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Differences in Phonation of Lesbian Spanish Speakers

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1. Introduction

It is well-studied that listeners can distinguish between normative male and female voices with almost perfect accuracy due to changes in speech caused by physiological differences (e.g. vocal fold length) based on "biological sex," which alters pitch and production more generally (Jacobs et al., 2000). A unique phenomenon takes place, however, when trying to distinguish between the voices of queer and non-queer speakers perceived to be of the same gender. It has been discovered that listeners can accurately distinguish between these voices with high enough accuracy to discard the possibility of it being caused by chance (Kachel, et al. 2018; Mack 2010, Smyth, et al. 2003). This leads to the theory that acoustic differences exist that influence queer speech perception, even when physiological differences are not presumed to be the determining factor. Most stereotypes associated with queer speech often cite pitch as the main factor in its perception, making it a focus in acoustic research (Kachel, et al. 2018; Barron-Lutzross 2018; Zimman 2017; Smyth, Jacobs, Rogers 2003; Smyth & Rogers 2008). Aside from pitch, production of sibilants (Kachel, et al. 2018; Zimman 2017; Smyth & Rogers 2008), vowel production (Smyth & Rogers 2008, Esposito 2020; Mack 2010; Crisoto, et al. 2015), Voice Onset Time (VOT) (Kachel, et al. 2018; Pahis 2017; Smyth & Rogers 2008), and length of word segments (Esposito, 2020) have also been correlated with this phenomenon. While the production and perception of queer speech has been studied at length, most extant data comes from English, limiting our knowledge of queer speech production and perception in other languages.

2. Literature Review

2.1 Theory 1: Reflection of Identity

The first of two approaches that have been seen in previous research, as first stated by Fabiana Piccolo (2008), considers queer speech as a reflection of identity. Under this theory, sexualities have a unique set of phonetic features characteristic of that specific group, making speakers passive enactors of their sexuality. Following this approach, researchers like Gaudio (1994), Weaksler (2001), Munson (2004), and more recently Barron-Lutzross (2015, 2018) and Pahis (2017), to name a few, have attempted to acoustically analyze speech recordings of self-reported gay or lesbian speakers to extrapolate patterns linking their sexuality to their speech. This approach allows researchers to take into consideration the pre-existing stereotypes associated with each sexuality and investigate those ideas further. A main example of this is the common stereotype that gay men speak in a manner similar to that of women, while lesbian women are considered to sound more similar to men, especially in terms of pitch. This popularized stereotype resulted in numerous papers studying pitch differences between queer and non-queer speakers, more specifically lesbian speech (Camp, 2009; Waksler, 2001; Cuddy, 2019; Van Borsel, et al., 2013) and gay speech (Katchel, et al., 2018; Gaudio, 1994; Rendall, et al., 2007).

Previous literature has also shown that listeners have the ability to accurately point out phonetic features and distinguish between the voices of queer and non-queer speakers, even when no visual cues were presented, with high enough accuracy to discard the possibility of it being caused by chance for both gay and lesbian speakers (Kachel, et al. 2018; Mack 2010, Smyth, et al. 2003). Research on this specific phenomenon has shown that it is easier to distinguish between the voices of homosexual and heterosexual male speakers compared to homosexual and heterosexual female speakers. Despite this challenge, however, research on both genders has shown great results and evidence to further support this theory.

While no concrete results have been concluded under this theory, extant data has proved the existence of acoustic cues related to each group

and patterns have been observed numerous times (see sections 2.3 and 2.4 for a thorough explanation of these patterns). For example, production of sibilants, vowel formants, as well as fundamental frequencies of vowels have so far been linked with "gay speech" (Pahis, 2017) On the other hand, pitch, pitch range, vowel formants, and creakiness have been linked with "lesbian speech." (Barron-Lutzross, 2018).

2.2 Theory 2: Performativity and Perceived Sexuality

The second approach that has been used while investigating queer speech states that speakers are social actors of their identity, and identity is not directly linked to a set group of phonetic features. In other words, queer speech is a reflection of society and its surroundings and is constantly being affected resulting in ever changing speech patterns. Supporters of this theory often use the idea of "performativity" introduced by Judith Butler (1990). Deborah Cameron (1997) explains this idea as, "Feminine" and "masculine'" are not what we are, nor traits we HAVE, but effects we produce by way of particular things we DO. This is further supported by Jennifer Coates (1986), in which she states that "in becoming linguistically competent, the child learns to be a fully fledged male or female member of the speech community; conversely, when children adopt linguistic behavior considered appropriate to their sex, they perpetuate the social order which creates gender distinctions." Following these principles, this theory considers queer speech as being a form of free variation, in which different phonetic features do not pertain to specific groups but rather are used interchangeably between them.

While this theory is supported for multiple reasons, the main argument in favor of this approach is that it accounts for speakers who may not fit the stereotypes associated with queer speech. For example, there are gay men who do not "sound gay" or lesbian women who do not "sound lesbian," similarly one may find heterosexual men and women who may have acoustic features associated with queer speech. This challenges the first theory by going against the belief that a set group of phonetic features exist for each sexuality. The first theory also cites pitch as a clear example of how queer speakers have a unique set of phonetic features, however Rudolf P. Gaudio (1994) provides some evidence against this

theory by stating that "Following the general practice in sociolinguistics of treating the categories "female" and "male" as both given and unitary, references to gender differences in intonation typically describe "feminine"-sounding speech in men and "masculine"-sounding speech in women as code-switching behavior between essentially "male" and "female" intonational styles." Once again arguing that queer speech is not characterized by specific acoustic cues, but is rather a style of speech that is altered by speakers in their own ways giving them the the freedom to choose what to sound like or how to interpret their own identities.

Proponents of this theory include Smyth et al. (2003), and more recently Mack (2010) and Kachel et al. (2018), to name a few. Some of the experimental procedures utilized to test this approach focus on listeners' perception of speech rather than the acoustics of audio from self-reported gay or lesbian speakers. This method solves the previously discussed issue where acoustic features may not be directly correlated to sexuality but rather used by groups interchangeably. As seen in Smyth et al. (2003), data was grouped by listeners' judgment of the voice stimuli presented and whether or not they sounded "gay" allowing participants to judge both straight and gay voices equally. Similar methodologies were also seen in Mack (2010) in which 23 participants rated the voices of 20 men on a scale of 1 to 5 ranging from "very gay" to "straight", and Katchel et al. (2018) in which 51 voices (25 gay and 26 straight) were categorizes as gay or straight by 74 listeners.

2.3 Characteristics of Lesbian Speech

2.3.1 Overall Production

Unlike previous research on men, most research on female speakers has had varying results, most of them yielding no concrete evidence that there are differences in the speech of lesbian and straight women, at least not acoustically speaking. Barron-Luztross (2015) had a total of 54 participants who self-identified as homosexual, bisexual, or heterosexual. In her first experiment she acoustically tested pitch, vowel production, sibilant production, creak, rate of speech, as well as word-final /t/ release. Despite the broad range of phonetic cues being tested, her experiments

discovered that none of them were correlated with sexuality. Similarly, Weaksler (2001) had a total of 24 participants to test pitch range and its connection to sexuality. Her results, like those from Barron-Luztross, concluded that pitch range may not be a distinguishing factor for female sexual orientation. Despite the lack of concrete results, some patterns have been discovered, most of them related to pitch and creaky voice. Unlike the results shown with gay male speakers, where there is a consensus on the phonetic features that mark sexuality (e.g. sibilant and vowel production), studies on female speech show contrasting findings.

2.3.2 Pitch and Fundamental Frequency (F0)

Like with men, most stereotypes associated with female lesbian speech often consider pitch to be the main factor linking perception to sexuality, however, pitch has a higher correlation with lesbian speech than gay speech. People believe lesbian speech to sound more "masculine" and often contain more slang when compared to heterosexual speech.

In their 2013 study, Van Borsel et al. studied the average pitch and pitch variation of a group of 34 lesbian women and 68 heterosexual women through acoustic analysis of read speech. The results showed a large correlation between sexuality and pitch, in which lesbian women had a lower mean fundamental frequency (194.9 Hz) when compared to heterosexual women (204.4 Hz). Similar results were also seen in their pitch variation which ranged from 111 to 232 Hz for lesbian women compared to 94 to 314 Hz for heterosexual women, also showing lesbian women have a lower pitch variation. Very similar results were concluded in Camp (2010), which discovered that heterosexual women exhibited a higher average pitch compared to lesbain women, this being almost two semitones higher. In terms of pitch variation, a correlation was also discovered in which a wider range was associated with heterosexual speakers while a smaller range was associated with lesbian speakers, their results had a difference in range of 1.2 semitones. These results were replicated once again in Cuddy (2019), which concluded that lesbian women had a mean Fundamental frequency (F0) about 5.5 Hz lower than heterosexual women; unlike the other two, however, Cuddy's results on pitch range showed no statistical significance.

While all results discussed so far have been connected with production, perception of sexuality in speech has also been thoroughly studied. Barron-Lutzross (2015) found a high correlation between acoustic factors and the perception of sexuality. Speakers with a higher median pitch were more likely to be rated as heterosexual. Like median pitch, the range of a speaker's pitch was also found to have a correlation and women with wider pitch ranges tended to be rated as more likely to sound lesbian (contradicting some of the production results previously discussed). Camp (2009) also showed that lower mean F0 as well as smaller pitch range were often correlated to the perception of lesbianism. Cuddy (2019) also discovered there is a correlation between F0 and perceived sexuality. In this study, lower F0 values were perceived as "less feminine" and therefore more lesbian-like overall when compared to higher F0 values, with a cutoff happening with a semitone between 10 and 13.

2.3.3 Creakiness

Creakiness is a phonetic phenomenon described as "a type of phonation (vocal fold vibration) whereby the vocal folds start to slow down and beat irregularly before closing, toward the end of an utterance. This behavior causes a rough voice quality, a lowered voice pitch, and sometimes a slower rate of speech. All contribute to make a speaker's voice sound creaky or raspy" (Behrens, 2014). This has been found to be correlated to the perception of lesbian speakers in Barron-Lutzross (2015,2018). In her 2015 paper, she discovered that a higher proportion of creaky voice often received higher lesbian ratings. The same result was recreated in 2018, where she once again found that a higher proportion of creaky voice was correlated with perception of lesbian speech. The reason why creak is highly correlated to the perception of lesbian voices might be due to the effects it causes on the voice itself. As stated before, it tends to result in a rough voice quality and a lower pitch, both of which are connected to lesbian speech stereotypes. Another cue that is part of the creak is speech rate. It can be concluded from these results that slower speech rates might be associated with perception of lesbian speech,

though this phenomenon was not studied specifically or in an isolated manner in these experiments.

2.4 Lesbian Speech in Spanish and Gaps in Literature

There is very limited research regarding lesbian speakers when it comes to languages other than English. Duarte (2022) looked at both lesbian and gay speakers of Mexican Spanish and their vowel productions, differences in pitch, and the perception of these voices. Two lesbian and two straight female speakers were compared and the results showed no significant difference when it comes to vowel production, however, lesbian women showed significantly smaller pitch range and lower average pitch when compared to straight women. When these voices were presented to listeners in a matched guise task, which showed that listeners were not good at distinguishing between straight and lesbian voices when presented without visual stimuli, going against Barron-Lutzross (2015) which found a high correlation between acoustic factors and the perception of sexuality.

Below is the summary of previous literature on lesbian speech in English and Spanish:

Phonetic Feature	Lesbian Speech (English)	Lesbian Speech (Spanish)
Vowel Production	- median F2 was a significant factor in lesbian ratings (Barron-Lutzross, 2018) - lesbian women were observed to produce more fronted vowels when compared to straight women (Pierrehumbert et al., 2004)	- No significant differences were observed (Duarte, 2022)
/s/ Production	- significant differences in COG between straight and lesbian women (Cuddy, 2019)	
Segment Duration		
Pitch Range	- mean pitch and pitch range were significant factors in lesbian ratings (Barron-Lutzross, 2018) - Mean F0 was significantly lower for lesbian women compared to	- significant differences were observed between lesbian and straight women (Duarte, 2022)

	straight women (Van Borsel et al., 2013) -significant difference in F0 of straight and lesbian women (Cuddy, 2019)	
VOT		
Voice Quality	- Significant difference between lesbian and straight women with lesbians producing a creakier voice(Barron-Lutzross, 2018)	

The gray cells in the table above show gaps in literature that have not been researched as of this paper. As shown above, lesbian speech has not been looked at in Spanish with the exception of Duarte (2022). Sibilant production, segment duration, VOT, and voice quality are still four acoustic cues that have been correlated with sexuality, yet not researched with lesbian speakers. To address one of these gray areas, this paper will look at the voice quality of lesbian Spanish speakers.

3. Research Questions and Hypotheses

Following Barron-Lutzross's (2015, 2018) findings on creakiness, this project aims to answer the following questions:

1. Do Spanish-speaking lesbian speakers produce more creakiness than straight women?
2. Does being openly lesbian affect the speaker's voice quality (supporting Theory 2) or will both openly and not openly lesbian speakers produce the same patterns (supporting Theory 1)?

I make the following predictions:

1. Similar to English, Spanish speakers will also show an effect from sexuality on voice quality.
2. Women who are not openly gay will pattern more with straight women as they do not want people to know they are gay.

4. Methodology

4.1 Participants

A total of four participants were used for this experiment. Two of them were lesbian women. One of them (P1) was not openly gay and only some of her closest friends knew about her sexuality, while the other participant (P2) was openly gay with friends and family. The other two participants were straight females. All four participants were college students in Michoacán, Mexico, and grew up in Tangancicuaro, Michoacan, where the interviews were conducted last summer.

4.2 Data

There were a total of three tasks: the first task collected semi-spontaneous speech through a cooperative description task in which participants worked in pairs. One participant had an image which they had to describe to the second participant for them to recreate. The second participant only had the background. Images were borrowed from Patel & Connaghan (2014) and Baker & Hazan (2011) and altered to fit the task described. The images are shown below:



Figure 1. Picture description task Stimuli

The second task collected natural speech through a sociophonetic interview that was also conducted in pairs. Participants were provided a list of topics (Appendix A) from which they had to choose two to discuss in depth with each other. Participants had to talk for about 30 minutes with the investigator serving as a moderator to keep the conversation going.

Lastly, Participants were also asked to complete a sociodemographic survey to collect extralinguistic information that might be relevant for data analysis (Appendix B).

4.3 Procedure

All recordings were collected in a furnished office to try to keep outside noise away as much as possible. The recordings were done using a Zoom HN4 recorder and two AKG head mounted microphones. For this project, only the interview audios were analyzed. All audios were transcribed using PRAAT (Boersma, 2001) and then aligned using the Montreal Forced Aligner (McAuliffe, et al., 2017). Once aligned, all stressed vowels were segmented by hand as shown below:

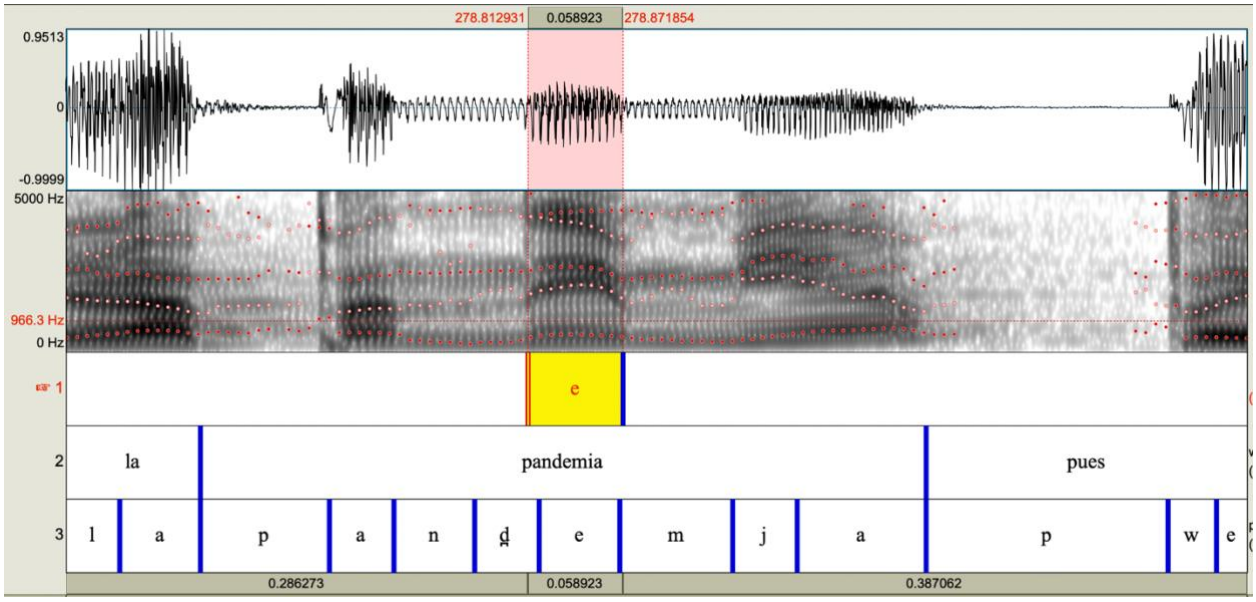


Figure 2. Vowel alignment PRAAT

Open Quotient, which subtracts the first harmonic (H1) from the second harmonic (H2), and degree of spectral tilt, which compares the first harmonic (H1) to the harcomic closest to the first formant (A1), were then calculated using VoiceSauce (Shue, Y.-L., P. Keating, C. Vicenik, K. Yu, 2011). Corrected measures were used (H1*-H2* and H1*-A1*) so that voice parameters can be compared across segments with different formant frequencies, e.g. different vowel qualities. Both of these are good measures to use to determine whether voice is creaky, modal, or breathy. If the OQ is negative, that means the voice is creaky, whereas a large positive number would signal a breathy voice. With degree of spectral tilt, a shallow decrease (smaller numbers) means creakier while a sharp decrease (larger numbers) means it is breathier.

5. Results

First I compared Open Quotient (OQ) values by group, meaning P1 and P2 were grouped and compared to P4 and P9 as a group. Results can be seen in the figure below:

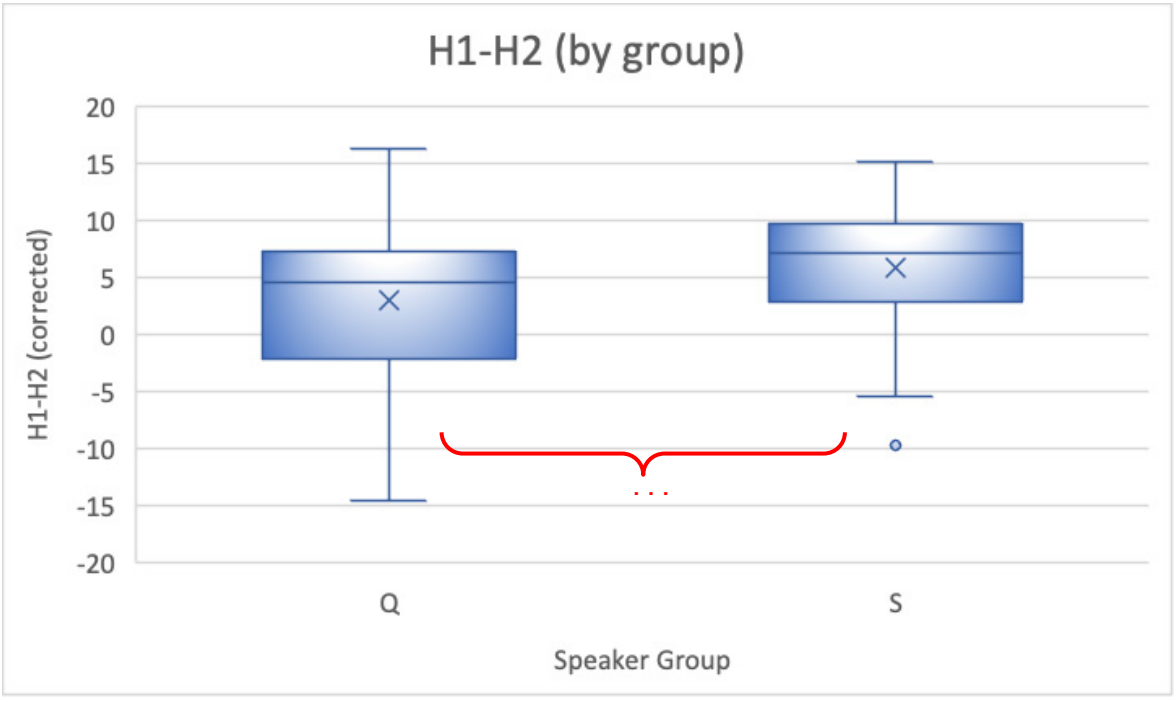


Figure 4. Open Quotient values by group (Q: queer, S: straight)

When comparing lesbian speakers to straight speakers, there was a significant effect for group for OQ (t(361) = -4.75, p = 2.94E-6), showing that OQ values differ between the two groups with the lesbian group showing higher rates of creaky voice.

I then compared OQ measurements for each participant separately. The following graph shows the results:

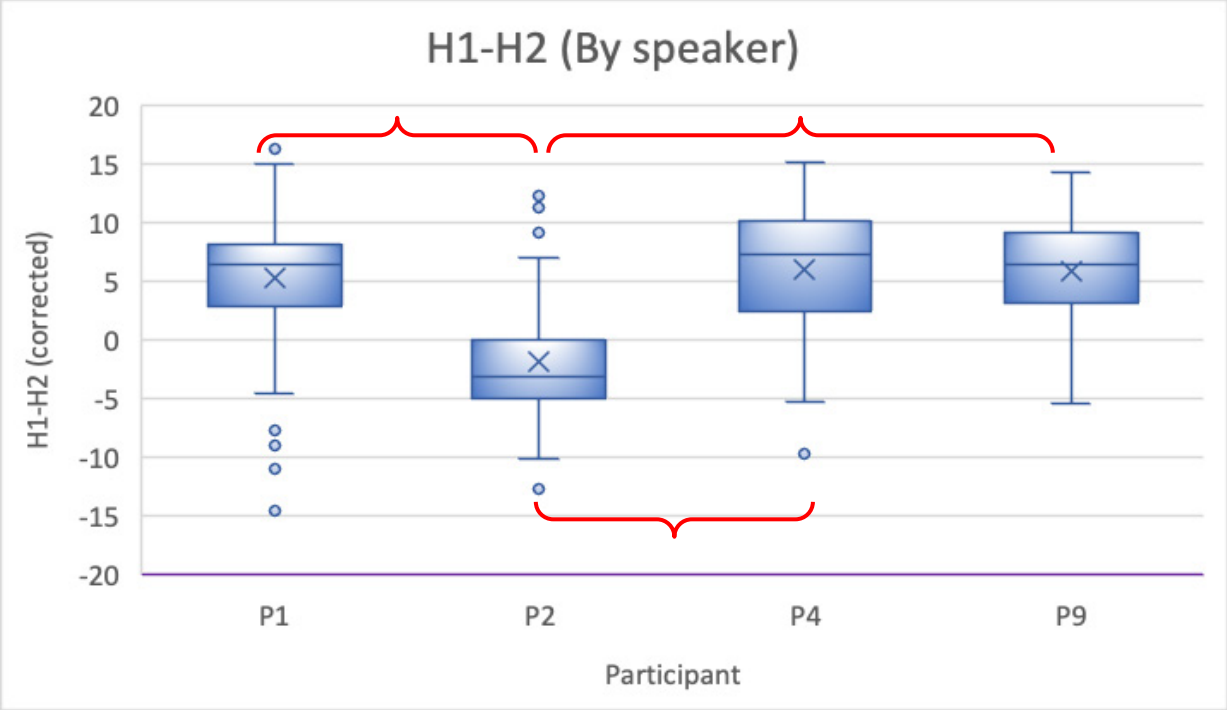


Figure 3. Open Quotient values by participant. P1: not openly gay, P2: Openly gay, P3 & P4: straight

Two-sample t-tests were used for a total of 6 comparisons and p-values were adjusted using the Bonferroni correction (0.05/6 = 0.008). When comparing both lesbian participants, there was a zsignificant effect for participants for OQ (t(208) = 9.41, p = 9.75E-18) showing that phonation differs between the two lesbian speakers with P2 having more creaky phonation. When comparing both straight participants, there was no significant effect for participants for OQ (t(151) = 0.14, p = 0.88). When comparing P1 to P4 and P9, there was no significant effect for participants for OQ (t(253) = -1.05, p = 0.29) and (t(186) = -0.68, p = 0.49) respectively. Lastly, when comparing P2 to P4 and P9, there was a significant effect for participants for OQ (t(172) = -9.16, p = 1.52E-16) and (t(106) = -8.22, p =

5.4E-13) respectively. This shows that P2 was significantly different from all participants, however, P1, P4, and P9, did not significantly differ from one another.

When looking at the degree of spectral tilt (DST), like with OQ, first I grouped speakers by sexuality to see if groups differed from each other. While there are various ways of calculating degree of spectral tilt, H1-A1 worked best for Spanish and this data. The results from this can be seen in the figure belowThe data can be seen in the figure below:

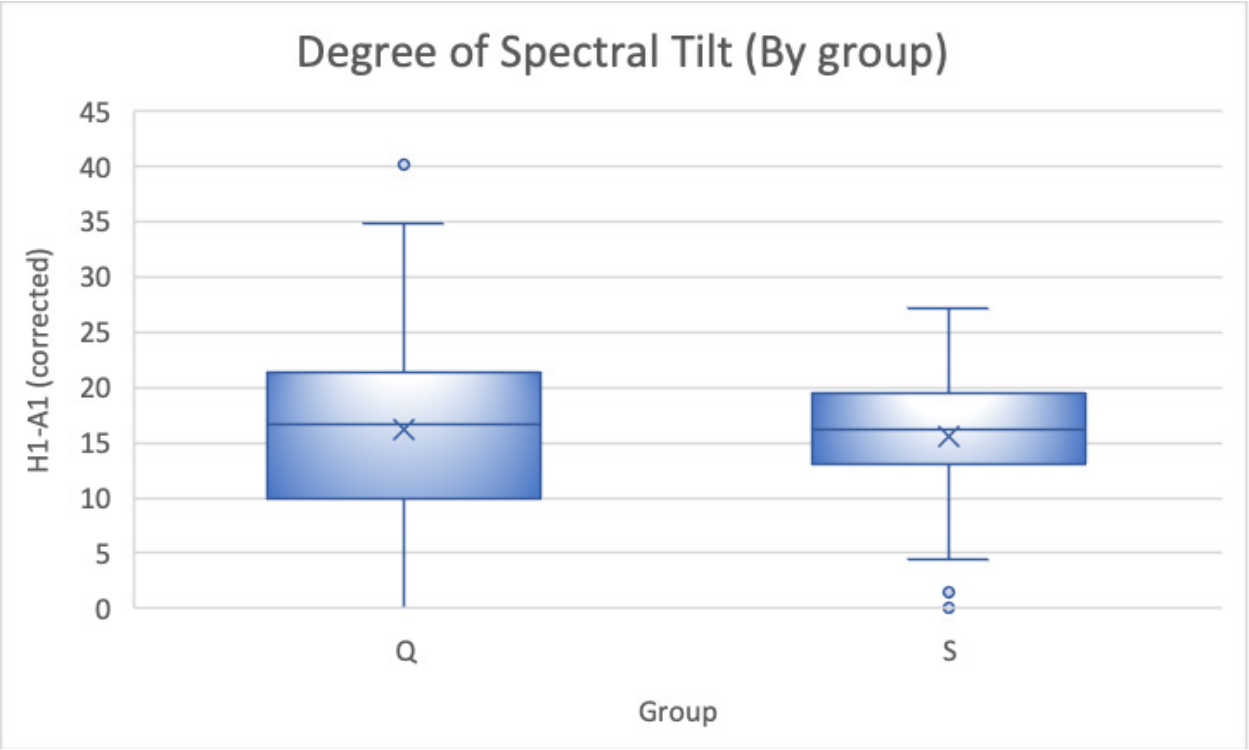


Figure 5. Degree of Spectral Tilt values by group (Q: queer, S: straight)

When comparing groups, there was no significant effect for group for DST ($t(361) = 0.8$, $p = 0.42$).

I then compared each speaker separately. Two-sample t-tests were used for a total of 6 comparisons and p-values were adjusted using the Bonferroni correction ($0.05/6 = 0.008$):

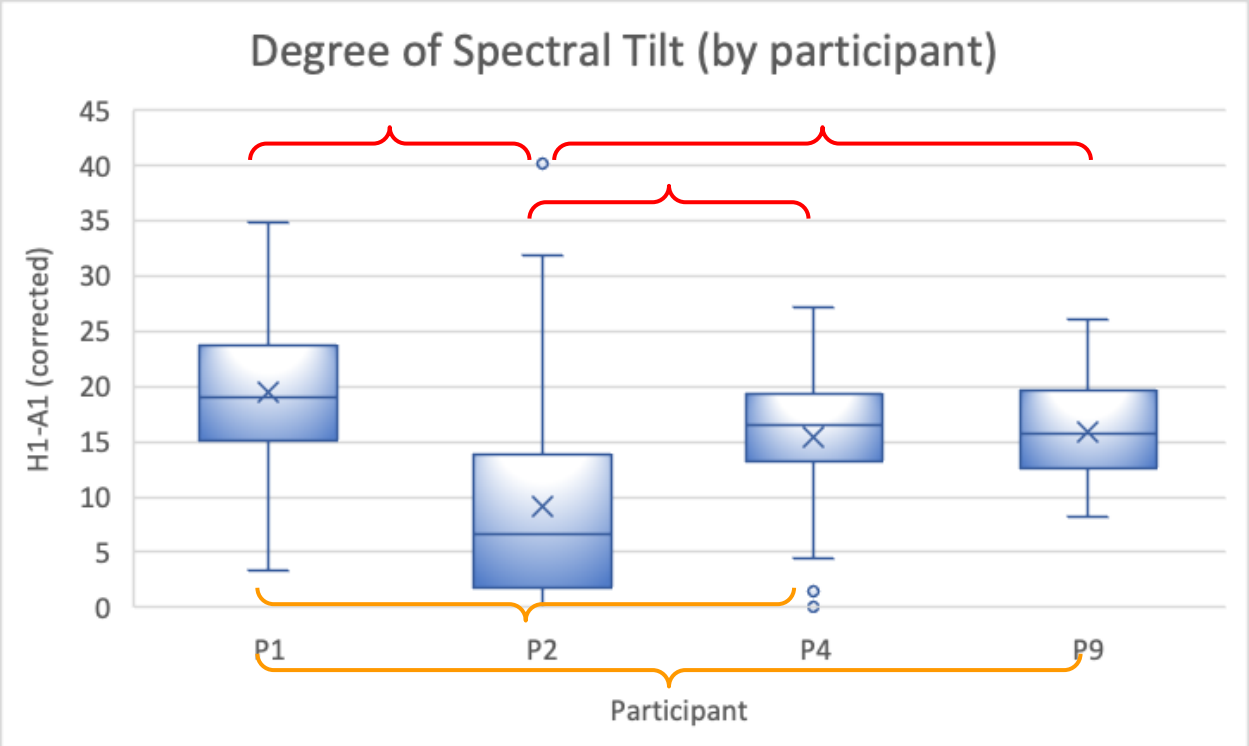


Figure 5. Degree of Spectral Tilt values by participant (P1: not openly gay, P2: Openly gay, P3 & P4: straight)

Both P1 and P2 were significantly different from each other and from both straight speakers. P1 vs P2 there was a significant effect for participants for DST ($t(208) = 8.99$, $p = 1.51E\text{-}16$). P1 vs P4 there was a significant effect for participants for DST ($t(253) = 4.68$, $p = 4.72E\text{-}6$). P1 vs P9 there was a significant effect for participants for DST ($t(186) = 3.16$, $p = 0.0018$). P1 was breathier than all other speakers, even the straight speakers. For P2 vs P4 there was a significant effect for participants for DST ($t(173) = -5.29$, $p = 3.62E\text{-}07$). P2 vs P9 there was a significant effect for participants for DST ($t(106) = -4.43$, $p = 2.32E\text{-}5$). P2 was significantly creakier compared to all the other participants. Lastly when comparing both straight speakers with each other, there was no significant effect for participants for DST ($t(151) = -0.39$, $p = 0.69$).

6. Discussion

Going back to the research questions posted at the beginning of this paper, first I tested whether lesbian and straight women differed in terms of creakiness or breathiness. We saw that lesbian women, at least when openly gay, do differ significantly and produce creakier phonation. I then tested whether the creakiness pattern observed with lesbian English speakers (Barron-Lutzross, 2015; 2018) would also be observed with Spanish speakers. The data not only showed that but it also gave us some insight into how this might differ depending on how open the speaker may be to their sexuality. When looking at P2, who is openly lesbian, shows OQ and DST values associated with lesbian speech in that her productions were overall creakier than all other participants which follows the patterns that were observed in English as shown by Barron-Lutzross (2015, 2018). However, when we look at P1, who is a closeted lesbian, we see that her productions are more similar to the straight speakers, and sometimes even breathier. This might be due to the fact that she is not openly gay and does not want people, especially her family, to know that she is gay. As a result, she may be trying to make her voice sound more feminine by making it breathier, which is associated with femininity in Mexico. This is a completely new finding supporting theory 2, as being openly gay does play a role in how speech is produced, at least from what the data has shown. We saw that when comparing P1 and P2, being openly gay, as is the case of P2, did have significant effects on her voice. While this was shown with this dataset, more participants are still needed to have better conclusions and results, especially when looking at the effects of being openly gay on speech.

6. Summary and Future Research

While this pilot study has yielded many interesting results, there is still a lot left that needs to be done. This data has yielded multiple new results: first it shows that Spanish speakers also use voice quality as a way to express their sexuality, similar to what other studies have shown in English. It also showed us that being openly gay or not also plays a big role on how speech is produced, something that had not been mentioned in previous research and further supporting hypothesis 2. As mentioned in the introduction, however, there are still a lot of gray areas that have not been looked at for Queer Spanish speakers that still need to be researched.

It will also be interesting to see whether the patterns observed with openness are also shown in the rest of the acoustic cues. I plan to continue collecting data in Mexico as well as in the US to be able to have a direct comparison between English and Spanish to determine whether these patterns are language specific or shared across cultures. I also plan to collect bilingual data in the US to test whether these patterns will transfer between languages or whether speakers will change the way they speak depending on the language they are using.

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Appendix A: Discussion Topics

1. Cada vez aparecen más anglicismos en el español. ¿En tu opinión, crees que hay que fomentar las expresiones propias del español o integrar los anglicismos en la lengua?

2. ¿Crees que México es un lugar seguro para las mujeres? ¿Qué medidas propones para reducir la sensación de inseguridad de las mujeres en México?

3. ¿Crees que hay racismo/clasismo en México? Pon algunos Ejemplos.

4. ¿Qué efecto crees que causan los chistes machistas, clasistas y racistas en una Conversación?

5. ¿Crees que hay mucho tráfico en Michoacán? ¿Qué medidas propones para disminuir el tráfico?

6. ¿Cuál crees que es el estado actual de las lenguas indígenas en Michoacán? ¿Crees que está disminuyendo el uso de las lenguas indígenas? ¿Qué medidas propones para el mantenimiento de las lenguas indígenas en Michoacán?

7. ¿Cuál crees que es el impacto de las redes sociales en los adolescentes? Pon algunos Ejemplos.

8. ¿Cómo ha cambiado tu vida desde el comienzo de la pandemia en el 2020? ¿Cuáles han sido los obstáculos más grandes en los últimos 3 años?

Appendix B: Sociodemographic questionnaire

Edad _____

Género _____
Orientación Sexual _____
¿Cuál es tu raza/etnicidad? (selecciona todos los que apliquen):

a. ____ Indígena de las Américas o nativa de Alaska
b. ___ Asiatica
c. ____ Negra
d. ___ Blanca
e. ____ Isleña del pacifico
f. ____ Hispana/Latina
g. ____ Otra: _____

País en el que naciste: _____
País en el que creciste: _____
País de residencia: _____
¿Qué idiomas hablas y cuál es tu nivel de competencia?

h. Lectura
i. Escritura
j. Habla
k. Entendimiento

¿A qué edad aprendiste cada idioma?
¿Qué tan frecuentemente utilizas el español?
¿Dónde utilizas el español?
Nivel más alto de educación completado