralization that was produced by the speakers was height rather than

frontness or backness. Each group produced a significantly higher ($p<0.05$) unstressed /a/ than its stressed /á/ in at least two of the tasks, whereas only the RM group produced an unstressed /a/ that was significantly more fronted ($p<0.05$) than its stressed /á/, and this in the OI task only.

These results seem to support the various theories discussed in the review of the literature section regarding the centralization of English unstressed vowels and the transfer of L1 phenomena into L2. As Flege (1995) pointed out, L2 phonemes that are perceived as similar to those of the L1 may even be classified as equivalent in the speaker's mind. Furthermore, Stockwell and Bowen (1965) state that the similarity between Spanish and English vowels can cause L1 English speakers to transfer their vowel system to the L2. The data from this study suggest that both L1 English speakers who have lived for an extensive amount of time in a Spanish-speaking country and L1 English speakers who have spent very little (if any) time in a Spanish speaking country transfer their L1 vowel system to their L2 and produce a centralized Spanish /a/ in unstressed environments, just as they do in their L1.

5.2 RESEARCH QUESTION #2. The second research question guiding this project was the following: If these populations do centralize their L2 Spanish /a/, does their centralization vary by task type? Does one group centralize more than another in different tasks? In regard to the first part of the question, and based on the statistical analysis alone, the answer is no: There was no significant difference found when comparing each group's centralization in one task to its centralization in any of the other two. Therefore, their centralization did not significantly vary by task type. In regard to the second part of the question, neither group significantly centralized more than the other in any task. Nonetheless, the data present some interesting trends that merit discussion.

Major (2004) says that it should be expected that L1 language transfer would decrease as the formality of the task increases. The data, although not statistically significant, show trends that support this theory. The tasks in this study were designed to elicit an increasingly formal style of speech—the OI task being the least formal because it had a conversational tone, the WL being the most formal because it asked the informants to pay attention to their speech while reading a word list, and the SS in between the two. However, only the RM group followed this trend; that is, as the task increased in formality, the amount of centralization gradually reduced, so much so that statistically speaking the RM group did not centralize its unstressed /a/ in the WL task (although there was vertical and horizontal movement). The AH group, on the other hand, centralized the unstressed /a/ nearly the same in the two extreme tasks, but centralized more in the intermediate SS task.

One possible explanation for the unique behavior in which the AH group centralized less in the OI task than in the SS task, whereas the RM group steadily decreased its centralization as the formality increased, could be the AH group's experience with oral interviews in a formal university setting. The AH group is made up of students who had studied many semesters of Spanish at the university. All of the Spanish classes leading up to the one in which they were enrolled at the time of the study required the students to participate in an oral interview as part of their semester's grade, much like that which was administered in this research project. The beginner and intermediate Spanish classes given at the university that the students attended required a graded oral interview many times each semester (as many as six or more or as few as two, depending on the level). Therefore, informants from the AH group were accustomed to scenarios in which they had to perform well in an oral interview in order to receive a desirable grade.

The RM group's performance in Spanish while living abroad, on the other hand, was not graded. In fact, no grade or formal recognition is given to these volunteer missionaries relating to their capability with their L2 at all. Rather, this group was very accustomed to intimate speaking scenarios (much like the OI task) as missionaries, an experienced gained as they spent time in people's homes teaching them about religious topics. It is possible that, because the AH group was more accustomed to receiving corrective feedback in an oral interview setting, and to performing well in order to receive a higher grade, the OI task essentially became a formal task for them rather than an informal, every-day conversation, thus leading them to focus greatly on their pronunciation throughout the open conversation simply out of habit. The RM group's relative lack of experience in performance-based outcomes in an oral interview setting, on the other hand, did not motivate them in the same way. Moreover, it seemed to this researcher that the RM group's rate of speech in the OI task was fast and of a conversation tone, whereas that of the AH group was deliberate, slow and focused (although no data was analyzed in regard to this aspect of the group's speech because it did not form part of the research questions). With this in mind, perhaps it wasn't that the AH group centralized less in the OI task than in the SS task, but that they considered the OI task to be just as formal a task as that of the WL.

In regard to the second part of this thesis question, it was found that neither group centralized more than another in any of the tasks. That is, the amount of centralization produced by each group in each task was not significantly different from that produced by the other groups. However, the data also presents other interesting information in regard to frequency of significant centralization ($p<0.05$). The AH group produced a significantly higher ($p<0.05$), and thus more centralized, unstressed /a/ than its stressed /á/ in each task. The RM group, on the other hand, produced a significantly centralized ($p<0.05$) unstressed /a/ in the OI and SS tasks

only; that is, the group that had nearly two years of experience living in a Spanish-speaking country was the only one to not significantly centralize its token of the unstressed Spanish /a/ in the WL task. These results seem to further support the previously mentioned theory that formality does in fact play a role in decreased language transfer. Furthermore, these results suggest that living abroad for an extensive period of time, such as the RM group, versus spending only a few weeks or less in a Spanish speaking country, can positively affect language production, at least in formal tasks.

In sum, it is evident by the results that both the AH and the RM groups centralize their production of L2 Spanish /a/. The results support the theory that L1 language transfer into L2 does exist, and it is apparent that it exists even in the realm of vowel phonemes. Furthermore, it is evident that there was variation in the amount of centralization produced by the groups depending on the formality of the task. The answer to whether or not one group centralized more than another depends on how the results are interpreted. If, on the one hand, one looks only at the significance of the centralization values of each group extracted at each task, viewing the results by task type individually, then the results indicate than neither group centralized more than the other. If, on the other hand, one interprets the data as a whole, including all the tasks as one large body of research, then it could be said that the RM group centralized less than the AH group because the AH group produced a significantly centralized ($p<0.05$) unstressed /a/ in all the tasks when compared to its stressed Spanish /á/, whereas the RM group significantly centralized ($p<0.05$) in only two of the tasks.

5.3 OTHER RESULTS WORTHY OF MENTION. Although the aim of this thesis was to research centralization produced by L1 English speakers in their L2 Spanish, some other interesting

results were found as well, which will be discussed in this subsection.

PRODUCTION OF THE STRESSED /Á/. Since centralization occurs in English in unstressed environments rather than in stressed, the focus of this thesis was each group's production of the unstressed Spanish /a/, and whether or not language transfer does exist in that area. However, the results also brought to light another phenomenon that was happening with the stressed /á/ tokens, which theoretically are not subject to centralization as is the unstressed /a/, among the speakers of the RM group. As seen in Figure 10, the RM group consistently produced a noticeably higher and more backed production of the Spanish /a/, both stressed and unstressed, than the NS group. In fact, as mentioned in the results section, the difference between the RM group's stressed F2 value and that of the NS group in the OI task was so great that it resulted in being statistically significant ($p<0.05$). Although not directly related to the research questions, this finding merits some discussion.

As mentioned in the review of the literature, Flege (1995) suggests that two unique phonemes from two different languages that are similar will cause difficulties for L2 learners. If we consider that the production of the /á/ by the native group represents a low, central vowel whose production is in between the English fronted /æ/ and the English backed /ɑ/, as Whitley (2002:28) states, and that a centralized version of the /a/ would be a mid, central vowel [ə] as displayed in O'Grady (2010:37), then the results show that the RM group produced a significantly more backed ($p<0.05$) token of /á/ than the NS group in this study. This seems to support Flege's theory of language transfer into the L2. Although data of the production of the AH and RM groups' English vowel system were not collected for comparison, the RM group produced a stressed /á/ that appears to mimic a backed /a/, much like the English /ɑ/. This

phenomenon could be due to the fact that these two phonemes are the most similar when comparing the two vowel systems, as Hualde (2010) pointed out. These results indicate that L1 language transfer into L2 Spanish occurred in both stressed and unstressed environments in the case of the RM group. Interestingly, only the RM group exhibited language transfer in both stressed and unstressed environments: It displayed language transfer as it assimilated its L1 and L2 vowel phonemes, producing a significantly more backed ($p<0.05$) stressed /á/ than that of the NS group, and it assimilated its L1 and L2 vowel allophones as it produced a schwa [ə] in unstressed environments. The AH group, on the other hand, displayed significant language transfer ($p<0.05$) in unstressed vowel environments only.

CENTRALIZATION BY THE NS GROUP. As pointed out in the results section, the NS group displayed movement in both height and frontness/backness in their production of the unstressed /a/. Interestingly, the NS group significantly centralized ($p<0.05$) the Spanish /a/ in the reading of the short story. Although a traditional description of a monolingual Spanish vowel system, as given in the review of the literature section of this paper, would suggest that it is stable and not subject to the same variability as that of the English vowel system, several studies have found some form of statistically significant vowel reduction in native Spanish speakers. For example, Harmegnies and Poch-Olivé (1992) found that the informant of their research significantly centralized Spanish vowels when comparing the speech samples taken from an oral interview to those of a reading of a word list. Others report phenomena such as vowel reduction and elision in spontaneous speech among native Spanish speakers, as well (see
Canellada and Zamora Vicente 1960, Lope Blanch 1963). The results from this study seem to

add to the present literature by supporting these and other researchers' claims that significant centralization of Spanish vowels by native Spanish speakers may in fact exist.

Other recent studies indicate that centralization of Spanish vowels also occurs among Spanish/English bilinguals, as well. For example, Menke and Face (2010) included a bilingual NS population in their study, and found that there was significant centralization in its production of the unstressed /e/ and /u/ when compared to their stressed counterparts. Rogers (2012) studied the vowel production of several generations of bilingual Miami-Cuban speakers and also found that significant vowel centralization does exist among bilinguals, even in the more Spanish-dominant generation. Ronquest (2013) studied the vowel production of heritage Spanish speakers and found similar results in that vowel quality was significantly affected by stress, and that the unstressed vowel tokens were significantly shorter than their stressed counterparts.

The question as to why significant centralization ($p<0.05$) occurred in the SS task only among those of the NS group, and not in the other tasks, may be due to the nature of the SS task itself. As noted earlier, the informants, including the NS group, were asked to focus on the content of the story as they read so that they could answer a series of questions afterward. Perhaps this focus drew their attention away from their speech production more than the OI task was able to do, consequently producing a significant change ($p<0.05$) between their production of the stressed /á/ and the unstressed /a/.

5.4 LIMITATIONS AND FURTHER RESEARCH. As with all research, this project had its limitations, but these limitations provide insight into further research that can be conducted. Some limitations to this project include: (a) the project focused only on the production of a single vowel phoneme /a/ rather than the entire Spanish vowel system, (b) learner variables such as motivation, age, and

gender were not included in the statistical analysis; and (c) the relatively small number of informants in each group.

Further research should explore these same thesis questions but include the entire Spanish vowel system and a third research question that studies what impact learner variables, including motivation and cultural sensitivity (see Alvord and Christiansen 2012, Tanner 2012), may play on L2 Spanish vowel acquisition. Additionally, it would be beneficial to collect data of the AH and RM group's production of the English vowel system for comparison to have a more accurate visual of the assimilation and language transfer that may occur in their L2 Spanish. Moreover, although 19 informants and five native Spanish speakers included in this study resulted in being sufficient to find significant p-values in the statistical analysis, it would be beneficial to include more informants to produce even more reliable results. Additional research could examine, beyond just the pronunciation, the rate of speech and syntax of these two groups, or study their ability to be understood by native Spanish speakers (Tanner, 2012).

6. CONCLUSION. This thesis was proposed with the aim to contribute to the published literature on L2 Spanish vowel acquisition in those who have lived for an extensive period of time in a Spanish-speaking country. Although some published research has addressed L2 phonological acquisition, not many studies have been carried out that concern the acquisition of L2 Spanish phonology, and even fewer address the acquisition of L2 Spanish vowels. The few that do address this topic do not provide data extracted from an acoustic analysis performed using speech-signal processing software, such as was done in this study. Furthermore, those studies do not address the impact that living for an extended period of time may have on the acquisition of L2 vowels or the study of L2 vowel production across varying styles of tasks. This thesis, on the

other hand, addresses these issues and aims to contribute to this aspect of the literature.

It was found that both the RM and AH groups significantly centralize ($p<0.05$) their production of the Spanish /a/. The RM group, who had spent an extensive time living in a Spanish-speaking country, produced an unstressed token of /a/ that was significantly more centralized ($p<0.05$) than that of its stressed counterpart in the less formal OI task and the intermediate SS task, but perhaps one of the greatest findings of this research was that there was no significant difference found between the RM group's stressed and unstressed Spanish /a/ in the formal WL task. On the other hand, the AH group, who had spent three weeks or less in a Spanish speaking country, produced a significant difference ($p<0.05$) between its stressed and unstressed /a/ in all three tasks. However, when comparing the centralization values produced by each group in each task, there was no significant difference found when comparing one group's centralization in one task to its centralization in another, or the centralization of one group to that of the other group in each task.

These results seem to support the theory discussed by many in the literature that L1 language transfer into L2 does indeed exist, even between two vowel systems. Furthermore, it adds to the literature by showing that those who lived for an extensive period of time, roughly two years, centralized less in a formal task than they did in gradually less formal tasks, while those who did not spend an extensive time living abroad did not. The results seem to suggest that living in a Spanish-speaking country for an extensive period of time may in fact have a positive impact on Spanish second language acquisition, particularly on L2 Spanish vowel acquisition. Nevertheless, the RM group was the only group to produce a significantly more backed ($p<0.05$) stressed /á/ than the NS group, suggesting that L1 transfer into L2 was present not only in an unstressed environment, but in a stressed environment as well.

Finally, it was found that the NS group produced a significantly higher ($p<0.05$) unstressed /a/ than the stressed /á/ in the SS task. These results seem to support Harmegnies and Poch-Olivé (1992) who found significant centralization in a native Spanish speaker, in addition to other studies that report vowel reduction and elision in Spanish (Canellada and Zamora Vicente 1960, Lope Blanch 1963). Others found similar results among Spanish/English bilinguals (Menke and Face 2010, Rogers 2012) and heritage speakers (Ronquest 2013).

It is hoped that the results from this thesis may add to today's SLA literature by providing a greater understanding of how well L2 Spanish learners acquire the Spanish vowel system and what affect living in a Spanish-speaking country may have on L2 Spanish learners in their pronunciation of Spanish vowels.

APPENDIX A

Name:_____

Background questionnaire

Demographic Information:

Age _____ Sex _____

Where were you born?

Where did you attend school?

What level of formal education have you completed?

What level of formal education did your mother complete?

What is your mother's occupation?

What level of formal education did your father complete?

What is your father's occupation?

Linguistic Background:

What Spanish classes are you currently enrolled in?

How many years of Spanish instruction did you receive in high school?

How many semesters of University Spanish instruction have you taken?

Have you ever taken a Spanish phonetics class? If so, when?

Do you live, or have you ever lived, in the Foreign Language House?

Have you lived in or visited a Spanish-speaking country (e.g. study abroad, mission, vacation)?

If so, please list the countries that you have visited here:

How long did you visit each place?

If you were a missionary, when did you return (month, year)?

Did you serve a Spanish-speaking mission in the United States?

Do you speak or have you studied any languages other than English or Spanish?

If so, please list other languages that you speak or have studied, and the number of years that you have spoken or studied them.

APPENDIX B

Survey of Motivational Intensity

This section provides information about your motivation to learn Spanish. Please be as sincere and accurate as possible. It is vital that you answer *ALL* of the questions in order for the test to be a useful measurement of motivation. Thank you for your time and attention!

1. I make a point of trying to understand all the Spanish I see and hear.
   1 strongly disagree 2 disagree 3 agree 4 strongly agree

2. I learn Spanish by working on it almost every day.
   1 strongly disagree 2 disagree 3 agree 4 strongly agree

3. When I have a problem understanding something we are learning in a Spanish class, I always try to find the answer. (Think back to your most recent class)
   1 strongly disagree 2 disagree 3 agree 4 strongly agree

4. I really work hard to learn Spanish.
   1 strongly disagree 2 disagree 3 agree 4 strongly agree

5. When I am learning Spanish, I ignore distractions and stick to the job at hand.
   1 strongly disagree 2 disagree 3 agree 4 strongly agree

6. I intend to improve my Spanish as much as I can.
   1 strongly disagree 2 disagree 3 agree 4 strongly agree

7. Being a person who knows Spanish is important to me.
   1 strongly disagree 2 disagree 3 agree 4 strongly agree

8. I am willing to dedicate time and effort to learning Spanish even if it is not convenient.
   1 strongly disagree 2 disagree 3 agree 4 strongly agree

9. I will not stop trying to learn until I have reached I reach the skill level in Spanish that I seek.
   1 strongly disagree 2 disagree 3 agree 4 strongly agree

APPENDIX C

Please read the following story. After reading the story, you will be asked to answer several questions about what you have read.

Rita la fabulosa

Rita cerró el libro y suspiró.

Leo Corazón de León el niño más valiente del mundo.

¡No era justo!

Rita estaba harta de leer historias sobre gente.

De pronto…se dio cuenta. En ese momento supo exactamente qué le faltaba.

Un nombre.

¡Por supuesto! Pero no un nombre cualquiera. Ya tenía uno de esos: Rita Contreras.

Vaya nombre. Y qué aburrido.

Lo que Rita necesitaba era un nombre que la describiera perfectamente. Un nombre que lo dijera todo. Un nombre que no fuera aburrido.

Le echó un vistazo a todos los libros que estaban sobre lfamnigaa mesa de la biblioteca y volvió a suspirar.

–¿Qué te pasa? –dijo su amiga Beatriz Ambrosio asomando la cara por detrás de su libro–. ¿Estás bien?

Como Rita siempre estaba suspirando, Beatriz no se preocupó mucho.

–No, no estoy bien –dijo Rita cruzando los brazos.

–¿Por qué? –preguntó Beatriz mirando a su alrededor–. ¿Israel te está molestando otra vez?

Beatriz miró al niño que estaba recargado en la pared de al lado. Rita también lo miró.

Israel Rojas era muy pecoso, muy pelirrojo y si le preguntabas a Rita, muy difícil de mirar por mucho rato. Por eso ella nunca lo hacía.

–No, no es eso –dijo Rita moviendo la cabeza.

–Vamos Rita, cuéntame –dijo Beatriz arrugando la frente.

–Que no soy nadie – dijo Rita–. ¡Quiero ser Rita la tal cosa! Los personajes famosos tienen un

nombre como Ramona la Valiente o Ezra el Espía.

Beatriz comenzó a reírse.

–No me estás ayudando –murmuró Rita con una risita nerviosa.

Beatriz tomó la mano de Rita.

–Perdón –murmuró–, yo tampoco soy nadie. Creo que Beatriz la Grande suena bastante atractivo.

Rita se recostó en la silla y volvió a abrir el libro y en lugar de leerlo trató de concentrarse.

Rita la…

Rita la…

Rita la… ¡¿qué?!

No podía ser que nada rimara con Rita.

–Oye, ya tengo uno –murmuró de pronto Beatriz.

Rita la miró con el ceño todavía fruncido.

–¿Cuál?

–Rita la Cascarrabias –respondió Beatriz.

Rita viró los ojos pero sabía que algo se le iba a ocurrir.

Mientras tanto, Beatriz seguía hablando en voz baja.

–Ramona la Valiente, Bob el Constructor, Marvin el Magnífico…

El corazón de Rita se aceleró. ¡Pero Claro! ¿Cómo no se le había ocurrido antes?

Increíble.

Maravillosa.

Excelente.

O tal vez…fabulosa.

–¡Mi nombre será Rita la Fabulosa!

Preguntas

1. ¿Por qué a Rita no le gustaba su nombre?

2. ¿Cómo se llama la amiga de Rita?

3. ¿Qué es lo que quería Rita?

4. ¿Cómo se llama el niño que molestaba a Rita?

5. ¿Qué nombre le darías a Rita?

6. ¿Qué nombre se puso Rita?

7. ¿Cuál sería tu nombre perfecto?

APPENDIX D

Please read the following words. Do your best to pronounce each one carefully.

1. aburrido
2. alrededor
3. Ambrosio
4. antes
5. asomando
6. Beatriz
7. biblioteca
8. cara
9. cascarrabias
10. cerró
11. constructor
12. Contreras
13. cruzando
14. cuéntame
15. detrás
16. difícil
17. dijera
18. era
19. estaba
20. Ezra
21. fabuloso
22. fuera
23. Israel
24. justo
25. leer
26. maravillosa
27. mesa
28. mirando
29. mirar
30. miró
31. mucho
32. mundo
33. murmuró
34. necesitaba
35. niño
36. nunca
37. ocurrido
38. otra
39. pecoso
40. pelirrojo
41. pero
42. preguntabas
43. pronto
44. rato
45. recargado
46. reirse
47. rimara
48. Rita
49. supo
50. suspirando
51. suspiró
52. vamos Rita

APPENDIX E

Task	Group	Token	F1	F2	Centralization
OPI	RM	/á/	6.26	10.48	0.88
OPI	RM	/a/	5.50	10.92	
OPI	AH	/á/	7.19	11.23	0.56
OPI	AH	/a/	6.66	11.41	
OPI	NS	/á/	6.74	11.55	0.45
OPI	NS	/a/	6.45	11.89	
SS	RM	/á/	6.17	10.67	0.49
SS	RM	/a/	5.74	10.91	
SS	AH	/á/	7.04	11.45	0.71
SS	AH	/a/	6.33	11.51	
SS	NS	/á/	6.81	11.50	0.70
SS	NS	/a/	6.11	11.55	
WL	RM	/á/	6.63	10.64	0.37
WL	RM	/a/	6.40	10.93	
WL	AH	/á/	7.37	11.39	0.58
WL	AH	/a/	6.80	11.48	
WL	NS	/á/	7.51	11.55	0.38
WL	NS	/a/	7.15	11.65	

Bark scale means for stressed and unstressed F1 and F2 for each group in all tasks.

APPENDIX F

Task	Group	Comparison	p-value
OI	RM	F1 /á/ vs. F1 /a/	<0.05
OI	RM	F2 /á/ vs. F2 /a/	<0.05
OI	AH	F1 /á/ vs. F1 /a/	<0.05
OI	AH	F2 /á/ vs. F2 /a/	N.S.
OI	NS	F1 /á/ vs. F1 /a/	N.S.
OI	NS	F2 /á/ vs. F2 /a/	N.S.
SS	RM	F1 /á/ vs. F1 /a/	<0.05
SS	RM	F2 /á/ vs. F2 /a/	N.S.
SS	AH	F1 /á/ vs. F1 /a/	<0.05
SS	AH	F2 /á/ vs. F2 /a/	N.S.
SS	NS	F1 /á/ vs. F1 /a/	<0.05
SS	NS	F2 /á/ vs. F2 /a/	N.S.
WL	RM	F1 /á/ vs. F1 /a/	N.S.
WL	RM	F2 /á/ vs. F2 /a/	N.S.
WL	AH	F1 /á/ vs. F1 /a/	<0.05
WL	AH	F2 /á/ vs. F2 /a/	N.S.
WL	NS	F1 /á/ vs. F1 /a/	N.S.
WL	NS	F2 /á/ vs. F2 /a/	N.S.

P-values for comparison of each group's stressed and unstressed F1 and F2 production in all three tasks.

Task	Centralization Comparison		p-value
OI	RM	AH	N.S.
OI	RM	NS	N.S.
OI	AH	NS	N.S.
SS	RM	AH	N.S.
SS	RM	NS	N.S.
SS	AH	NS	N.S.
WL	RM	AH	N.S.
WL	RM	NS	N.S.
WL	AH	NS	N.S.

P-values of the comparison of each group's centralization in all three tasks.

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End Notes

[1] The Spanish course is titled Spanish 321: Third-Year Spanish Reading, Grammar, and Culture. It is described by Brigham Young University as follows: "Intensive study and practice with Spanish grammar, vocabulary, and writings incorporating cultural and literary readings. NOTE: First class for returned Spanish-speaking missionaries. Fullfills the University Core Languages of Learning requirement. Required for Spanish major and minor" (http://spanport.byu.edu/spanish/courses/).

[2] For more information, see: http://www.actfl.org/professional-development/certified-proficiency-testing-program/testing-proficiency?pageid=3348