LIQUID VARIANTS USED BY DOMINICAN SPEAKERS OF SPANISH

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ABSTRACT. This study offers a comprehensive phonetic and acoustic analysis of the 'r' and 'l' sounds in Dominican Spanish as spoken in three rural towns, focusing on the patterns of neutralization and coda liquid realization. The speech of 12 speakers, categorized by education level, town, gender, and other variables, was analyzed, resulting in a total of 5,802 tokens. The findings indicated that the [ɾ] and [l] variants were most prominent in San Juan, while the vocalized [j] variant was particularly prevalent in Mao. These variations were particularly pronounced in coda positions, highlighting their significance in linguistic patterns associated with coda liquid realizations.

CONTENTS

1. Introduction

1.1. Background.

The study of phonetic variation in different linguistics contexts provides valuable insights into how sounds are produced, perceived, and reproduced. The variations of liquid sounds, such as /l/ and /ɾ/, in speakers can reveal patterns that may be influenced by regional dialects.

Previous literature has underscored the regional differences in coda liquid patterns within Dominican Spanish. Studies by [Unr40], [Nav56], and [Nav56] agree that these patterns vary regionally and are well recognized in the context of Dominican Spanish. Alba [Alb04] suggests that there might be a misconception that these dialectal variants are uniform and uniformly produced by all speakers. The coda liquid vocalization, particularly in the Cibao dialect where both liquids are often vocalized as a front vowel, is well-documented ([Alb04], [Alb88], [Alb90]; [AM14]; [Sab75]; [Nav56]; [Gol76]). This vocalization occurs both within words and across word boundaries.

More recent research by Willis and Ronquest [WR22] offers additional insights into coda liquid realizations. Their study, conducted in Santiago, Dominican Republic, analyzed 480 tokens from 24 speakers. They used the realization of coda /s/ as a validity criterion, discovering that 20% of both /r/ and /l/ sounds were vocalized, with significant allophonic overlap. The study found that middle-class speakers and women tended to produce more canonical allophones compared to lower-class speakers and men. Additionally, the realization of /s/ was the strongest predictor of canonical coda liquid realization, suggesting that linguistic performance or style influences coda liquid realization.

1.2. Definitions.

Liquid Sounds: A category of consonant sounds of both lateral /l/ sounds and rhotic /r/ sounds (tap 'ɾ' and trill 'r').

Coda Positioning: Coda positioning refers to the placement of the sound at the end of the syllable within a word.

Coda Liquid Realization: Specific ways in which liquid consonants are pronounced when they occur at the end of a syllable.

Neutralization: The process where distinct phonemes or sounds become indistinguishable from one another in specific phonological contexts.

2. Research and Hypotheses

2.1. Hypotheses.

Hypothesis 1: There will be a statistically significant difference in the production of lateral variants [l] for taps /ɾ/ based on the independent variables

Hypothesis 2: There will be a statistically significant difference in the production of tap variants [ɾ] for laterals /l/ based on the independent variables.

Hypothesis 3: There will be a statistically significant difference in the production of aspirated variants for trills /r/ based on the independent variables.

Hypothesis 4: There will be a statistically significant difference in the production of vocalized variants for taps /ɾ/ and laterals /l/ based on independent variables

Hypothesis 5: There will be a statistically significant difference in the production of lateral variants [l] for taps /ɾ/ and laterals /l/ based on independent variables

Hypothesis 6: There will be a statistically significant difference in the production of neutralized variants, i.e [ɾ] and hybrid sounds for laterals /l/, and [l] and hybrid sounds for taps /ɾ/ based on the independent variables

2.2. **Data Collection.**

Data was provided by Dr. Tight and Dr. Vigil from the Department of Modern and Classical Languages at the University of St. Thomas, St. Paul. They ensured that participants completed an Institutional Review Board (IRB) consent form, responded to a background questionnaire, and engaged in a 65-question sociolinguistic interview. The interviews were audio-recorded, and the responses were subsequently transcribed and coded into various variables.

2.3. **Participants.**

All 12 participants are native Dominican Spanish speakers. The participants are distributed as follows.

- Constanza: 4 participants (2 males aged 22 and 23 years, and 2 females aged 33 and 54 years)
- Mao: 4 participants (2 males aged 34 and 76 years, and 2 females aged 37 and 73 years).
- San Juan: 4 participants (2 males aged 39 and 40 years, and 2 females aged 37 and 45 years)

FIGURE 1. Location of towns where participants are from

2.4. **Independent Variables.** Responses from participants are organized into the following independent variables. Town, Birth Town, Gender, Age, Education, Profession, Point of articulation of preceding segment(PPA), Manner of articulation of preceding segment (PMA), Point of articulation of following segment (FPA), Manner of articulation of following segment (FMA), Position in word, Stress of the syllable the dependent variable is in, Morphological value of the dependent variable, Number of syllables of the word, Type of word, and Phonological context of the word

2.5. **Variants.** Previous researchers, when analyzing the dataset, meticulously listened to each word spoken by the participant and recorded the canonical pronunciation of the word's liquid sound as the "Dependent Variable". An additional variable, "Variant", was created to accurately record what the actual liquid sound was. If no variation occurred, this variable was categorized identically to the canonical liquid sound.

Table 1. Variant vs Dependent Variable

	lateral /l/	tap /ɾ/	trill /r/
aspirated tap [ʰɾʰ]	0	1	29
aspirated trill [ʰrʰ]	0	0	3
elision [ø]	35	160	0
hybrid [ɾˡ]	14	53	0
lateral [l]	2182	172	0
nasal [n]	4	8	0
post-aspirated tap [ɾʰ]	0	1	10
pre-aspirated tap [ʰɾ]	0	3	51
pre-aspirated trill [ʰr]	0	0	15
tap [ɾ]	38	2072	65
trill [r]	0	8	28
vocalized [j]	41	88	0
weak tap [ɾ̞]	2	712	7

2.6. **Confounding Variables.** In analyzing the data collected by Dr. Tight and Dr. Vigil for this research, it became apparent that there are imbalances between the intersection of independent variables. These imbalances raise concerns about the potential influence of confounding variables, as any significant results attributed to a particular independent variable could be influenced by these imbalances. To illustrate these disparities, we will present several tables showing the intersections between certain independent variables. Some of these tables will display the speaker count, while others will focus on the word count. This approach allows us to highlight how these imbalances may affect the interpretation of the findings and underscores the importance of considering confounding variables in our analysis.

Table 2. Town vs Gender - Speaker Count

	F	M	Totals
Constanza	2	2	4
Mao	2	2	4
San Juan	2	2	4
Totals	6	6	12

Table 3. Age vs Education - Speaker Count

	Primary School	High School	University Diploma	Totals
22-34	0	3	1	4
37-40	0	0	4	4
45-76	4	0	0	4
Totals	4	3	5	12

TABLE 4. Gender vs Education - Speaker Count

	Primary School	High School	University Diploma	Totals
F	3	0	3	6
M	1	3	2	6
Totals	4	3	5	12

TABLE 5. Town vs Education - Speaker Count

	Primary School	High School	University Diploma	Totals
Constanza	1	2	1	4
Mao	2	1	1	4
San Juan	1	0	3	4
Totals	4	3	5	12

Table 2 shows a balanced distribution across towns and genders, but does not account for other factors like age or education. In table 3 we observe significant imbalances. For instance, all speakers in the 22-34 age group have either a high school diploma (3 speakers) or a university diploma (1 speaker), with none having only a primary school education. The 45-76 age group consists entirely of speakers with only a primary school education. The 37-40 age group is exclusively composed of university-educated individuals. These imbalances suggest that age and education are highly correlated in this sample, meaning that any significant effects attributed to age might be confounded by education level, and vice versa. Table 4 outlines an imbalance in the distribution of educational attainment across genders. For example, among females, there is an even split between those with only primary school education (3 speakers) and those with a university diploma (3 speakers), while no female speakers have just a high school diploma. Male speakers are more evenly spread across the three education levels, with 1 male having primary school education, 3 with high school diplomas, and 2 with university diplomas. This uneven distribution indicates that any gender-related findings could be influenced by the differences in educational backgrounds, complicating the interpretation of results regarding the impact of gender on linguistic performance. Table 5 highlights an imbalance in educational attainment across different towns. For instance, in Constanza and Mao, speakers are fairly distributed across all three education levels, but in San Juan, there is a strong skew towards speakers with university diplomas (3 out of 4), with no speakers having high school education. This suggests that any significant findings related to town effects could be confounded by the differences in educational backgrounds, making it challenging to disentangle the impact of town from that of education.

TABLE 6. Town vs Gender - Word Count

	F	M	Totals
Constanza	487	1151	1638
Mao	1086	1212	2298
San Juan	871	995	1866
Totals	2444	3358	5802

The word count table (Table 6) highlights significant imbalances in word distribution by gender across three towns: Constanza, Mao, and San Juan. Unlike the perfectly balanced speaker count table (Table 5), this table shows that male speakers consistently contribute more words than female speakers, with the largest discrepancy observed in Mao. These imbalances suggest that gender significantly influences the total word count, potentially confounding any gender-related findings. Additionally, the variation in total word counts across towns indicates that town effects might also be influenced by the volume of speech produced, complicating the interpretation of results.

3. Methodology

To evaluate the impact of independent variables on linguistic performance, while considering potential confounding variables, we performed a chi-square test for each variable within our hypotheses. Additionally, we performed a separate chi-square test specifically targeting the realization of coda liquids to gain further insights into its influence.

3.1. **Contingency Tables.** To perform a chi-square test, it is essential to first create a contingency table, which effectively organizes the data between two categorical variables. For our analysis, we constructed contingency tables between the "Variant" variable and each independent variable to examine whether there is a statistically significant association between them.

	Lateral	Tap	Totals
Coda	134	451	585
Other	38	1621	1659
Totals	172	2072	2244

Table 7. Comparing coda position to other variants given /ɾ/ $\longrightarrow$ [l] and /ɾ/ $\longrightarrow$ [ɾ]

3.2. **Filtering for Coda Position.** A liquid sound is identified to be in coda positioning by filtering the dataset based on the variables "Context" and "FMA". A sound qualifies as being in the coda position if it is either heterosyllabic or phrase-final. However, if the sound is heterosyllabic, it must be followed by a non-vowel manner of articulation to be considered in coda positioning.

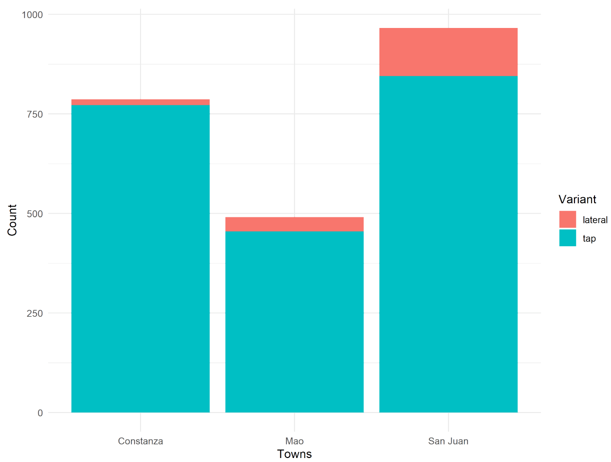
3.3. **Chi-Square Test.** In our analysis, we performed chi-square tests on the contingency tables to assess the statistical significance of observed differences between variables. These tests are crucial for determining whether the distribution of categorical data across different groups deviates from what would be expected under the null hypothesis. For a detailed explanation of how chi-square tests function and how they were applied in this study, please refer to Appendix A. This section provides an in-depth discussion of the methodology, including the calculation of chi-square values and the interpretation of p-values.

To decide whether to reject the null hypothesis, we compare the chi-square statistic to the critical value found. If the chi-square value exceeds the critical value, and if the p-value computed through statistical software, is less than 0.05, we can reject the null hypothesis.

In our analysis, we applied the Bonferroni correction to account for the multiple comparisons made. Specifically, given that we performed around 150 comparisons, we adjusted the significance threshold by multiplying the p-value by the number of comparisons.

4. Results

In the results presented, only the variables "Town" and "Context", and Hypotheses #1-4 are discussed, as they yield the most significant findings. Variables such as "Age" and "Education" are illustrated in Appendix B to provide examples of results involving confounding variables. It was collectively concluded that no significant differences were observed for other variables. However, it is important to acknowledge the possibility that this conclusion might be reconsidered, as experts from the Department of Modern and Classical Languages may potentially identify differences that were not apparent in our analysis.

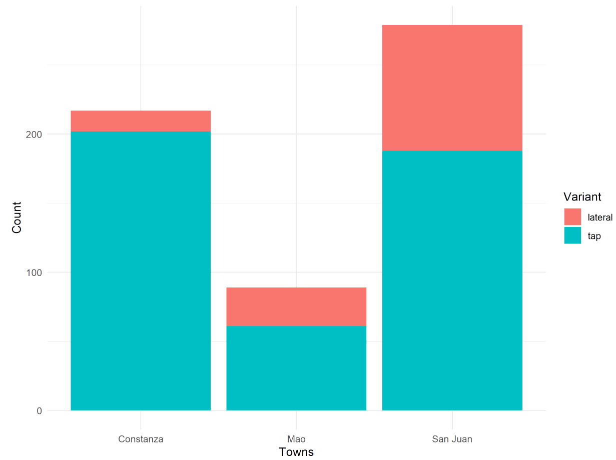


	Lateral	Tap	Totals
Constanza	Obs: 15 Exp: 60 Chi-Sq: 34.05	Obs: 772 Exp: 727 Chi-Sq: 2.83	787
Mao	Obs: 36 Exp: 38 Chi-Sq: 0.07	Obs: 455 Exp: 453 Chi-Sq: 0.01	491
San Juan	Obs: 121 Exp: 74 Chi-Sq: 29.78	Obs: 845 Exp: 892 Chi-Sq: 2.47	966
Totals	172	2072	2244

Figure 2. Histogram and corresponding contingency table for H1 Town.

4.1. **Hypothesis # 1: Comparing /ɾ/ $\longrightarrow$ [l] and /ɾ/ $\longrightarrow$ [ɾ] within towns.**

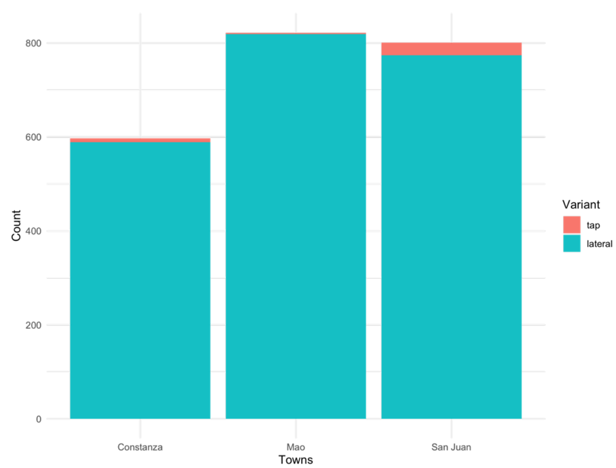
Figure 2 presents the counts for which /ɾ/ was the dependent variable. The "Lateral" column represents instances where the lateral variant [l] occurred, while the "Tap" column represents instances where no variant was present for contrast. In this analysis, we compare the tap /ɾ/ sounds across different towns. Each cell in the table contains its respective observed count, expected value, and chi-square contribution. The overall chi-square value for the test was 69.208, with an initial p-value of 9.368×10^{-16}. After applying the Bonferroni correction, the p-value remains small enough to suggest a significant statistical difference. The accompanying figure illustrates the variation proportions for each variable. From these results, we can conclude that San Juan shows a marked tendency toward the /ɾ/ $\longrightarrow$ [l] variant.



	Lateral	Tap	Totals
Constanza	Obs: 15 Exp: 50 Chi-Sq: 24.23	Obs: 202 Exp: 167 Chi-Sq: 7.2	217
Mao	Obs: 28 Exp: 20 Chi-Sq: 2.84	Obs: 61 Exp: 69 Chi-Sq: 0.84	89
San Juan	Obs: 91 Exp: 64 Chi-Sq: 11.49	Obs: 188 Exp: 215 Chi-Sq: 3.41	279
Totals	134	451	585

FIGURE 3. Histogram and corresponding contingency table for H1 Town given coda position.

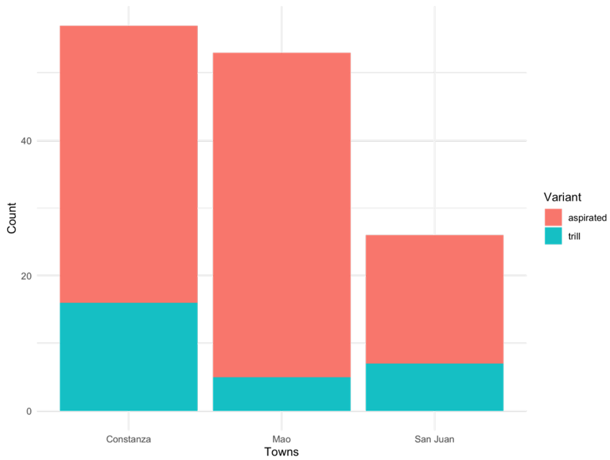
4.2. **Hypothesis # 1: Comparing /ɾ/ ⟶ [l] and /ɾ/ ⟶ [ɾ] within towns given coda position.** Figure 3 illustrates the frequency of instances where /ɾ/ occurred in coda position. The sample size is notably smaller, representing only about one-fourth of the totals from figure 2. The overall chi-square value for the test was 50.019, with an initial p-value of 1.379×10^{-11}. After applying the Bonferroni correction, the resulting p-value remains small, indicating a significant statistical difference. This suggests that the /ɾ/ ⟶ [l] variant is more prevalent in coda position.



	Tap	Lateral	Totals
Constanza	Obs: 8 Exp: 10 Chi-Sq: 0.49	Obs: 589 Exp: 587 Chi-Sq: 0.01	597
Mao	Obs: 3 Exp: 14 Chi-Sq: 8.71	Obs: 819 Exp: 808 Chi-Sq: 0.15	822
San Juan	Obs: 27 Exp: 14 Chi-Sq: 12.88	Obs: 774 Exp: 787 Chi-Sq: 0.22	801
Totals	38	2182	2220

FIGURE 4. Histogram and corresponding contingency table for H2 Town.

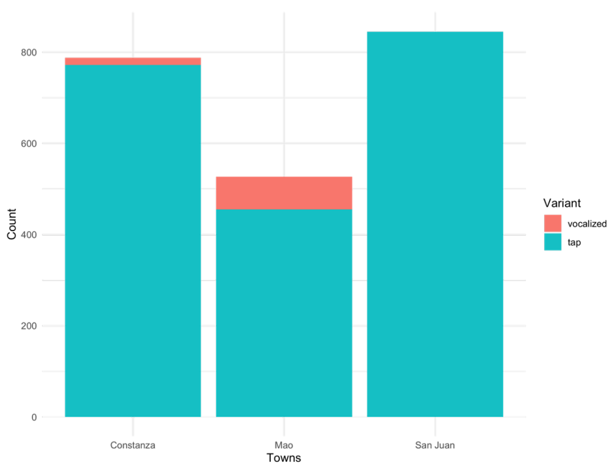
4.3. **Hypothesis # 2: Comparing /l/ ⟶ [ɾ] and /l/ ⟶ [l] within towns.** Figure 4 presents the /l/ ⟶ /ɾ/ variant. As illustrated in both the table and graph, the [ɾ] variant is relatively infrequent compared to the [l] variant shown in Figure 2. San Juan exhibits the highest number of recorded variations, with 27 observed instances. The overall chi-square value for the test was 22.457, with a p-value of 1.329×10^{-5}. Even after applying the Bonferroni correction, the p-value remains small, indicating a statistically significant difference. This suggests that the /l/ ⟶ [ɾ] variant is more commonly produced in San Juan.



	Aspirated Variants	Trill	Totals
Constanza	Obs: 41 Exp: 45 Chi-Sq: 0.40	Obs: 16 Exp: 12 Chi-Sq: 1.55	57
Mao	Obs: 48 Exp: 42 Chi-Sq: 0.83	Obs: 5 Exp: 11 Chi-Sq: 3.20	53
San Juan	Obs: 19 Exp: 21 Chi-Sq: .13	Obs: 7 Exp: 5 Chi-Sq: 0.51	26
Totals	108	28	136

FIGURE 5. Histogram and corresponding contingency table for H3 Town.

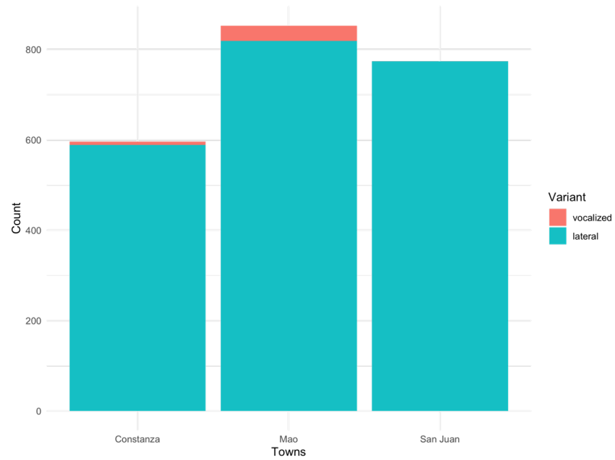
4.4. **Hypothesis #3: Comparing /r/ $\longrightarrow$ [aspirated variants] and /r/ $\longrightarrow$ [r] within towns.** Figure 5 presents the /r/ $\longrightarrow$ [aspirated variants] group.The aspirated variants group comprises [^{h}ɾ], [^{h}ɾ^{h}], [ɾ^{h}], [^{h}r], and [^{h}r^{h}]. The figure shows that some Dominican Spanish speakers do not articulate the /r/ sound accurately, instead producing one of these variants. The overall chi-square value for the test is 6.6231, with a p-value of 0.03646. After applying the Bonferroni correction, the p-value exceeds 0.05, indicating that we cannot reject the null hypothesis, and thus, there is no statistically significant difference.



	Vocalized	Tap	Totals
Constanza	Obs: 16 Exp: 32 Chi-Sq: 8.08	Obs: 772 Exp: 756 Chi-Sq: 0.34	788
Mao	Obs: 72 Exp: 21 Chi-Sq: 118.92	Obs: 455 Exp: 506 Chi-Sq: 5.05	527
San Juan	Obs: 0 Exp: 34 Chi-Sq: 34.43	Obs: 845 Exp: 811 Chi-Sq: 1.46	845
Totals	88	2072	2160

FIGURE 6. Histogram and corresponding contingency table for H4.1 Town.

4.5. **Hypothesis #4.1: Comparing /ɾ/ $\longrightarrow$ [j] and /ɾ/ $\longrightarrow$ [ɾ] within towns.** Figure 6 presents the first aspect of Hypothesis #4, examining the /r/ $\longrightarrow$ [j] variant. The overall chi-square value is 168.28, with a p-value less than 2.2×10^{-16}. After applying the Bonferroni correction, the p-value remains small, indicating a statistically significant difference. This suggests that the /ɾ/ $\longrightarrow$ [j] variant is most prevalent in Mao.



	Vocalized	Lateral	Totals
Constanza	Obs: 7 Exp: 11 Chi-Sq: 1.45	Obs: 589 Exp: 585 Chi-Sq: 0.03	596
Mao	Obs: 34 Exp: 16 Chi-Sq: 21.21	Obs: 819 Exp: 837 Chi-Sq: 0.40	853
San Juan	Obs: 0 Exp: 14 Chi-Sq: 14.28	Obs: 774 Exp: 760 Chi-Sq: 0.27	774
Totals	41	2182	2223

FIGURE 7. Histogram and corresponding contingency table for H4.2 Town.

4.6. **Hypothesis #4.2: Comparing /l/ $\longrightarrow$ [j] and /l/ $\longrightarrow$ [l] within towns.** Figure 7 focuses on the second aspect of Hypothesis #4, analyzing the /l/ $\longrightarrow$ [j] variant. The test yielded a chi-square value of 37.631 and a p-value of 6.378×10^{-9}. After applying the Bonferroni correction, the p-value remains significantly low, confirming a statistically significant difference. This finding highlights Mao as the location where the /l/ $\longrightarrow$ [j] variant is most strongly evident.

5. Conclusions

Our objective was to conduct a comprehensive phonetic and acoustic analysis of the 'r' and 'l' sounds in Dominican Spanish, with a particular focus on patterns of neutralization and coda liquid realization. Throughout our investigation, we faced significant challenges due to confounding variables, which made it difficult to definitively identify the true influencing factors. Furthermore, our analysis revealed no significant differences across several other variables, leading us to concentrate primarily on the relationship between a speaker's town and their pronunciation in coda positions.

Our findings are consistent with previous studies, reinforcing the idea that coda liquid patterns exhibit regional variation. The data revealed that the [ɾ] and [l] variants were most prominent in San Juan, while the vocalized [j] variant was particularly prevalent in Mao. Notably, the /l/ variant was especially pronounced in coda positioning. When examining the /r/ $\longrightarrow$ [aspirated variants], no significant differences were found. However, this outcome effectively demonstrates that not everyone can produce the trill correctly, aligning with observations from previous research.

There are numerous avenues we would have liked to explore further, but due to the limited time frame of this summer, our focus was necessarily constrained. Future research could delve into additional variants, particularly those that we were unable to investigate, and also provide a more in-depth examination of Hypotheses #5 and #6. Moreover, subsequent studies could benefit from a more balanced word count, a larger pool of speakers, and a reduction in confounding variables to yield more robust findings.

References

[Alb88] Orlando Alba, *Estudio sociolingüístico de la variación de las líquidas finales de palabra en el español cibaeño*, Georgetown University Pres, 1988.

[Alb90] ______, *Variación fonética y diversidad social en el español dominicano de santiago*, : Pontificia Universidad Católica Madre y Maestra, 1990.

[Alb04] ______, *Como hablamos los dominicanos*, Grupo Leon Jimenes, 2004.

[AM14] Junice Altagracia Acosta-Martinez, *Phonological variation in cibaeño spanish: Social networks as potential predictors of semi-vocalization*, University of Illinois at Chicago (2014).

[Gol76] Pablo Golibart, *Cibaeño vocalization*, University of Kansas (1976).

[Nav56] Tomas Navarro, *Apuntes sobre el español dominicano*, Revista Iberoamericana (1956).

[Sab75] Maximiliano A. Jimenez Sabater, *Mas datos sobre el espanol de la republica dominicana*, Ediciones INTEC, 1975.

[Unr40] Pedro Henriquz Unrena, *El español en santo domingo.*

[WR22] Erik W. Willis and Rebecca E. Ronquest, *A sociophonetic exploration of coda liquids and vocalization in cibao dominican spanish*, Routledge New York (2022).

Appendix A. Chi-Square Test

To perform Chi-square test, we perform the following steps:

(1) Calculate Expected Values:

$$\text{Expected Value} = \frac{(\text{Row Total} \times \text{Column Total})}{\text{Grand Total}} \tag{1}$$

	Lateral	**Tap**	**Totals**
Coda	Obs: 134 Exp: 45	Obs: 451 Exp: 540	585
Other	Obs: 38 Exp: 127	Obs: 1621 Exp: 1532	1659
Totals	172	2072	2244

Table 8. Comparing coda position to other variants given /ɾ/ ⟶ [l] and /ɾ/ ⟶ [ɾ] (with rounded expected values)

(2) Calculate Chi-Square:

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i} \tag{2}$$

where O_i and E_i are the observed and expected frequencies, respectively.

	Lateral	Tap	Totals
Coda	Obs: 134 Exp: 45 Chi: 177.29	Obs: 451 Exp: 540 Chi: 14.72	585
Other	Obs: 38 Exp: 127 Chi: 62.52	Obs: 1621 Exp: 1532 Chi: 5.19	1659
Totals	172	2072	2244

Table 9. Comparing coda position to other variants given /ɾ/ ⟶ [l] and /ɾ/ ⟶ [ɾ] (with rounded expected values and chi values)

$$\chi^2 \approx 177.29 + 14.72 + 65.52 + 5.19 \approx 259.72 \tag{3}$$

The degrees of freedom (df) for the test are calculated as:

$$\text{df} = (r - 1) \times (c - 1)$$

where r is the number of rows and c is the number of columns in the contingency table.

$$\text{df} = (2-1) \times (2-1) = 1$$

This formula reflects the number of independent values that have the freedom to vary. Once the df value is determined, it is used to find a critical value from the chi-square distribution table based on the chosen significance level, in our case 0.05. The p-value is calculated computationally, where the p-value < 0.05 for us to conclude there is a significant statistical difference. The lower the p-value, the more confident we are about this difference.

Listing 1. R Studio code to perform Chi-square tests

```
We conducted our chi-square test on R Studio using the following code

chi_square_result <- chisq.test(contingency_table)

print(chi_square_result)
```

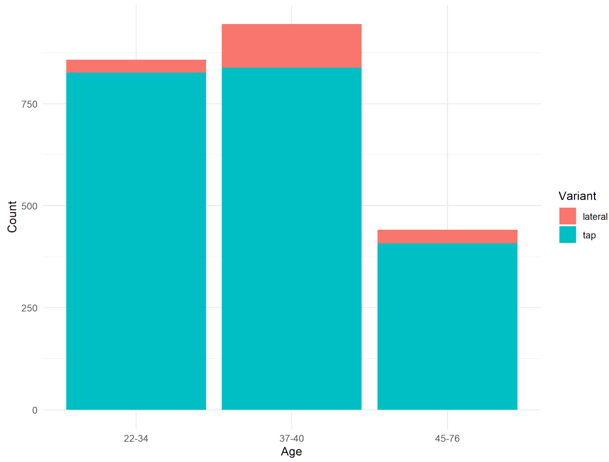
This code would print the chi-square value and p-value of the chi-square test performed on "contingency$_table$”.
To create contingency tables, we used the following code:

Listing 2. R Studio code to create contingency tables

```
data <- read.csv("location/MainSpanishData.csv")

filtered_data <- data %>% filter(Dependent.variable == 'tap'
& (Variant == 'tap' | Variant == 'lateral'))

contingency_table <- table(filtered_data$Town, filtered_data$Variant)

print(contingency_table)
```

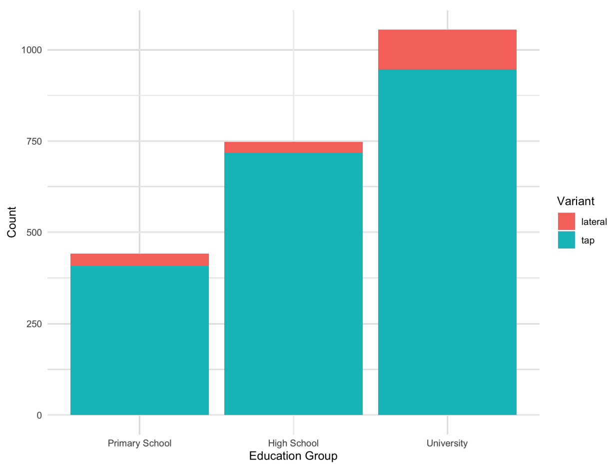
In this case, we started by assigning the full dataset to "data". We then filter the data set to only have the words were the dependent variable is "tap" and the variant is "tap" or "lateral". This case refers to Hypothesis 1. Using the "table()" command, we create the contingency table where, in this case, the rows are the tows and the columns are the variants.

Appendix B. Confounding Variable Results



	Lateral	Tap	Totals
22-34	Obs: 32 Exp: 66 Chi-Sq: 17.34	Obs: 826 Exp: 792 Chi-Sq: 1.44	858
37-40	Obs: 107 Exp: 72 Chi-Sq: 16.50	Obs: 838 Exp: 873 Chi-Sq: 1.40	945
45-76	Obs: 33 Exp: 34 Chi-Sq: 0.02	Obs: 408 Exp: 407 Chi-Sq: 0.00	441
Totals	172	2072	2244

Figure 8. Histogram and corresponding contingency table for H1 Age.



	Lateral	Tap	Totals
Primary School	Obs: 33 Exp: 34 Chi-Sq: 0.02	Obs: 408 Exp: 407 Chi-Sq: 0.00	441
High School	Obs: 30 Exp: 57 Chi-Sq: 13.03	Obs: 718 Exp: 691 Chi-Sq: 1.08	748
University Dimploma	Obs: 109 Exp: 81 Chi-Sq: 9.79	Obs: 946 Exp: 974 Chi-Sq: 0.81	1055
Totals	172	2072	2244

Figure 9. Histogram and corresponding contingency table for H1 Education.

Figure 8 examines the /ɾ/ $\longrightarrow$ /l/ variant in relation to Age, while Figure 9 analyzes the same variant in the context of Education. Both figures provide insights into how this linguistic phenomenon varies across these demographic factors. However, due to the imbalances observed in Table 3, it is important to note that all individuals in the 37-40 age group hold a University Diploma. This overlap makes it challenging to determine whether Age or Education is the primary influencing factor.