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Abstract: The present study explored development in Spanish vowel production during a short-term study abroad program. The production patterns of a group of learners studying abroad in a 4-week program in the Dominican Republic were compared in terms of overall vowel quality, tendency to diphthongize /e/ and /o/, and vowel duration to those of a similar group of learners studying in the at-home context. Results revealed no significant changes or differences between groups in vowel quality or diphthongization, but a significant improvement (i.e., reduction) in vowel duration for /a/, /o/, and /u/ for the at-home group only. Findings are discussed in relation to previous research, and areas for future research are outlined.

Keywords: phonetic development, second language acquisition, Spanish, study abroad, vowels

1 Introduction

The study abroad experience, with its presumed promise of increased exposure to and opportunities to use a second or foreign language (henceforth L2), has come to be considered "a crucial step in the development of ability to use a language in a range of communicative settings" (Kinginger 2009: 4–5). In fact, the number of U.S. students who study abroad has increased more than fourfold over the past decade, with nearly 300,000 students participating in such an experience in the 2012–2013 academic year (Institute of International Education 2014). The majority of these students — roughly 60 % — participate in summer or short-term programs (i.e., less than 8 weeks in length; Institute of International Education 2014). Research on the impact of study abroad on L2 linguistic development has focused primarily on longer sojourns abroad and has pointed to tenuously positive, albeit inconsistent effects of time abroad on development

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in specific linguistic domains (e.g., Collentine and Freed 2004; Lafford and Uscinski 2014). The growing popularity of summer and short-term programs raises the question as to the efficacy of short-term programs for L2 development and how such development may compare to that observed in a traditional, at-home classroom context.

Much of the research on context of learning and, more specifically, study abroad, has explored the development of general proficiency, oral fluency, and/or pragmatic competence (e.g., Cohen and Shively 2007; Freed, Segalowitz and Dewey 2004; O'Brien, Segalowitz, Freed and Collentine 2007), although focused studies of morphosyntactic development as well as the development of sociolinguistic aspects of the use of certain morphosyntactic features have also been conducted (e.g., Collentine 2004; Geeslin, Fafulas and Kanwit 2013; Geeslin, García-Amaya, Hasler-Barker, Henriksen and Killam 2010; Kanwit and Solon 2013; Segalowitz, Freed, Collentine, Lafford, Lazar and Díaz-Campos 2004). Studies of phonetic and phonological development have lagged somewhat behind but are growing in number and have included several in depth studies of consonantal production as well as studies of the development of regional pronunciation variants and intonation patterns (e.g., Bongiovanni, Long, Solon and Willis 2015; Crane 2011; Díaz-Campos 2004, 2006; Díaz-Campos and Lazar 2003; Henriksen, Geeslin and Willis 2010; Knouse 2012; Lord 2010; Ringer-Hilfinger 2012; Stevens 2011). The present study aims to build upon this growing body of research through the examination of the development of Spanish vowels by two groups of learners: one studying abroad in a short-term program in the Dominican Republic and the other studying in an at-home environment.

The case of Spanish vowel acquisition by English-speaking learners provides an opportunity to explore the impact of context of learning on L2 phonetic and phonological development. Models of L2 speech learning (e.g., Best and Tyler 2007; Flege 1995) suggest that the learning of the five-vowel Spanish system (described in more detail in the following section) by native speakers of English, whose first language (L1) vowel system possesses more and different phonemes, may present substantial challenges in that learners must acquire both new phonemes (i.e., Spanish /a/) as well as adjust phonetic properties (i.e., quality and length) of existing L1 phonemes to arrive at an accurate representation and target-like production of the L2 system. The present study examines learners' productions of L2 Spanish vowels (including vowel quality, quantity, and tendency toward diphthongization) both before and after participation in a 4-week summer study abroad program or an at-home course of similar length to examine both the L2 acquisition of Spanish vowels and the role of context of learning in such development.

2 Background

2.1 Vowels in English and Spanish

Spanish possesses a five-vowel system comprised of the high front vowel /i/, mid-front vowel /e/, low central vowel /a/, mid-back vowel /o/, and high back vowel /u/ (Hualde 2005). Spanish vowels are typically considered to be pure monophthongs and, in comparison to English, to be relatively shorter in duration (Hualde 2005). Additionally, few dialectal differences in Spanish vowel production have been noted (although see Willis 2005 for evidence of some variation from the description of standard Spanish vowels in the Spanish of the Southwest U.S.). Spanish vowels are also generally thought to show fewer or even no differences in stressed versus unstressed contexts, although recent research has shown evidence of centralization of unstressed vowels in native Spanish (e.g., Cobb and Simonet 2015; Menke and Face 2010).

Two studies (Willis 2008; Fermin 2016) have examined the production of vowels by native speakers of Dominican Spanish. Willis (2008) observed, overall, a more or less "typical" triangular vowel space (such as that described by Quilis and Esgueva 1983) but with greater variability in the realization of mid-vowels in this dialect, especially in unstressed position, where they tended to overlap with neighboring high vowels. Fermin's (2016) results, however, suggest that this overlap may be an artifact of task. Her findings showed that, in a task that elicited laboratory speech (i.e., reading of phrases with nonce words), Dominican Spanish speakers, similar to the Mexican and Iberian Spanish speakers tested, showed no overlap between vowel categories. During a map task, more variation in vowel production was observed, especially for the Dominican Spanish speaker group, though, again, mid-vowels were not overlapping. The findings of Willis (2008) and Fermin (2016) suggest that some dialectal differences do exist in vowel realization across varieties of Spanish and also that individual variability exists in Dominican vowel production. Nevertheless, speakers of Dominican Spanish maintain distinct acoustic spaces for each vowel category, thus we would not predict that the variability to which learners are exposed to be a complicating factor in vowel development. To include consideration of the specific dialectal vowel target of our study abroad learners, we will present normalized formant values from Willis (2008) as points of comparison/reference for our own results.[1] It should be noted, however, that no direct, statistical comparison to native speakers is made, as the main objective of the current study is

1 We gratefully acknowledge Erik Willis for his willingness to share his original data with us for normalization and comparison purposes.

to observe potential change in learner production. To the best of our knowledge, no instrumental studies of Dominican Spanish vowel duration exist.

General American English, in contrast, is generally described as having approximately 14–15 vowels (e.g., Giegerich 1992; Ladefoged 2006), including several diphthongs such as those in the words *cake* and *coat*. Although several of the vocalic phonemes that comprise the Spanish system are also present in the English system (i.e., /i e o u/), none of the Spanish vowels is exactly like any of the English vowels (Hualde 2005). For example, Stockwell, Bowen and Martin (1968) describe English /i/ as being produced in a slightly lower position than Spanish /i/ and gliding up; English /u/ is often quite fronted (Bradlow 1995), whereas Spanish /u/ is backer; and English /e o/ tend to become diphthongs [e̯ɪ̯] and [o̯ʊ̯], respectively. Finally, whereas Spanish has one low central vowel /a/, English contrasts two vowels: /æ/ as in *cat* or *bat*, and /ɑ/ as in *cot* or *pot*. American English is also known for systematic centralization of its vowels in unstressed positions (i.e, [ə]) as well as extensive vocalic variation (e.g., Ladefoged 2006).

English speakers learning Spanish, then, have to reorganize their vowel systems, learning to make fewer distinctions in their L2 than in their L1. Additionally, target-like production of Spanish vowels by L1 English learners requires the adjustment of the phonetic properties of phonemes they already possess (e.g., producing the Spanish-like higher /i/ or backer /u/), the elimination of English-like diphthongs, a reduction of typical English-like (longer) vowel duration, and less differentiation between vowels in stressed and unstressed syllables (i.e., less reduction and centralization of unstressed vowels in Spanish than in English). Anecdotally and empirically, such changes present significant challenges to L2 learners. The next section reviews the existing literature on the acquisition of L2 Spanish vowels.

2.2 L2 Spanish vowels

In comparison to research on the acquisition of Spanish consonantal segments, L2 Spanish vowels have received relatively less attention. Nevertheless, a few recent studies have offered accounts of the production of L2 Spanish vowels by English-speaking learners, and these studies serve as a starting point, empirically and methodologically, and as comparative references for the present study.[2] Menke and Face (2010), for instance, conducted a cross-sectional

2 Because of the present study's focus on vowel production, we center this review around previous production studies, but it should be noted that there also exists a body of research on the perception of L2 Spanish vowels (e.g., García Bayonas 2007; Morrison 2003).

analysis of the L2 Spanish vowel productions of 60 learners of Spanish from three levels of study: fourth-semester Spanish students, graduating Spanish majors, and PhD students, as well as six native Spanish speakers. The authors examined vowel quality along high-low and front-back dimensions via measurements of the first and second formants (i.e., F1 and F2), respectively, in stressed and unstressed syllables. It was found that fourth-semester learners exhibited a smaller vowel space than that of graduating majors and PhD students, whose vowel spaces resembled those of the native Spanish speakers (albeit with a few statistical differences) and that /a/ presented the most challenges across learner groups. Additionally, all three learner groups showed patterns of reduction or centralization of vowels in unstressed positions, especially along the front-back (i.e., F2) dimension. Interestingly, the native speakers' productions also showed evidence of some centralization of unstressed vowels, but less so (i.e., affecting fewer vowels) than any of the learner groups.

Cobb and Simonet (2015) conducted a similar analysis of L2 Spanish vowel production by 10 English-speaking learners — five of whom were proficient late L2 learners and five of whom were intermediate-level late L2 learners — as well as five native Spanish speakers. Similar to Menke and Face's (2010) analysis, Cobb and Simonet examined vowel productions in stressed and unstressed contexts by extracting F1 and F2 measurements. Unlike Menke and Face, Cobb and Simonet found few differences between the F1 and F2 values of the learners' productions and those of the native speakers — except with respect to the vowel /u/, which was produced in a very fronted position by the intermediate learners, a backed position by the native speakers, and an even backer position by the advanced learners. Similar to Menke and Face, Cobb and Simonet found evidence of centralization for both learner groups as well as for native speakers.

Díaz and Simonet (2015) explored the production of Spanish /e/ and /ei/ (e.g., in *pena* 'pity' vs. *peina* 's/he combs,' respectively) by intermediate and advanced English-speaking learners of Spanish as compared to that of a comparable group of native Spanish speakers. The /e/-/ei/ contrast had previously been identified as difficult for L2 learners of Spanish with English as a L1 because of their tendency to lower and/or diphthongize Spanish /e/ and because of a documented pattern of insufficient off gliding of /ei/ (e.g., Hammerly 1982; Serradilla Castaño 2000). The results indicated that, whereas few differences in the production of /e/ were observed across the three participant groups, the production of /ei/ varied more widely, with the native speakers and advanced learners producing highly diphthongal realizations and the intermediate learner group less so. Based on these findings, Díaz and Simonet argue that the monophthongal quality of /e/ is acquired earlier than the diphthongal quality of /ei/.

Unlike the previous studies that examined vowel production in terms of formant values, Stevens (2011) examined the duration of L2 Spanish vowels as produced by two groups of English-speaking learners: 11 studying abroad during a summer program in Spain and 11 studying in a four-week at-home summer session. Both groups produced significantly longer vowels than native Spanish speakers both at the pretest (i.e., prior to the programs) and at the posttest, but only the study abroad group showed improvement in vowel production via shorter vowel durations at the posttest than at the pretest. Additionally, both learner groups produced shorter vowels in unstressed positions than in stressed positions.

Some general conclusions can be drawn from these previous studies: (a) Learners' Spanish vowel productions tend to differ from native speakers' vowel productions along F1 and F2 dimensions (Cobb and Simonet 2015; Menke and Face 2010; although the vowels that differ and the extent of those differences vary greatly between the two studies) and duration (Stevens 2011), (b) learners at all levels exhibit reduction of unstressed vowels in that they produce more centralized and shorter vowels in unstressed syllables (Cobb and Simonet 2015; Menke and Face 2010; Stevens 2011); native speakers also show evidence of centralization but not to the same degree (Cobb and Simonet 2015; Menke and Face 2010), and (c) there is some evidence of development in vowel production in that Menke and Face's (2010) graduating majors and PhD students' vowel productions were significantly more target-like than those of the fourth-semester learners, and Cobb and Simonet's (2015) intermediate learners produced a much more fronted /u/ (likely under influence from English) than the more advanced learners. Additionally, Stevens (2011) offers preliminary evidence of a positive effect of study abroad on vowel development with respect to vowel quantity. Nevertheless, more research is warranted both on vowel production — and especially under-researched aspects of this production such as whether or not English-speaking learners' L2 Spanish vowels exhibit English-like diphthongization — and the impact of context of learning on development in such production. We next turn our attention to the issue of context of learning and its importance in L2 acquisition.

2.3 Context of learning

Research examining the role of context of learning (and, in the following cases, specifically, the context of study abroad) in L2 development has explored its impact on, for example, morphosyntax (e.g., Collentine 2004; Segalowitz et al. 2004), pragmatics (e.g., Cohen and Shively 2007), and oral fluency (e.g., Freed

et al. 2004; O'Brien et al. 2007; Segalowitz and Freed 2004) and has found a generally positive effect for time abroad on these areas of linguistic development (e.g., Collentine 2009). Research on the role of context of learning and study abroad on L2 phonological and phonetic development has been, as previously mentioned, somewhat less researched, although work in this area is growing (e.g., Alvord & Christiansen 2012; Bongiovanni et al. 2015; Díaz-Campos 2004, 2006; Lord 2010), and studies in this vein have reported rather modest and inconsistent benefits for the study abroad environment over the at-home context. For example, with regard to development in the production of word-initial /p t k/, Díaz-Campos (2004, 2006) and Bongiovanni et al. (2015) found that at-home and study abroad learners made statistically similar gains over the respective time periods studied (for Bongiovanni et al. 2015 gains were only observed for /p/ and /k/, not /t/); Crane (2011) also reported positive results for the study abroad environment in the production of these sounds, but included no at-home comparison group. Similarly, in their studies of the development of the spirantized allophones of intervocalic /b d g/, Alvord and Christiansen (2012) and Lord (2010) both reported gains by study abroad learners (but these studies did not include at-home comparison groups), Díaz-Campos (2004, 2006) reported no gains by either the study abroad or the at-home group, and Bongiovanni et al. (2015) showed a positive effect for the study abroad environment but only in the pronunciation of /d/ (not of /b/ or /g/). Differences in the lengths of programs studied and the types of analyses employed as well as inconsistencies in the inclusion of a comparison group have somewhat hindered the development of a clear picture of the potential impact of study abroad on L2 phonetic and phonological development; however, the growing body of research promises to shed additional light on the topic. In the next section, we review those studies that have specifically focused on the role of context of learning in the L2 development of Spanish vowels.

2.4 Context of learning and L2 Spanish vowels

To our knowledge, only three previous studies have explored the relationship between context of learning and the acquisition of L2 Spanish vowels. Although the foci, contexts, and methodologies of these three studies have differed greatly, all three point to positive effects of contexts with greater potential contact with native speakers. Simões (1996) examined the development of oral fluency in five learners of Spanish studying at the 5-week Summer Linguistics Institute in Costa Rica. Simões proposed as his measure of fluency "the number of accurately pronounced syllable nuclei in sequences of words found

acceptable in Spanish discourse" (p. 87). In other words, accuracy focused on the pronunciation of vowels, and inaccuracy (coded impressionistically) included the production of lengthened vowels, schwa, incorrect lexical stress, and glottal stops. Thus, fluency was calculated "as the ratio of the number of acceptable syllabic nuclei over the duration of phonetic continua in spontaneous oral discourse" (p. 90). Two of Simões's five participants — the two participants who began the program with the lowest level according to their Time 1 Oral Proficiency Interview (OPI) — showed improvement in fluency; the other three participants did not. Nevertheless, although this fluency rating was based on the production of syllabic nuclei (i.e., vowels), little is known about what specifically changed or improved in the pronunciation of vowels by these participants over the 5 weeks.

In her 2010 dissertation, Menke explored the impact of context of learning on the development of Spanish vowels by first, third, fifth, and seventh grade learners. In the case of Menke's study, context of learning referred to two different domestic immersion programs, as the author compared vowel development in learners enrolled in a one-way (i.e., foreign language) immersion program compared to that of learners enrolled in a two-way (i.e., bilingual) program. As Menke describes, "one-way immersion programs predominantly educate majority-language learners (i.e., in the U.S., native English speakers) whereas two-way programs educate majority-language and minority-language students simultaneously" (p. 4). Menke measured the vowel space and prototypicality of vowel productions by these learners in her cross-sectional study and found that the vowel productions of the two-way immersion learners became more nativelike as grade level increased, whereas the vowel productions of the one-way immersion learners did not. Menke attributed some of this difference to the context of learning and to the fact that the primary difference between the programs was the amount of contact with native speakers of Spanish.

Finally, as previously mentioned, Stevens (2011) investigated change in vowel duration by study abroad and at-home learners over a 4-week period. He found that the students studying abroad in Spain decreased their vowel length by the end of the 4-week program, whereas no change was observed in the vowel duration of the at-home learners.

Thus, unlike research on the acquisition of consonantal segments, the existing research on context of learning and L2 Spanish vowel development points, at least preliminarily, to a clearer role for contexts of learning that provide greater opportunities for input and contact with native speakers (e.g., study abroad, two-way immersion programs). Nevertheless, the research on this topic is still quite nascent. The present study takes these previous findings as its point of departure and aims to further explore the role of context of learning in

the development of L2 Spanish vowels. We employ acoustic analysis to explore changes in the production of vowels by two groups of learners — one studying abroad in the Dominican Republic and another studying in the at-home environment — over 4 weeks. Additionally, to expand on previous analyses, we examine vowel quality (i.e., via analyses of F1 and F2), vowel quantity (i.e., via analyses of the duration of vowel productions), and whether or not (and the extent to which) learners diphthongize their Spanish vowel productions — an aspect of vowel production not explored in the studies reviewed in this section — at the beginning and end of the time abroad/at-home course.

3 Present study

The present study is guided by the following research questions:

1. Do intermediate learners of Spanish show change/development in vowel production in terms of general vowel quality (i.e., as measured by F1 and F2 taken from the midpoint of the vowel) over 5 weeks?
2. Do intermediate learners of Spanish show change/development in vowel production in terms of tendency to diphthongize /e/ and /o/ (i.e., as measured by F1 and F2 taken at three points over the duration of the vowel) over 5 weeks?
3. Do intermediate learners of Spanish show change/development in vowel production in terms of vowel quantity (i.e., articulation-rate-normalized duration as measured in milliseconds) over 5 weeks?
4. Are there differences in the change/development in vowel production — in general vowel quality, tendency to diphthongize, or vowel duration — between the at-home and study abroad groups?

3.1 Participants

The participants were 27 intermediate-level (based on institutional course enrollment) learners of Spanish whose native language was English.[3] These learners were enrolled in a summer introductory course in Hispanic linguistics offered at

3 This study examines the same participants and data set as Bongiovanni et al. (2015), which looked at consonantal development during the same time period. Taken together, we believe these two studies provide a well-rounded picture of segmental development during short-term study abroad.

a large university in the Midwestern region of the United States. Twelve of the participants were taking the course at their home institution (AH group), and the other 15 took the course while studying in the Dominican Republic (SA group). Table 1 summarizes characteristics of the learners in both groups at the beginning of the study period. The information provided in Table 1 was elicited at Time 1 by means of a background questionnaire, which included Elliott's (1995) Pronunciation Attitude Inventory (PAI), and a proficiency test, which will be described in the next section. As observed in Table 1, learners from each group were comparable in terms of Spanish language proficiency and learning experience.

Table 1: Summary of learner characteristics by group.

Group	*n*	*M* years studying Spanish	*M* self-rating of outside-of-class Spanish use (1=never; 5=daily)	*n* with previous study abroad experience	*M* proficiency score at Time 1 (out of 25)	*M* PAI score (12=negative attitude; 60=positive attitude)
AH	12	4.8 years	3.9	4	12.5	43.67
SA	15	5.5 years	3.9	5	13.9	48.67

Note: The groups did not exhibit statistical differences in terms of proficiency, $t(25) = -0.99$, $p = 0.332$, or years studying Spanish, $t(25) = -0.073$, $p = 0.48$. Differences in PAI scores were not tested, given that this individual characteristic was not expected to vary as a function of language experience and/or proficiency.

Participants in the AH group attended class approximately 6.25 hours per week during a 6-week period. Learners in the SA group, on the other hand, were enrolled in a 4-week program. In addition to the course on Hispanic linguistics, they took a course on Hispanic cultures, and both courses together accounted for 4 hours of class, 4 days a week. Additionally, learners in the SA group participated in cultural activities (e.g., visits to local museums and historical sites) and homestays with local families. Because the durations of the programs were not identical, the timing of data elicitation was adapted to compare the same interval of time (between Time 1 and Time 2) across learner groups (see next section for details).

One limitation of the present study is that it was not possible to control for the potential effect of instructor, as both programs were taking place during the same time period. The linguistics instructors in both contexts were near-native speakers of Spanish and specialists in Hispanic linguistics. However, they did differ in terms of research focus (language contact [instructor AH] vs. phonetics/phonology

[instructor SA]); as a result, they may have given more attention to different units of the course (e.g., phonetics/phonology, morphology, syntax, etc.). Despite these potential differences, both instructors covered the same general content in their respective courses, as outlined by the departmental course requirements.

3.2 Elicitation tasks and procedure

To elicit learners' productions of Spanish vowels, all participants completed a three-part passage reading task in which target vowels were embedded in words scattered throughout each passage. Each passage was short, ranging from four to ten lines. The content of each passage was fictional and designed by the researchers to be entertaining and to include vocabulary that would be familiar to the learners. Each target vowel token ($n = 22$ per speaker per time) occurred in stressed, open syllables flanked by one of the following consonant segments: /p b d t g k s x/.[4] Additionally, vowels occurred in either word-medial or word-final position, but no vowel occurred in phrase final position as vowel quality and duration may be affected in this prosodic position (Oller 1973). The entire passage reading task is provided in Appendix A with the target vowels in bold (the version participants received did not include any textual emphasis).

Participants were recorded at two times. To ensure that the same approximate time interval (5 weeks) elapsed between recordings for each group, the AH group was recorded during the first and fifth weeks of classes, and the SA group was recorded a week prior to departure and during the final week of classes in the Dominican Republic. At Time 1, all learners (AH and SA groups) were recorded in a sound attenuated booth at the home institution. At Time 2, learners in the AH group were recorded in the same sound attenuated booth, whereas learners in the SA group were recorded in an open classroom in the Dominican Republic. For both participant groups, and at both times, elicited speech was recorded using a USBpre external soundcard connected to a laptop computer and a Shure WH20 head-mounted microphone.

At Time 1, participants in both groups also completed a background questionnaire, which elicited data on previous language learning experience and use and explored participant attitudes towards L2 pronunciation accuracy (adapted from Elliott's 1995 PAI); relevant data from the background questionnaire were presented in Table 1. Additionally, in order to assess the comparability between participant groups with regard to level of general Spanish proficiency, a

4 Vowels flanked by these particular consonants were selected for acoustic analysis, as vowel quality is not predicted to be influenced greatly by them.

grammar proficiency test was administered. This test, employed in previous research on L2 Spanish (e.g., Geeslin and Gudmestad 2008), had a cloze format, and each item targeted linguistic structures known to be challenging for L2 learners of Spanish (e.g., copula contrast, clitic pronouns, preterit-imperfect contrast, etc.; Geeslin 2014). An analysis of internal consistency demonstrated that the grammar test was reliable, $\alpha = 0.75$ (Nunnaly 1978); each groups' Time 1 proficiency test results are also presented in Table 1.

3.3 Instrumental analysis

Target productions of stressed /i e a o u/ were extracted and analyzed using Praat (Boersma and Weenink 2014). To identify the onset of the vowel, we first located the release of the previous consonant by inspecting the waveform and the spectrogram. The main cue employed was an increase in intensity in the waveform in comparison to the adjacent consonants. Additionally, an increase in energy in the regions of F1 and F2 was taken to indicate vowel onset. The offset of the vocalic portion was identified based on a sudden loss of intensity and energy in the waveform and loss of formant structure in the spectrogram. For purposes of consistency, all vowels were segmented at zero-crossings.

The acoustic characterization of the learners' vowel space was obtained by means of formant measurements. Vowel quality was determined by F1 and F2 frequencies, taken at the midpoint of each target vowel. F1 inversely indexes vowel height (a high F1 signals a low vowel), whereas F2 indicates vowel fronting or backing (a high F2 indicates a more backed vocalic production). In order to examine diphthongization of the mid-vowels (i.e., /e o/), formant measurements were also taken at two additional temporal points within the vocalic segment: 25 % and 75 %. In all cases, formant measurements were extracted from the vowels semi-automatically with a Praat script developed by McCloy (2012). The advantage of semi-automatic extraction is that it allows the correcting of formant settings (i.e., number and maximum frequency of formants) to minimize formant tracker errors. Figure 1 exemplifies measurement landmarks with a mid vowel token.

Because speakers' vocal tracts differ in size, formant resonances may differ from speaker to speaker. In order to reduce formant frequency variation due to anatomical differences, formant measurements were normalized using Lobanov's (1971) z-score transformation in NORM, a web-based vowel-normalization suite (Thomas and Kendall 2007). All statistical analyses (described in detail in the following section) were based on normalized vowel formant measurements.

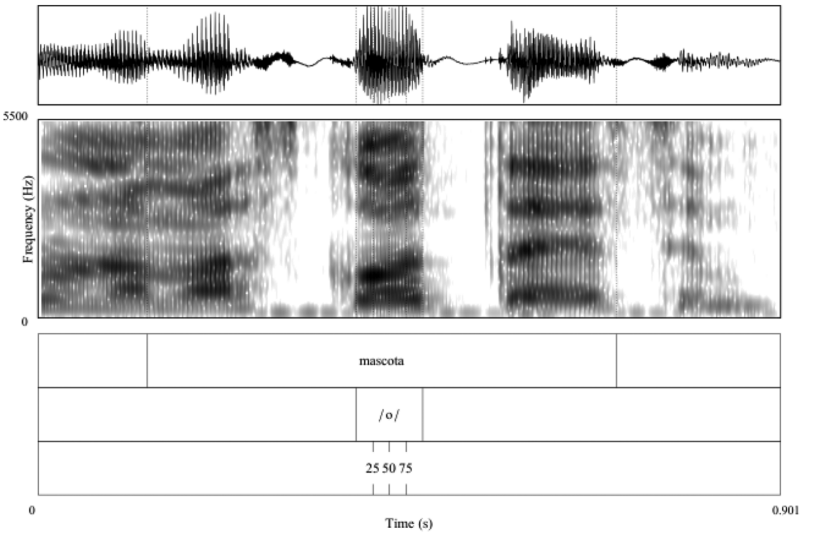

Figure 1: Waveform and spectrogram of the word *mascota* 'pet,' produced by Participant 9 in the reading passage, with measurement landmarks.

Vowel duration measurements (in milliseconds) were extracted automatically using a Praat script. Given that vowel duration varies as a function of speech rate, all duration measurements were then normalized according to each individual speaker's rate of articulation (i.e., number of syllables per speaking time) at each time of recording. Articulation rate was calculated using De Jong and Wempe's (2009) Praat script that is designed to recognize syllable nuclei and, from there, calculate a speaker's speech and articulation rates (among other things). To normalize vowel duration rates, the duration of each vocalic segment was divided by that speaker's articulation rate for that particular recording (i.e., Time 1 or Time 2). It should be noted that, for one speaker at one recording time, the script was unable to automatically calculate articulation rate; this speaker's data were excluded from the duration analysis.

3.4 Statistical analysis

The theoretical ceiling for number of tokens was 1,188 (22 target segments × 2 times × 27 learners). However, a total of 222 tokens were excluded from the formant analyses given that they constituted instances of disfluencies, creaky voice, nontarget productions, or formant tracker errors that could not be

corrected. Thus, the total number of observations analyzed in the formant analyses was 966. For the duration analyses, in addition to the exclusion of one speaker's data, additional tokens were excluded if difficulties were experienced in precisely locating the boundary between a vowel and a preceding or following segment. The total number of observations analyzed in the duration analysis was 872.

Mean normalized F1 and F2 values were calculated for each vowel by group (i.e., AH or SA) and time of data collection (i.e., Time 1 or Time 2). To determine whether learners demonstrated changes in vowel quality over the 5-week study period, a series of linear mixed models were conducted in R (R Core Team 2016), one for each measurement-vowel combination (i.e., F1 for /i/, F2 for /i/, F1 for /e/, F2 for /e/, etc.). For each analysis, the dependent variable was the measurement value (i.e., normalized F1 or F2); random effects included speaker and token; and fixed effects included group (SA vs. AH), time (Time 1 vs. Time 2), and Group × Time.

For the analysis of learners' tendency to diphthongize Spanish mid-vowels, repeated-measures ANOVAs were conducted, one for each measurement-vowel combination. The dependent variable was the measurement value, and the independent variables included time, group, and time point in the duration of the vowel (i.e., 25 %, 50 %, or 75 %). The alpha level for all analyses was set at 0.05.

Finally, for the analysis of vowel quantity (i.e., duration), another series of linear mixed models were run for each vowel with articulation-rate-normalized duration as the dependent variable; speaker and token as random effects; and group, time, and Group × Time as fixed effects.[5]

4 Results

4.1 Vowel quality

To determine the degree to which learners of Spanish show change in vowel production in terms of general vowel quality over 5 weeks, Tables 2 and 3 present mean normalized formant values for each vowel at Time 1 and Time 2 for the AH and SA learners, respectively. Figures 2 and 3 present the same results in the form of vowel charts representing the vowel space of AH and SA

5 Mixed models were generated (as opposed to ANOVAs) to analyze vowel quality and quantity to specify speaker and token as random and not fixed effects.

Table 2: Mean normalized formant values for AH learners at Time 1 and Time 2.

Vowel	Time 1			Time 2		
	n	F1	F2	*n*	F1	F2
/i/	31	−0.74	1.17	33	−0.64	1.23
/e/	23	0.01	0.79	21	0.12	0.76
/a/	50	1.21	−0.29	43	1.13	−0.39
/o/	44	0.17	−0.74	43	0.02	−0.54
/u/	44	−0.66	−0.50	49	−0.52	−0.45

Table 3: Mean normalized formant values for SA learners at Time 1 and Time 2.

Vowel	Time 1			Time 2		
	n	F1	F2	*n*	F1	F2
/i/	52	−0.93	1.34	58	−0.70	1.07
/e/	34	0.12	0.80	34	0.15	0.82
/a/	73	1.25	−0.43	66	1.41	−0.46
/o/	70	0.24	−0.88	68	0.20	−0.81
/u/	65	−0.64	−0.67	65	−0.57	−0.55

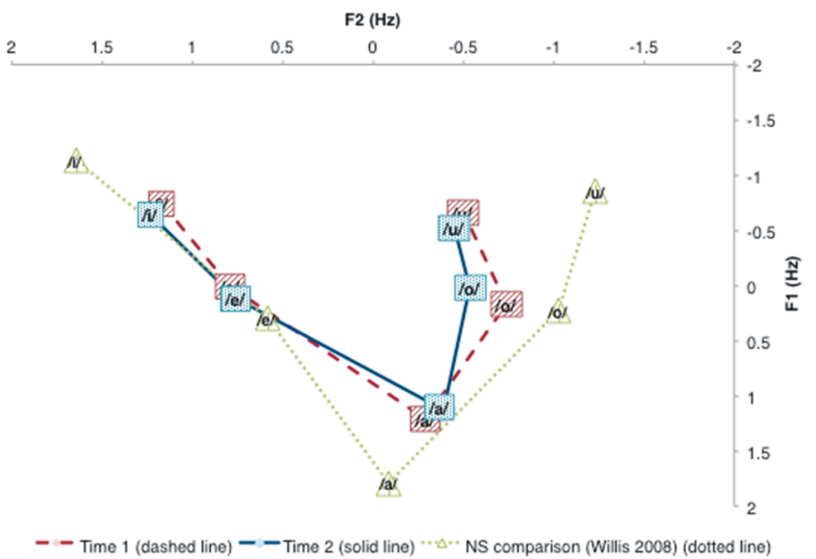

Figure 2: Vowel chart for AH learners at Time 1 and Time 2.

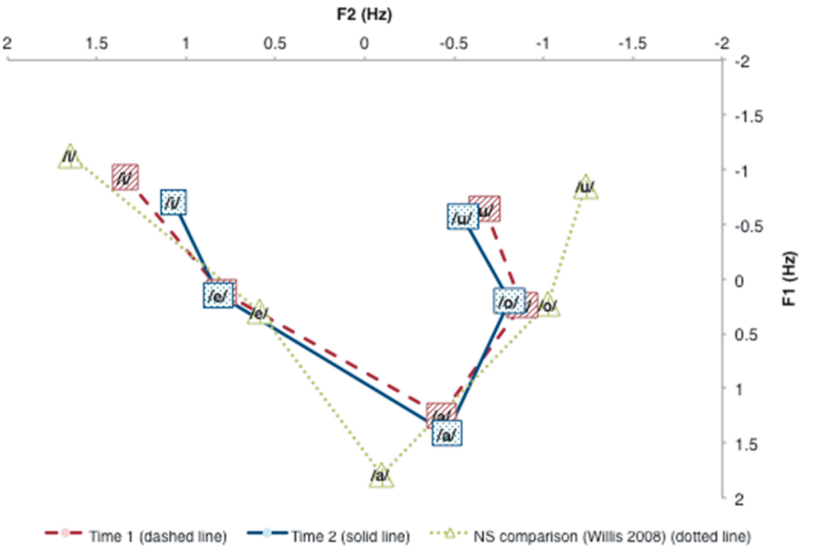

Figure 3: Vowel chart for SA learners at Time 1 and Time 2.

learners, respectively, at Time 1 and Time 2. Normalized F1 and F2 means from Willis's (2008) native speakers of Dominican Spanish are included for comparison purposes (though it should be emphasized that no statistical comparison to native speaker data is made).

A series of linear mixed models for each formant and each vowel revealed no significant effects of group or time nor any significant Group × Time interaction for F1 or F2 for any vowel (see Tables 8 and 9 in Appendix B, for summary of statistics for F1 and F2, respectively). In other words, learners did not demonstrate significant changes in vowel production in terms of general vowel quality over the 5-week period in either context of learning.

4.2 Diphthongization

It will be recalled that English-speaking learners face the challenge of eliminating diphthong-like productions for /e/ and /o/ in Spanish. For the present study, we further sought to examine whether learners' tendency to diphthongize /e/ and /o/ changed over 5 weeks, as well as the role of learning context in the potential reduction of this non-target-like phonological process. As a reminder, to quantify diphthongization, we measured F1 and F2 frequencies at three points in learners' productions of /e/ and /o/: 25 %, 50 %, and 75 %. In the case of a

diphthongized production of /e/ (i.e., [eɪ̯]), one would expect lower F1 and higher F2 values at the 75 % time point in the vowel than at the 50 % and 25 % time points, as the tongue shifts toward the higher and more fronted [ɪ] position. A diphthongized /o/ (i.e., [oʊ̯]) would present lower F1 and lower F2 values at the 75 % time point, indexing the higher and more backed [ʊ]. With these predictions in mind, we present mean normalized formant values at the 25 %, 50 %, and 75 % time points for /e/ and /o/ produced by AH and SA learners at Time 1 and Time 2 in Tables 4 through 7.

Table 4: Mean normalized formant values at 25 %, 50 %, and 75 % of /e/ and /o/ for AH learners, Time 1.

Vowel	*n*	F1			F2		
		25 %	50 %	75 %	25 %	50 %	75 %
/e/	23	−0.00	0.01	−0.19	0.70	0.79	0.90
/o/	44	0.10	0.17	0.04	−0.70	−0.74	−0.61

Table 5: Mean normalized formant values at 25 %, 50 %, and 75 % of /e/ and /o/ for AH learners, Time 2.

Vowel	n	F1			F2		
		25 %	50 %	75 %	25 %	50 %	75 %
/e/	21	0.09	0.12	−0.05	0.65	0.76	0.82
/o/	43	0.01	0.02	0.00	−0.53	−0.54	−0.45

Tables 4 and 5 suggest that the AH learners have a tendency to diphthongize /e/ both at Time 1 and Time 2 in that, generally, lower F1 values and higher F2 values are observed at the 75 % time point than at the 25 % and 50 % time points. Results for /o/ are less clear: Although the AH group's /o/ appears to raise toward the end of the vowel (i.e., with a lower F1 value at the 75 % time point than at the 25 % and 50 % time points), movement along the front-back dimension (F2) does not point to diphthongization at Time 1 or Time 2, as the F2 values at the 75 % time point are not consistently lower (which would indicate a backward — toward [ʊ] — movement) than at the 25 % and 50 % time points. Interestingly, these same trends were observed for the SA learners (Tables 6 and 7), suggesting no difference between groups in terms of the tendency to diphthongize /e/ and /o/.

Table 6: Mean normalized formant values at 25 %, 50 %, and 75 % of /e/ and /o/ for SA learners, Time 1.

Vowel	n	F1			F2		
		25 %	50 %	75 %	25 %	50 %	75 %
/e/	34	0.51	0.12	0.03	0.75	0.80	0.84
/o/	70	0.23	0.24	0.19	−0.85	−0.86	−0.71

Table 7: Mean normalized formant values at 25 %, 50 %, and 75 % of /e/ and /o/ for SA learners, Time 2.

Vowel	n	F1			F2		
		25 %	50 %	75 %	25 %	50 %	75 %
e	34	0.11	0.15	0.09	0.65	0.82	0.90
o	68	0.12	0.20	0.13	−0.85	−0.81	−0.64

Two repeated-measures ANOVAs (one for F1 and another for F2; based on normalized formant values; Thomas and Kendall 2007) revealed a significant main effect for time point (i.e., 25 %, 50 %, and 75 %) for /e/ on the F1 dimension and for /e/ and /o/ on the F2 dimension (see Tables 10 and 11, in Appendix B, for summary of statistics for F1 and F2, respectively). For /e/, mean F1 values were significantly lower at the 75 % time point than at the 25 % ($p = 0.013$) and 50 % time points ($p < 0.001$), and mean F2 values at the 50 % and 75 % time points were significantly higher than at the 25 % time point (both p's < 0.001). For /o/, mean F2 values were significantly higher at the 50 % and 75 % time points than at the 25 % time point (both p's < 0.001). There was no significant main effect for group or time, indicating that learners' tendency to diphthongize /e/ and /o/ did not vary over time or as a function of learning context.

4.3 Duration

Finally, the role of time abroad in development in L2 Spanish vowel quantity was explored by measuring the duration of vowels in productions by both the AH and SA groups at Time 1 and Time 2. To account for potential variation in overall speech rate by speaker and time, all vowel durations were normalized by dividing the duration of each vowel by the rate of articulation of each particular

speaker at each time. The results reported below correspond to normalized vowel durations.

Figure 4 presents mean normalized vowel durations by group (AH vs. SA) and time (Time 1 vs. Time 2); standard deviations are indicated via error bars.

As can be observed in Figure 4, duration by vowel varied for both groups: /a/ tended to have the longest duration and /i/ the shortest. In general, the AH group's vowels were shorter in duration overall (and for each vowel) than the SA group. Additionally, the AH group appears to produce numerically shorter mean normalized vowel durations at Time 2 than at Time 1 across all vowels, whereas the SA appears to produce longer vowels at Time 2 than at Time 1 (except for /e/, which appears to be shorter at Time 2 than Time 1 for this group).

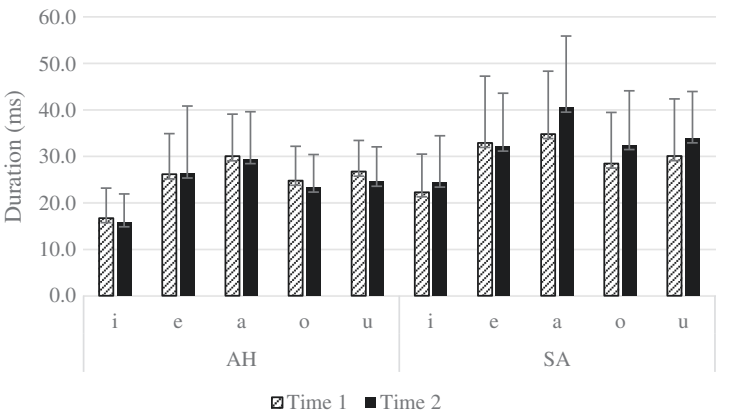

Figure 4: Mean vowel duration in milliseconds by group and time.

A series of linear mixed models revealed a significant effect of group for /i/, no significant effect of time for any vowel, and significant Group × Time interactions for /a/, /o/, and /u/ (see Table 12, in Appendix B, for summary of linear mixed model results). For /i/, the AH group produced shorter durations than the SA group overall (i.e., at both data collection times). With regard to the significant interactions, the mean differences observed between Time 1 and Time 2 vowel durations for /a/, /o/, and /u/ in Figure 4 differ significantly between the AH and the SA. Whereas the AH group reduces mean vowel duration of /a/, /o/, and /u/ over the study period, the SA group's durations increase for these vowels.

5 Discussion

The primary objective of the present study was to explore the role of context of learning in the development of L2 Spanish vowels. Specifically, we examined potential changes in overall vowel quality and quantity and the tendency of English-speaking learners to diphthongize /e/ and /o/ over 5 weeks, as well as potential differences between the AH and SA learner groups. In response to the first research question (i.e., change in stressed vowel quality), learners did not show change in vowel production in terms of overall vowel quality over 5 weeks. In fact, learners' Spanish vowel space showed very few differences between Time 1 and Time 2 (see Figures 2 and 3), and some of the minor adjustments to vowel production between Time 1 and Time 2 that can be observed appear to move away from Dominican native speaker norms as presented in Willis (2008). Production of /u/ also suggests persistent influence of English, as observed from the considerably fronted productions at the beginning and end of the study period. These results suggest that acoustic-level adjustments to the phonetic/phonological system for features such as vowel quality may not occur over such short study periods. Additionally, that the learners' productions of /u/ in particular remain considerably fronted lends support to the idea that perceived L1-L2 phonetic dissimilarity plays a role in the successful production of L2 sounds (Flege 1995); however, additional research on learners' perception *and* production of Spanish vowels is needed to facilitate more informed discussion of this idea in relation to L2 Spanish vowel development in the present study.

The lack of group differences (Research Question 4) found for overall vowel quality suggests that, at least in the short term, learning context does not differentially impact vowel quality acquisition. That is, the assumed benefits of study abroad in terms of increased input and contact with native speakers did not result in any additional gains in vowel quality over the AH group in the present study. In comparing these findings with those of previous studies, it will be recalled that there is only one study (i.e., Menke 2010) that examined change in vowel quality as a result of learning context; in that study, two-way immersion learners demonstrated more target-like change than one-way immersion learners. Given the distinct learner populations and learning contexts examined in Menke and the present study, it is challenging to compare findings directly. Nevertheless, the differences may point to an important interaction between context of learning and length of time studied with regard to vowel acquisition whereby differential effects of learning context are only observed in the long term: The present analysis explored development over a short-term (4 week) study abroad program; Menke (2010) explored development over years,

accounted for cross-sectionally. More research is needed to explore this potential interaction and to expand the discussion of the impact of learning context on the development of vowel quality for L2 learners.

In response to the second research question (i.e., regarding diphthongization), the findings of the present study similarly revealed no change in learners' tendency to diphthongize /e/ and /o/ over 5 weeks. Furthermore, no differences were found with regard to learning context (Research Question 4). Taken together, these findings suggest that English-speaking learners of Spanish continue to face the challenge of reducing L1 influence in their production of /e/ and /o/, and exposure to a context in which learners may have more opportunities for input and interaction with native speakers does not necessarily yield change or development. Although there is no existing research on the role of study abroad in English-speaking learners' tendency to diphthongize Spanish vowels with which to compare, these findings go hand-in-hand with Díaz and Simonet's (2015) conclusion that diphthongal qualities may be later acquired than monophthongal qualities of Spanish vowels by English-speaking learners. Given the persistence of diphthongization in the present study's and Díaz and Simonet's intermediate learners' speech, future studies should examine development — characterized as reduction in diphthongization — further with more learners and across learning contexts.

Finally, with regard to Research Question 3 (i.e., regarding vowel duration), significant differences in the changes made over time were observed between the SA and the AH groups; specifically, whereas the AH group reduced the duration of /a/, /o/, and /u/ between Time 1 and Time 2, the SA group's mean duration of these vowels increased. Thus, whereas the AH group's patterns of vowel duration production moved in a target-like direction for these three vowels, those of the SA group moved in a non-target-like direction. It should be recalled that, in Stevens' (2011) study, it was the SA learners who demonstrated improvement in producing target-like vowel duration over a 4-week period whereas the AH learners did not. One central difference between the present study and that of Stevens is that the present study normalized vowel duration measurements by articulation rate, whereas Stevens did not. Nevertheless, it seems unlikely that such a difference would result in almost entirely opposite findings. One other hypothesis, related to Bongiovanni et al. (2015), which found the most obvious improvement and differences between the SA and AH groups was in terms of rhotic production, is that, given the dialectal features of the variety spoken in the region in which the present SA students studied abroad, perhaps more attention was dedicated to the production of consonants with salient regional variation to the potential neglect or even detriment of vowel production. Future research that takes into account the specific exposure to, instruction regarding, and attention to

pronunciation features during study abroad (as compared to study at home) would assist in teasing apart the influence of these various factors at play during a sojourn abroad.

6 Conclusion

The present study explored development in Spanish vowel production during a short-term study abroad program. The production patterns of a group of learners studying abroad in a 4-week program in the Dominican Republic were compared to those of a comparable group studying in the at-home context in terms of overall vowel quality, tendency to diphthongize /e/ and /o/, and vowel duration. Results revealed no significant changes or differences between groups in vowel quality or diphthongization, but a significant improvement (i.e., reduction) in vowel duration for /a/, /o/, and /u/ for the AH group only. Although the results may contradict long-held beliefs and assumptions about the efficacy and importance of study abroad for L2 development, recognition of the present results is important in that they may point to potential limits of study abroad, for example, with regard to program duration and/or to the development of specific linguistic phenomena. We hope this study prompts continued research into the acquisition of phonetics and phonology during study abroad — particularly, short-term study abroad, which is increasing in popularity in US-based foreign language learning programs.

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Appendix A

Passage-reading task
Part 1:
P**a**blo quiere tener una mascota. El problema es que la mamá no lo d**e**ja, sin importar de qué masc**o**ta se trata. P**a**blo le ofreció varias opciones, pero ella encontró un problema con c**a**da una de ellas. Un perro suelta mucho pelo y siempre tiene el morro s**u**cio. Un toro seguro que come mucho (¡qu**é** caro será

darle de comer!). Una araña espanta a las vis**i**tas. Y ni hablar de un caracol. Es un animal demasiado lento. Un zorro es un lindo animal, pero t**o**do el tiempo, la mamá piensa que habrá pelo por t**o**das partes, que la cola del animal tirará el jarrón de la sala y que, en el jardín, arruinará el clavel. Quizás un caballo... ¿comerá arroz? ¡Tener una masc**o**ta es impos**i**ble! Será mejor conseguir un abog**a**do para resolver esta cuestión familiar.

Part 2:

A ver... tengo que armar la lista de materiales que neces**i**to para mi clase de dib**u**jo. Primero y principal, neces**i**to un pincel. ¿Qué más hace falta? Mmmm... creo que también tengo que comprar acrílicos. Voy a comprar de color dorado y de color celeste. El dorado ideal para el dib**u**jo de la torre hecha de ling**o**tes de oro que pidió de tarea la profesora. Y de fondo voy a pintar un cielo despej**a**do muy celeste, sin ninguna nube. Será un gran golpe de creatividad. Y para el dib**u**jo de naturaleza muerta, voy a imaginar una escena en una cocina en la edad media y voy a pintar un higo junto al fuego. También tengo que comprar para eso. ¿Qué más? Por las d**u**das, también voy a comprar papel.

Part 3:

Me gustan los cuentos de fantasía. Me gusta que siempre hay un hada y un mago que resuelven los problemas de todos. También me gustan esos detalles que luego se convierten en símbolos. Por ejemplo, el cab**e**llo largo de Rapunzel, las migajas de Hansel y Gretel o la nariz larga de madera de Pinocho.

Appendix B

Table 8: Summary of linear mixed-effects statistics for models predicting normalized F1 values.

Vowel	*n*	Fixed Effects	ß	*SE*	*t*	*p*	Random effects	Variance	SD
/i/	174	Intercept	−0.72	0.14	−5.37	0.243	Speaker	0.08	0.27
		Group (SA)	−0.20	0.17	−1.18	0.243	Token	0.00	0.05
		Time (Time 2)	0.14	0.14	0.94	0.347			
		Group x Time	0.09	0.18	0.47	0.637			
/e/	112	Intercept	0.01	0.20	0.04	0.970	Speaker	0.02	0.14
		Group (SA)	0.14	0.17	0.88	0.383	Token	0.08	0.28
		Time (Time 2)	0.11	0.17	0.69	0.495			
		Group x Time	−0.13	0.21	−0.63	0.532			

(*continued*)

Table 8: (*continued*)

Vowel	*n*	Fixed Effects	ß	*SE*	*t*	*p*	Random effects	Variance	SD
/a/	232	Intercept	1.19	0.19	6.17	< 0.001	Speaker	0.24	0.49
		Group (SA)	0.03	0.25	0.12	0.909	Token	0.01	0.09
		Time (Time 2)	−0.03	0.17	−0.20	0.840			
		Group x Time	0.17	0.21	0.78	0.437			
/o/	225	Intercept	0.12	0.13	0.99	0.333	Speaker	0.04	0.20
		Group (SA)	0.07	0.14	0.46	0.645	Token	0.02	0.12
		Time (Time 2)	−0.15	0.13	−1.17	0.244			
		Group x Time	0.10	0.16	0.60	0.552			
/u/	223	Intercept	−0.63	0.13	−4.97	< 0.001	Speaker	0.02	0.14
		Group (SA)	0.02	0.13	0.13	0.897	Token	0.02	0.13
		Time (Time 2)	0.15	0.12	1.24	0.215			
		Group x Time	−0.08	0.16	−0.52	0.602			

Note: Reference categories indicated in parentheses.

Table 9: Summary of linear mixed-effects statistics for models predicting normalized F2 values.

Vowel	n	Fixed Effects	ß	*SE*	*t*	*p*	Random effects	Variance	SD
/i/	174	Intercept	1.17	0.18	6.61	< 0.001	Speaker	0.17	0.42
		Group (SA)	0.14	0.23	0.61	0.548	Token	0.00	0.00
		Time (Time 2)	0.05	0.17	0.31	0.755			
		Group x Time	−0.30	0.22	−1.38	0.170			
/e/	112	Intercept	0.77	0.19	4.02	0.003	Speaker	0.05	0.21
		Group (SA)	0.00	0.19	0.00	0.999	Token	0.05	0.22
		Time (Time 2)	−0.01	0.18	−0.38	0.709			
		Group x Time	0.08	0.24	0.35	0.729			
/a/	232	Intercept	−0.30	0.09	−3.16	0.002	Speaker	0.03	0.16
		Group (SA)	−0.15	0.12	−1.20	0.237	Token	0.00	0.00
		Time (Time 2)	−0.10	0.12	−0.80	0.422			
		Group x Time	0.07	0.15	0.43	0.671			
/o/	225	Intercept	−0.75	0.14	−5.47	< 0.001	Speaker	0.10	0.31
		Group (SA)	−0.13	0.18	−0.71	0.484	Token	0.00	0.00
		Time (Time 2)	0.19	0.14	1.32	0.187			
		Group x Time	−0.13	0.18	−0.70	0.487			
/u/	223	Intercept	−0.41	0.19	−2.19	0.044	Speaker	0.10	0.32
		Group (SA)	−0.17	0.20	−0.84	0.407	Token	0.04	0.19
		Time (Time 2)	0.07	0.17	0.42	0.672			
		Group x Time	0.04	0.21	0.16	0.871			

Note: Reference categories indicated in parentheses.

Table 10: Summary of ANOVA statistics for F1 of /e/ and /o/.

Effect	*F*	*df*	*p*	Partial eta squared
/e/				
Group	0.53	1	0.474	0.024
Point	**39.15**	**2**	**< 0.001**	**0.789**
Time	0.54	1	0.471	0.024
Group × Point	0.09	2	0.910	0.000
Group × Time	0.28	1	0.601	0.013
Point × Time	1.59	2	0.228	0.131
Group × Point × Time	0.65	2	0.534	0.058
/o/				
Group	0.60	1	0.447	0.027
Point	2.17	2	0.139	0.171
Time	0.26	1	0.612	0.012
Group × Point	0.89	2	0.427	0.078
Group × Time	1.14	1	0.297	0.049
Point × Time	1.61	2	0.223	0.133
Group × Point × Time	1.18	2	0.327	0.101

Note: Significant effects appear in bold.

Table 11: Summary of ANOVA statistics for F2 of /e/ and /o/.

Effect	*F*	*df*	*p*	Partial eta squared
/e/				
Group	0.10	1	0.765	0.004
Point	**18.24**	**2**	**< 0.001**	**0.635**
Time	0.23	1	0.639	0.010
Group × Point	0.00	2	0.996	0.000
Group × Time	0.22	1	0.645	0.010
Point × Time	0.90	2	0.424	0.079
Group × Point × Time	2.87	2	0.079	0.215
/o/				
Group	0.22	1	0.646	0.010
Point	**37.58**	**2**	**< 0.001**	**0.782**
Time	0.27	1	0.609	0.012
Group × Point	0.47	2	0.631	0.043
Group × Time	0.07	1	0.788	0.003
Point × Time	0.52	2	0.604	0.047
Group × Point × Time	0.35	2	0.709	0.032

Note: Significant effects appear in bold.

Table 12: Summary of linear mixed-effects statistics for models predicting normalized vowel duration.

Vowel	n	Fixed Effects	ß	*SE*	*t*	*p*	Random effects	Variance	SD
/i/	158	Intercept	17.16	2.87	5.98	< 0.001	Speaker	25.00	5.00
		Group (SA)	**5.03**	**2.39**	**2.11**	**0.042**	Token	14.35	3.79
		Time (Time 2)	−0.47	1.49	−0.31	0.754			
		Group × Time	3.45	1.87	1.85	0.067			
/e/	102	Intercept	26.82	3.41	7.86	< 0.001	Speaker	18.66	4.32
		Group (SA)	7.04	3.71	1.90	0.063	Token	8.84	2.97
		Time (Time 2)	0.89	3.66	0.24	0.809			
		Group × Time	−1.82	4.65	−0.39	.697			
/a/	212	Intercept	33.00	3.95	8.35	< 0.001	Speaker	60.20	7.76
		Group (SA)	4.43	3.37	1.31	0.912	Token	42.92	6.55
		Time (Time 2)	−0.18	1.59	−0.11	0.912			
		Group × Time	**6.14**	**2.00**	**3.07**	**0.003**			
/o/	208	Intercept	25.10	2.70	9.28	< 0.001	Speaker	45.12	6.72
		Group (SA)	4.15	2.99	1.39	0.175	Token	8.13	2.85
		Time (Time 2)	−1.04	1.50	−0.69	0.489			
		Group × Time	**4.94**	**1.89**	**2.61**	**0.010**			
/u/	192	Intercept	24.97	3.37	7.41	< 0.001	Speaker	33.53	5.79
		Group (SA)	2.87	2.70	1.062	0.295	Token	21.26	4.61
		Time (Time 2)	−1.03	1.48	−0.70	0.486			
		Group × Time	**4.81**	**1.92**	**2.51**	**0.013**			

Note: Reference categories indicated in parentheses. Significant effects appear in bold.

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