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*Bisexuality and /s/ production*

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by

Chloe Marie Willis

Committee in charge:

Professor Lal Zimman, Chair

Professor Mary Bucholtz

Professor Argyro Katsika

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The thesis of Chloe Marie Willis is approved.

Mary Bucholtz

Argyro Katsika

Lal Zimman, Committee Chair

March 2020

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ABSTRACT

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The folk linguistic notion that there are systematic differences in speech production as a function of sexual orientation has given rise to a vast body of work investigating the acoustic correlates of sounding queer. Although gay-sounding voices and to a lesser extent lesbian-sounding voices are well represented in this literature, bisexuality is conspicuously absent. The current study addresses this gap through an acoustic analysis of bisexuals' read speech vis-à-vis lesbian, gay, and straight speakers, specifically attending to three measures of the fricative /s/: center of gravity, skew, and duration. The results suggest that bisexual women and men do not form a cohesive group in terms of /s/ production. Moreover, the results indicate that bisexual women differ from lesbian and straight women in a way that is distinct from how bisexual men differ from gay and straight men. Given these results, I argue that (1) grouping bisexual speakers with either straight or lesbian/gay speakers is not empirically justified and (2) the lack of uniformity among the bisexual speakers is potentially explained by the different ways in which bisexual women and men experience the intersection of sexuality and gender normativity. Overall, these findings trouble the stereotype that bisexuality is simply an amalgam of lesbianness/gayness and straightness and shed light on the intersectional experiences of bisexuals.

TABLE OF CONTENTS

# 1. Introduction

The field of language and sexuality has emerged as an important area of interest, garnering attention in variationist sociolinguistics, sociocultural linguistics, and sociophonetics. One of the most vigorously pursued questions in this body of literature concerns the idea that an individual's sexuality is indexed through linguistic variation. This particular research focus parallels the folk linguistic notion that there are systematic differences in speech production as a function of sexual orientation (Pierrehumbert et al., 2004). Evidence has emerged that this notion is not entirely unfounded; studies suggest that listeners are able to judge the sexual orientation of speakers at above-chance levels based on speech samples alone (e.g., Gaudio, 1994; Linville, 1998; Carahaly, 2000; see also Munson & Babel, 2007).

Over the past twenty-five years, there have been a number of studies investigating the acoustic correlates of gay-sounding male voices (e.g., Smyth, Jacobs & Rogers, 2003; Pierrehumbert et al., 2004; Munson et al., 2006a, 2006b; Munson, 2007; Levon, 2006, 2007; Campbell-Kibler, 2007, 2011; Zimman, 2013; *inter alia*). The work on sounding lesbian is much more limited (e.g., Moonwomon-Baird, 1997; Waksler, 2001; Pierrehumbert et al., 2004; Munson et al., 2006a, 2006b; Levon, 2011; Borsel et al., 2013; Barron-Luztross, 2015). One possible explanation for this disparity is that stereotypes about gay men's voices (e.g., the gay "lisp") are much more prevalent and salient than stereotypes about lesbian voices in popular US culture. An alternative explanation is that this disparity reflects systematic inequality that privileges certain queer identities over others. It is no coincidence that the overwhelming majority of participants in language and sexuality studies have been white, middle-class, cisgender gay men and that their needs have historically been prioritized over other members of the queer community, such as people of color, lesbians, trans and non-binary people, asexuals, and bisexuals, in both academic and political domains.

Despite calls to action in studies as early as Gaudio (1994), bisexuality has been conspicu-

ously absent from language and sexuality studies. (However, see Murphy (1997) on bisexuality and lexico-semantic change and Thorne (2013) on how bisexuality is constructed in interaction.) That is not to say bisexuals are not mentioned, but when bisexual speakers are represented, they are few in number (if the exact numbers are reported at all) and they are categorized with lesbian and gay speakers (e.g., Pierrehumbert et al., 2004; Munson et al., 2006a, 2006b, though see Barron-Luztross 2015, who treats bisexual women as an independent category). While some studies provide empirical justifications for grouping bisexuals with lesbian/gay speakers (e.g., Pierrehumbert et al., 2004, who observed no significant differences between bisexual and lesbian women in initial data analyses), others do not. The assumption that bisexual speakers will exhibit speech patterns similar to lesbian/gay speakers is made a priori. I argue below that this assumption is unfounded, as bisexual-identified people experience the intersection between gender and sexuality in a way that is distinct from straight and lesbian/gay speakers. First, however, I discuss a few of the many ways a closer examination of bisexuality and the voice informs the methodological and theoretical underpinnings of sociophonetic studies of language, gender, and sexuality.

The inclusion of bisexuality challenges the established methodologies used in (particularly experimental) studies of gender, sexuality, and the voice. The way participant labels are assigned in such studies reveals how dominant ideologies of gender and sexuality influence researchers' decisions at the level of methodology. For example, Smyth, Jacobs, and Rogers (2003) report that one of their groups of listeners was "explicitly identified as gay males" whereas "the remainder formed a mixed group, by which we mean that we did not ask about their sexual orientation and we presume that most identified as heterosexual" (334). Although it can be assumed that the first group of participants explicitly reported identifying as gay, the presumption that the second group of listeners mostly identified as heterosexual is effectively bisexual erasure. How the gender/sex of the participants was determined in this study is similarly unclear; nothing beyond the numbers of female and male participants is reported. This particular case is indicative of two assumptions that are implicit in many studies: (1) partici-

pants who are not lesbian/gay are straight and (2) participants are cisgender (see Zimman 2013 for more discussion of the second point). The intention of this critique is not to question the value of such studies. Rather, my intention is to underscore that, until a more diverse range of gender and sexual identities, including bisexuality, is incorporated into the field, researchers cannot conclude that sexuality has acoustic correlates that go beyond cultural ideologies concerning the differences between lesbian/gay and straight cisgender speakers.

Bisexuality also complicates the theoretical underpinnings that permeate language, gender, and sexuality studies. For example, surveying the methods used for eliciting sexuality judgements in perception tasks through a bisexual lens is instructive. Typically, sexuality judgements are elicited using either a binary forced-choice task (e.g., Smyth, Rogers & Jacobs, 2003) or an odd-point scale (e.g., Munson et al., 2006a). In the forced-choice paradigm, listeners are presented with a voice and asked to evaluate it as lesbian/gay-sounding or straight-sounding. In the odd-point scale paradigm, listeners are asked to evaluate the voice as lesbian/gay-sounding or straight-sounding on a 5,7, or 9-point Likert scale in which one end represents lesbian/gay-sounding and the other straight-sounding. Intentional or not, both of these paradigms not only preclude the possibility that a speaker will be perceived as bisexual, but also implicitly reinforce problematic conceptualizations of sexuality. On the one hand, the binary forced-choice paradigm reinforces a binary understanding of sexuality. On the other hand, the odd-point scale paradigm renders unintelligible those who do not sound unambiguously gay, lesbian, or straight; it is not clear what, or rather who, the middle of a lesbian/gay-straight scale represents. Moreover, a representation of bisexuality in which it lies in the middle of a lesbian/gay-straight scale implicitly constructs bisexuality as an amalgam of lesbian/gay and straight, contributing to the othering and erasure of non-monosexual identities. Bisexuality is not the midpoint on a lesbian/gay-straight scale; it is an identity in its own right that is worthy of investigation.

Another key component of the literature to which bisexuality contributes is the theorization of the gender-sexuality interface. The intersection between gender and sexuality is often left implicit in sociophonetics studies, rendering the theorization of the interplay between the

two largely incomplete (though see Munson et al., 2006a: 234, who investigate whether LGB speech styles are "whole-scale adoptions of sex-opposite speech patterns"). Bisexuality has much to contribute towards how the intersection between gender and sexuality is understood. When studies group participants as normative (straight) versus non-normative (lesbian/gay), bisexuals are categorized with LG speakers and therefore are positioned as non-normative (e.g., Munson et al., 2006a; 2006b). However, this categorization does not necessarily reflect how bisexuals' normativity is constructed in daily life. The ideological connection between gender normativity and sexuality is ever present in the lives of bisexual women and men much as it is for everyone else, but the manner in which this connection exerts influence over their lives is not the same in all contexts. On the one hand, bisexuals in a straight-passing relationship (i.e., a relationship with someone of a different gender) are seen as normative both in terms of gender and sexuality. On the other hand, bisexuals in lesbian/gay-passing relationship (i.e., a relationship with someone of the same gender) are seen as sexually deviant and gender non-normative[1]. In other words, the potential fluidity and dynamic nature of gender and sexuality is particularly salient for bisexual people. Thus, the ideology of gender, sexuality, and their interplay assumed in most sociophonetic studies does not account for the experiences of bisexual people, who therefore warrant further examination.

## 2. Literature Review

A few key acoustic features have been repeatedly investigated in linguistic studies of sexuality and the voice, including pitch, vowels, and the fricative /s/. Pitch (including F0, pitch range, variability) is perhaps the most thoroughly investigated acoustic feature of gay styles, yet it remains the most mysterious. Despite the attention given to the relationship between vocal pitch and sexual orientation, no cohesive picture has emerged (for gay men, see Gaudio, 1994; Linville, 1998; Smyth et al., 2003; Zimman, 2013; for lesbians, see Moonwomon-Baird,

[1]These situations presented are intended to be heuristic rather than an exhaustive description of bisexual people's experiences. Not all people's sexuality requires the context of a relationship in order to be intelligible; some people will be read as queer regardless of whether they are in a relationship, particularly those who present as gender-non-conforming (Zimman, personal communication).

1997; Waksler, 2001; Levon, 2011; Borsel et al., 2013). Gaudio (1994) finds that overall pitch range and variability do not reliably predict whether a man sounds gay. Linville (1998) reports that differences in mean F0 do not reliably predict whether a man is perceived as gay, nor do gay men produce significantly different mean F0 compared to straight men. On the other hand, Zimman (2013) reports that the cisgender gay men in his study produced significantly lower mean F0 than cisgender straight men, with transgender men of varying sexual orientations falling in between. As for lesbians, Waksler (2001) finds no significant difference in pitch or pitch variation between lesbian and straight women. However, Borsel and colleagues (2013) report that lesbians in their study produced significantly lower mean F0 and lower than average pitch fluctuations than straight women. Given the lack of stability in these findings, pitch is not considered in the present analysis.

The acoustic properties of vowels (e.g., vowel quality and duration, vowel space dispersion) have also been frequent objects of interest (for gay men, see Linville, 1998; Jacobs et al., 2000; Zimman, 2010; for lesbians, see Rendall et al., 2008; for LG women and men, see Pierrehumbert et al., 2004; Munson et al., 2006a). Although some studies of vowel quality and perceived sexuality such as Linville (1998), Jacobs and colleagues (2000), and Zimman (2010) do not report a correlation between vowel quality and perceived sexuality, Munson (2007) reports a positive correlation between relatively high-frequency F1 values and sounding gay. Moreover, Pierrehumbert et al. (2004) report significant differences in vowel quality between lesbian/bisexual and heterosexual women for the back vowels /ɑ/ (F1 and F2) and /u/ (F1 only), whereas the gay and straight men in their study differ in terms of F1 and F2 for /i/, /ɑ/, and /æ/. Other studies have found a correlation between vowel space dispersion and perceived sexual orientation (Smyth & Roberts, 2002; Pierrehumbert et al., 2004). Similar to examinations of pitch as it relates to sexuality, the results of studies examining the link between vowels and sexuality are inconsistent and sometimes contradictory and therefore vowels are not considered in this analysis.

In contrast to analyses of pitch and vowels as they relate to sexuality, examinations of the

acoustic properties of /s/ have been substantially more consistent and reliable (Zimman, 2013). The frontedness of /s/ in particular has received considerable attention. Frontedness is typically measured with respect to center of gravity, the weighted mean of frequencies in the spectrum, such that higher center of gravity correlates with fronted /s/. Comparing across genders, studies indicate that women produce a more fronted /s/ than men (e.g., Fuchs & Toda, 2010; Hazenberg, 2012). English-speaking adult women's center of gravity typically ranges from 6,400 to 8,500 Hz while men's range from 4,000 to 7,000 Hz (Zimman, 2017). Studies of men's /s/-fronting vis-à-vis sexual orientation have found that gay men produce more fronted /s/ than straight men (Zimman, 2013; Calder, 2019; but also see Podesva & Van Hofwegen, 2014). Studies of women's speech have been less conclusive; Barron-Luztross (2015) reports no correlation between /s/ production and sexual orientation in women. In contrast, Hazenberg (2016) finds that straight women produce more fronted /s/ than lesbian women. Similarly, Munson and colleagues (2006a) report that straight women produce /s/ with a higher center of gravity than lesbian/bisexual women. Overall, results indicate a robust correlation between /s/-fronting, as measured by center of gravity, and sexual orientation in men, though less so in women.

Another measure of /s/ often discussed is skew. Skew or skewness is a measure of spectral tilt, or how fast the amount of energy falls off as frequency increases (Thomas, 2010). Positive skew indicates prominence in the low frequency ranges, whereas negative skew indicates prominence in the higher frequency ranges. Munson and colleagues (2006a, 2006b) report that women produce /s/ with a more negative skew than men. Likewise, they find that gay men produce /s/ with a more negative skew than straight men, though lesbian/bisexual and straight women do not differ in this respect. The perceptual study by Munson, Jefferson, and McDonald (2006b) finds that men who produce /s/ with a more negative skew are more likely to be rated as gay/bisexual-sounding, whereas the production study by Munson and colleagues (2006a) reports that gay/bisexual-sounding men produce /s/ with a more negative skew than straight-sounding men. In sum, it appears that differences in skew, both from a production and perception standpoint, are significant when comparing across genders or comparing straight

men to gay men.

Evidence has emerged that duration is another important measurement of /s/ for language, gender, and sexuality research. Crist (1997) finds that /s/ is lengthened in stereotypical gay male speech, but only in certain phonological contexts. Likewise, Linville (1998) reports that the gay male speakers in her study tend to produce /s/ with longer duration than the straight male speakers. She also reports that /s/ duration correlates with both perceived and actual sexual orientation. Similarly, a perceptual study by Rogers, Smyth, and Jacobs (2000) finds that speakers rated as "gayer-sounding" had significantly longer mean normalized /s/ and /z/ durations than those rated as straighter-sounding. In contrast, Levon (2007) reports that digitally manipulating the duration of /s/ tokens is not enough to significantly alter listeners' perceptions of the sexuality of the single participating speaker in his case study. However, Levon does not claim that /s/ duration (and pitch range, which he also examines) plays no part in listeners' assessments of speakers' sexuality. Rather, Levon suggests that /s/ duration may need to be combined with other features in order to alter listeners' perceptions of speakers' sexuality. In any case, the literature, when viewed holistically, suggests that there is a relationship between sexuality and /s/ duration. Overall, investigations of /s/ produce results that are far more consistent than those for pitch or vowels. Therefore, I focus on three measures of /s/ production in my analysis: center of gravity, skew, and duration.

Another benefit of analyzing /s/ is that, unlike pitch and (back) vowel quality, differences in /s/ production are not grounded in sexual dimorphism. Sex-based differences in the vocal anatomy are thought to mainly exist in the posterior of the vocal tract. However, the frequency profile of /s/ is primarily determined by the size of the front cavity, or the space between the tongue constriction and the teeth (Shadle, 1985; 1991). Overall, evidence suggests that differences in /s/ production are socially, rather than biologically, conditioned (e.g., Zimman, 2017). In turn, this implies that speakers may exercise some degree of awareness and control over how they produce /s/. The combination of speaker agency on the one hand and sexualized, gendered markedness on the other is precisely what makes /s/ variation ideal for analyzing language vis-

à-vis gender and sexuality.

## 3. Methods

### *3.1. Participants*

Participants consisted of 27 cisgender speakers (5 bisexual women, 5 lesbian women, 5 straight women, 5 gay men, 5 straight men and 2 bisexual men). All speakers were students at the University of California, Santa Barbara (UCSB) at the time of participation. Speakers were recruited using snowball sampling and through flyers distributed electronically and posted in various locations on the UCSB campus. Some of the speakers were known to me while others were not. Eligible participants were compensated with course credit. The recruitment process, compensation, and consent process were all approved by the Institutional Review Board at UCSB.

All participants were between 18 and 30 years of age. There was no significant difference between the ages of women and men who participated ($M_{men}$ = 21.4, $SD_{men}$ = 4.5, $M_{women}$ = 20.3, $SD_{women}$ = 2.9). All were native speakers of English, though some also spoke other languages. None reported speaking or hearing problems. Most participants (n = 23) identified one city/area as their hometown/place of origin, though others (n = 4) named several locations when asked where they were from. The majority of participants were from the United States, California being particularly well represented, though participants identified the UK, Poland, and India as places of origin as well. Participants also reported their ethnoracial identities. The majority of speakers identified as White, though Latinx, Asian, and multiracial speakers are also represented. Individual information about each participant is included in Table 1 below.

| Speaker | Gender | Sexuality | Age | Ethnicity/Race | Place of Origin |
|---|---|---|---|---|---|
| 1 | Cis man | Bisexual | 18 | Latinx | California |
| 2 | Cis man | Bisexual | 19 | White | Texas, Arkansas, California |
| 3 | Cis man | Gay | 28 | White | Illinois |
| 4 | Cis man | Gay | 27 | White | Colorado |
| 5 | Cis man | Gay | 18 | Latinx/White | California |
| 6 | Cis man | Gay | 30 | White | Montana |
| 7 | Cis man | Gay | 24 | Asian | India |
| 8 | Cis man | Straight | 18 | Latinx | California |
| 9 | Cis man | Straight | 18 | Latinx | California |
| 10 | Cis man | Straight | 18 | Latinx | California |
| 11 | Cis man | Straight | 19 | White | Washington, D.C. |
| 12 | Cis man | Straight | 20 | White | Massachusetts |
| 13 | Cis woman | Bisexual | 26 | White | California |
| 14 | Cis woman | Bisexual | 25 | Latinx/Pacific Islander or Hawaiian Native | California |
| 15 | Cis woman | Bisexual | 18 | White | California |
| 16 | Cis woman | Bisexual | 18 | White | California |
| 17 | Cis woman | Bisexual | 19 | White | Massachusetts |
| 18 | Cis woman | Lesbian | 20 | Latinx/White | Colorado |
| 19 | Cis woman | Lesbian | 26 | White | Oregon, California, Utah, Poland, Texas |
| 20 | Cis woman | Lesbian | 19 | White | Texas |
| 21 | Cis woman | Lesbian | 19 | White | California, the U.K. |
| 22 | Cis woman | Lesbian | 21 | Jewish/White | California |
| 23 | Cis woman | Straight | 18 | Asian | California |
| 24 | Cis woman | Straight | 20 | Asian | Texas, California |
| 25 | Cis woman | Straight | 18 | Latinx | California |
| 26 | Cis woman | Straight | 19 | White | Declined to answer |
| 27 | Cis woman | Straight | 19 | White | California |

**Table 1:** Speaker information

### *3.2. Stimuli*

Speakers were recorded reading the Rainbow Passage (Fairbanks, 1960), a scientific passage about rainbows, as well as a list of 240 phonetically balanced sentences (Rothauser, 1969). All participants recorded the passage first, then the sentences. They were instructed to read the stimuli as naturally as possible and to read both the passage and all sentences twice only. All sentences were read in the same order for all participants. The present analysis focuses only on the reading passage data.

### *3.3. Procedure*

Speakers were recorded in a sound-attenuated booth using Audacity audio editing software (Audacity Team, 2019). Recordings were taken at a 44.1 kHz sample rate with 16-bit quantization on either a Blue Snowball iCE USB Condenser microphone, a Blue Yeti USB microphone, or an AKG C 3000 B microphone. I impressionistically noticed no significant differences in audio quality.

During the informed consent process, participants were initially told that they were participating in the speaking component of a two-part experiment studying LGBQ and allied voices in California. They were told that they would be further debriefed on how I intended to use their data after the recording was completed and that they would have the opportunity to withdraw consent and destroy their data at that time. After obtaining their initial consent, speakers filled out a survey asking for personal information such as age, gender, sexual orientation, ethnicity/race, languages spoken, and so on. Participants were informed that they could decline to answer any question. When they finished recording, participants answered additional questions about their gender presentation and sexual preferences in a post-test survey. This survey was presented after the tasks in order to minimize priming effects. Again, participants were informed that they could decline to answer any question. Finally, participants were debriefed on how I intended to use their recordings. They were informed that an acoustic analysis would be conducted on their speech with the express goal of studying the speech production patterns of LGBQ and allied speakers. Second, they were told that their speech would be used to create

stimuli for a perception study in which listeners would make various judgements about them, including their sexuality (Willis, in preparation). After the debriefing, speakers were given the opportunity to withdraw consent and permanently delete their data. None opted to do so.

### *3.4. Analysis*

Word-initial tokens of /s/ from the first reading of the Rainbow Passage (Fairbanks, 1960) were transcribed in Praat (Boersma, 2011) and then extracted using a Python script. Tokens from the word STRIKE and the phrase FRIENDS SAY were discarded for all participants because of their phonological context. In more specific terms, STRIKE tokens were discarded due to the well documented pattern of /s/ retraction in /str/ clusters (e.g. Shapiro, 1995). FRIENDS SAY was discarded because of the tendency for the final /z/ in 'friends' to blend with the initial /s/ in 'say', making the /s/ token difficult to segment consistently, which is potentially problematic for duration measurements. Disfluencies in which the speaker did not produce the target word in full as well as /s/ tokens judged to contain periodicity were also excluded. In total, 95 tokens were discarded, such that 380 tokens were analyzed ($M_{\text{per speaker}}$ = 14 tokens). The Python script, written by Lal Zimman, generated measurements for center of gravity, skew, standard deviation, kurtosis and duration. Center of gravity, skew, and duration were considered in this analysis. Measurements that were atypical relative to the standards found in the literature were checked manually in Praat.

The results below are divided into three sets of analyses: center of gravity, skew, and duration. For each set of dependent measures, linear mixed-effects regression models were fitted using the lmer function from the lmerTest package in R (R Core Development Team, 2019). The regression model for each dependent variable was stepped down using the function drop1 from the lme4 package from a full model that included GENDER, SEXUALITY, and their interaction as fixed effects. GENDER had two levels (FEMALE and MALE) and SEXUALITY had three levels (BISEXUAL, LESBIAN/GAY, and STRAIGHT). SPEAKER (27 levels) and WORD (15 levels) were included as random effects with varying intercepts. Then, the anova function from the R base package was used in order to determine the significance of the main ef-

fects and their interactions. I discuss the statistical findings for each of the dependent variables in turn, before going on to consider the ramifications.

Although the main goal of this thesis is to compare bisexual speakers' /s/ production to that of their lesbian/gay and straight counterparts, I was also interested in comparisons between the other groups (e.g., straight women versus gay men, lesbian women versus straight men, etc.). To that end, post-hoc pairwise comparisons were calculated using the relevel function from base R. The relevel function lets the user choose the first level of a given factor (factors are ordered alphabetically by default), therefore changing the intercept (also known as the baseline) of the model. This process allowed me to compute comparisons not available from the original model output. Additionally, the Bonferroni method was used to compensate for evaluating the models multiple times. Specifically, I apply the Bonferroni correction using the method described by Ackerman (2018) to adjust the p-values directly, rather than adjusting the alpha level. For example, I evaluated the model for center of gravity five times in total in order to compute the initial model and the pairwise comparisons. The raw p-values are then multiplied by five to calculate the adjusted p-values. Ackerman (2018) suggests this method of adjusting the p-values directly may be more accessible to those unfamiliar with the Bonferroni method.

The Bonferroni method was chosen because it is the most suitable correction method known to me for this type of data. Other methods were not appropriate because the data used here violates their assumptions (the Tukey method, for example, requires that the data points are independent). However, the Bonferroni method has some disadvantages. Namely, it is intolerant to Type I errors. In other words, it is unnecessarily conservative and often fails to detect real

differences (Lee & Lee, 2018: 357).

# 4. Results

## *4.1. Center of gravity (COG)*

4.1.1. COG linear mixed effects regression model

Center of gravity measurements (n = 380) extracted from Praat (Boersma, 2011) were submitted to a linear mixed-effects regression model. Model selection with drop1 indicated that the maximal model, in which GENDER, SEXUALITY, and their interaction were included as factors, was the best fit. The random effect SPEAKER accounted for approximately 47% of the variance in the data, whereas the random effect WORD accounted for about 7% of the variance.

A significant main effect of GENDER was found, such that women generally produced /s/ with a higher COG than men ($\chi^2(1) = 5.9$, $p = 0.01$). The interaction between GENDER and SEXUALITY was also significant ($\chi^2(2) = 9.5$, $p < 0.01$). The main effect of SEXUALITY was not significant, but the SEXUALITY factor could not be removed from the model due to its participation in a significant interaction.

The coefficients generated by the COG linear mixed-effects model (Table 2) indicate that, among women, straight women produce the highest estimated COG (8208 Hz), followed by bisexual women (8103 Hz) and then lesbian women (6611 Hz). The straight and bisexual women in this sample produced COG that fell on the higher end of the expected range for women (6400-8500 Hz) whereas lesbian women's COG was on the lower end. A significant difference was found between bisexual women and lesbian women ($p < 0.05$), but no significant difference was found between bisexual women and straight women.

Among the men's groups, gay men produced the highest estimated COG (6929 Hz), followed by straight men (6608 Hz), and then bisexual men (6529 Hz). The gay men in this sample produced /s/ with COG on the higher end of the spectrum for men, but still within the range considered typical (4000-7000 Hz). Bisexual and straight men's COG is well within the expected range of values. No significant differences were found between the groups of men for

this dependent measure.

| Fixed effects | Estimate | Standard error | t-value | Pr(>\|t\|) |
|---|---|---|---|---|
| Intercept (bisexual women) | 8102 | 362.89 | 22.329 | <2e-16*** |
| Gender:M (bisexual men) | -1574.26 | 661.39 | -2.380 | 0.02689* |
| Sexuality:Lesbian/gay (lesbian women) | -1491.66 | 500.37 | -2.981 | 0.00712** |
| Sexuality:Straight (straight women) | 105.87 | 500.27 | 0.212 | 0.83445 |
| Gender:M, Sexuality:Lesbian/gay (gay men) | 1891.74 | 829.31 | 2.281 | 0.3311* |
| Gender:M, Sexuality:Straight (straight men) | -25.60 | 829.27 | -0.031 | 0.97567 |

**Table 2:** Linear mixed effects regression model results for center of gravity

The model (Table 2, Figure 1) finds that bisexual women produce /s/ with a significantly higher COG compared to bisexual men ($p < 0.03$), lesbian women ($p < 0.01$), and gay men ($p < 0.04$). It is perhaps unsurprising that the COG of /s/ tokens produced by bisexual women is significantly different from that of the two male groups, given the generalization that women produce /s/ with a higher COG than men. However, it is noteworthy that there is a significant difference between bisexual women and lesbian women's COG ($p < 0.05$). That bisexual women's COG does not clearly pattern with that of lesbian women troubles the a priori categorization of bisexual women with lesbian women (e.g., Munson et al., 2006a). This result is also consequential, given that Pierrehumbert and colleagues (2004) found that bisexual women pattern with lesbian women, albeit they examined vowels rather than /s/. Moreover, the model finds no significant difference between the COG estimates for bisexual women and straight women, suggesting that bisexual women may pattern more closely with straight women in some cases (but not others, as demonstrated by Pierrehumbert et al., 2004).

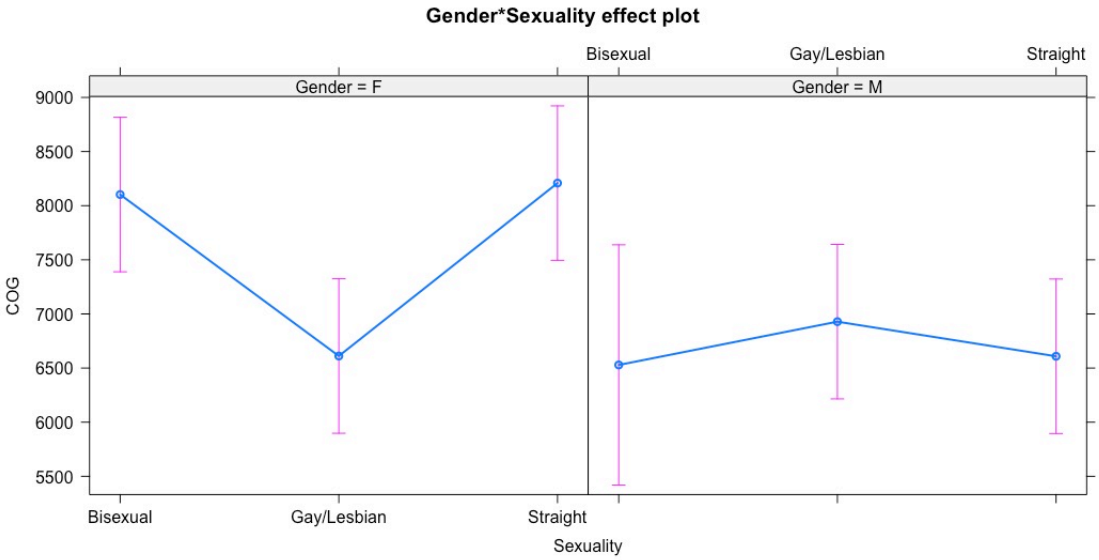


**Figure 1:** COG regression model effects plot, vis-à-vis the interaction between gender and sexuality

4.1.2. COG post-hoc pairwise comparisons

Next, the model was releveled four times in order to examine the full list of pairwise comparisons. Releveling allowed me to obtain p-values for all GENDER*SEXUALITY comparisons (Table 3). I used the Bonferroni correction as described in the Analysis section to compensate for evaluating the model multiple times.

Comparing within sexuality but across genders (Figure 2, Table 3), bisexual women's and men's COG differs significantly before the correction ($p < 0.05$), but this difference loses significance after the correction is made. However, straight women's and straight men's COG are significantly different even with the correction ($p = 0.02$) such that straight women produce /s/ with a higher COG than straight men. Interestingly, lesbian women's and gay men's COG are not significantly different both before and after the correction. The results suggest that the generalization that women produce /s/ with a higher COG than men may not hold true for all groups of women and men.

Comparing within gender but across sexuality, bisexual women's COG differs significantly from that of lesbian women before ($p < 0.05$) and after ($p < 0.01$) the correction, such that bisexual women produce /s/ with higher COG than lesbian women. In contrast, bisexual women's

COG does not differ from that of straight women before or after the correction. Lesbian women's COG is significantly different from straight women's COG before ($p < 0.005$) and after ($p < 0.05$) the correction, such that lesbian women produce /s/ with a lower COG than straight women. No significant differences were found between the men's groups.

| **Group comparison** | | **Raw p-value** | **Bonferroni corrected p-value** |
|---|---|---|---|
| Bisexual women | Bisexual men | 0.02689* | 0.13445 |
| Bisexual women | Lesbian women | 0.00712** | 0.0356* |
| Bisexual women | Gay men | 0.03311* | 0.16555 |
| Bisexual women | Straight women | 0.83445 | 4.17225 |
| Bisexual women | Straight men | 0.97567 | 4.87835 |
| Bisexual men | Lesbian women | 0.03311* | 0.16555 |
| Bisexual men | Gay men | 0.517 | 2.7585 |
| Bisexual men | Straight women | 0.9757 | 4.8785 |
| Bisexual men | Straight men | 0.90456 | 4.5228 |
| Lesbian women | Gay men | 0.53261 | 2.6631 |
| Lesbian women | Straight women | 0.00437** | 0.0219* |
| Lesbian women | Straight men | 0.01312* | 0.0656 |
| Gay men | Straight women | 0.0131 | 0.0655 |
| Gay men | Straight men | 0.5296 | 2.648 |
| Straight women | Straight men | 0.00433** | 0.0217* |

**Table 3:** Linear mixed effects regression model results for center of gravity

Comparing across sexuality and gender, the results suggest that gay men's and straight women's COG are significantly different, such that gay men produce /s/ with lower COG ($p < 0.05$), but this difference is no longer significant after the correction. Similarly, the analysis suggests that lesbian women and straight men differ significantly from each other, such that lesbian women produce /s/ with higher COG ($p < 0.05$), but again this difference is no longer significant after the correction. In any case, these findings cast doubt on the notion that LG speakers adopt the speech style of their ideologically opposite straight counterparts.

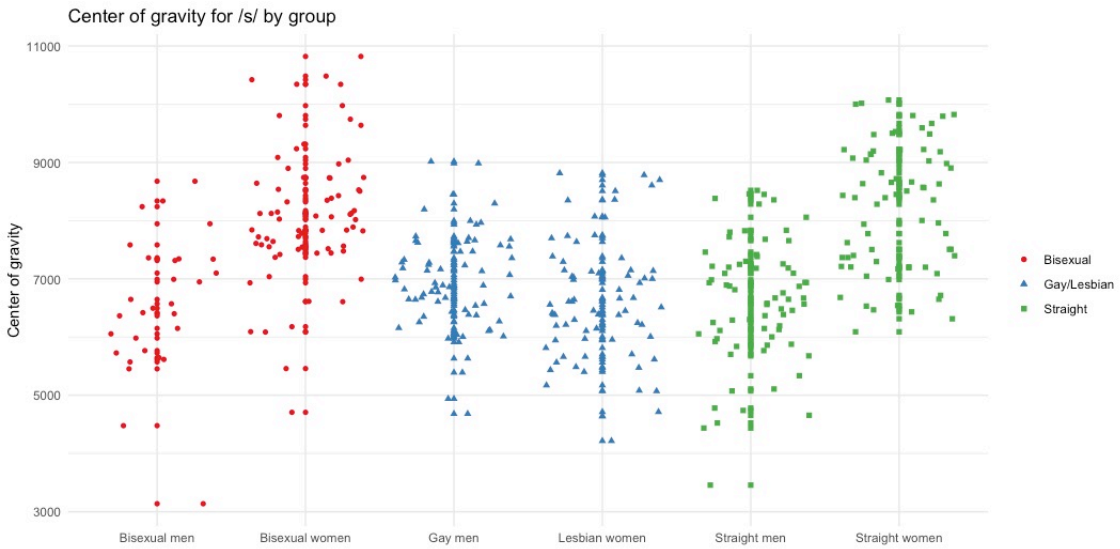


**Figure 2:** Center of gravity of /s/ by group, vis-à-vis gender and sexuality

### *4.2. Skew*

4.2.1. Skew linear mixed effects regression model

Skew measurements (n = 380) extracted from Praat (Boersma, 2011) were submitted to a linear mixed-effects regression model. Model selection using drop1 indicated that neither GENDER, nor SEXUALITY, nor their interaction contributed to the overall fit of the model. The random effect SPEAKER accounted for 58% of the variance in the data while WORD accounted for about 1% of the variance. Figure 3 shows the distribution of skew measurements by group vis-à-vis gender and sexuality. It suggests that gay men produce /s/ with a more negative skew than straight men, which aligns with previous research (Munson et al., 2006a).

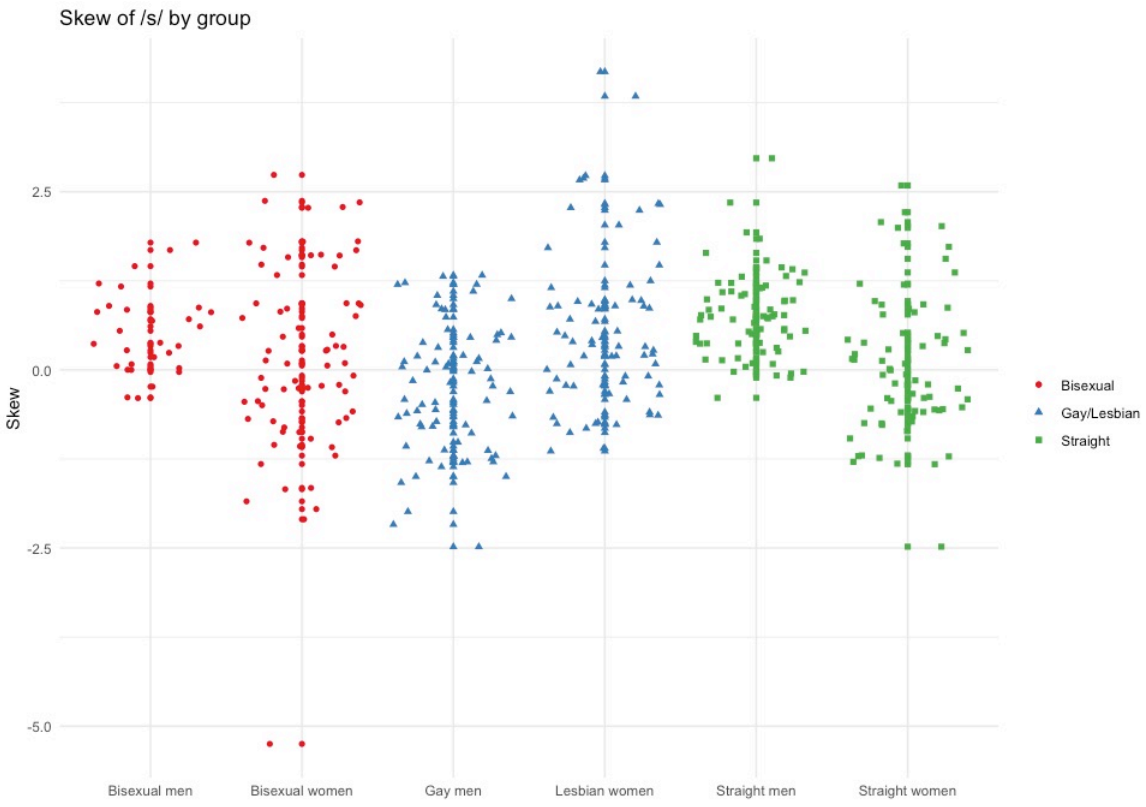


**Figure 3:** Skew of /s/ by group, vis-à-vis gender and sexuality

### *4.3. Duration*

4.3.1. Duration linear mixed effects regression model

Duration measurements (n = 380) extracted from Praat (Boersma, 2011) were submitted to a linear mixed-effects regression model. Model selection using drop1 indicated a model containing only SEXUALITY as a fixed effect was the optimal fit. The random effect SPEAKER accounted for approximately 14% of the variability while WORD accounted for about 43% of the variability.

A significant main effect of SEXUALITY was found ($\chi^2(2) = 29.2$, $p < 0.001$), such that bisexual speakers produce /s/ with shorter duration compared to lesbian/gay speakers and straight speakers (Table 4). GENDER as a main effect, however, was not significant. The interaction between GENDER and SEXUALITY was also not significant. Figure 4 shows the distribution of duration measurements by group vis-à-vis gender and sexuality.

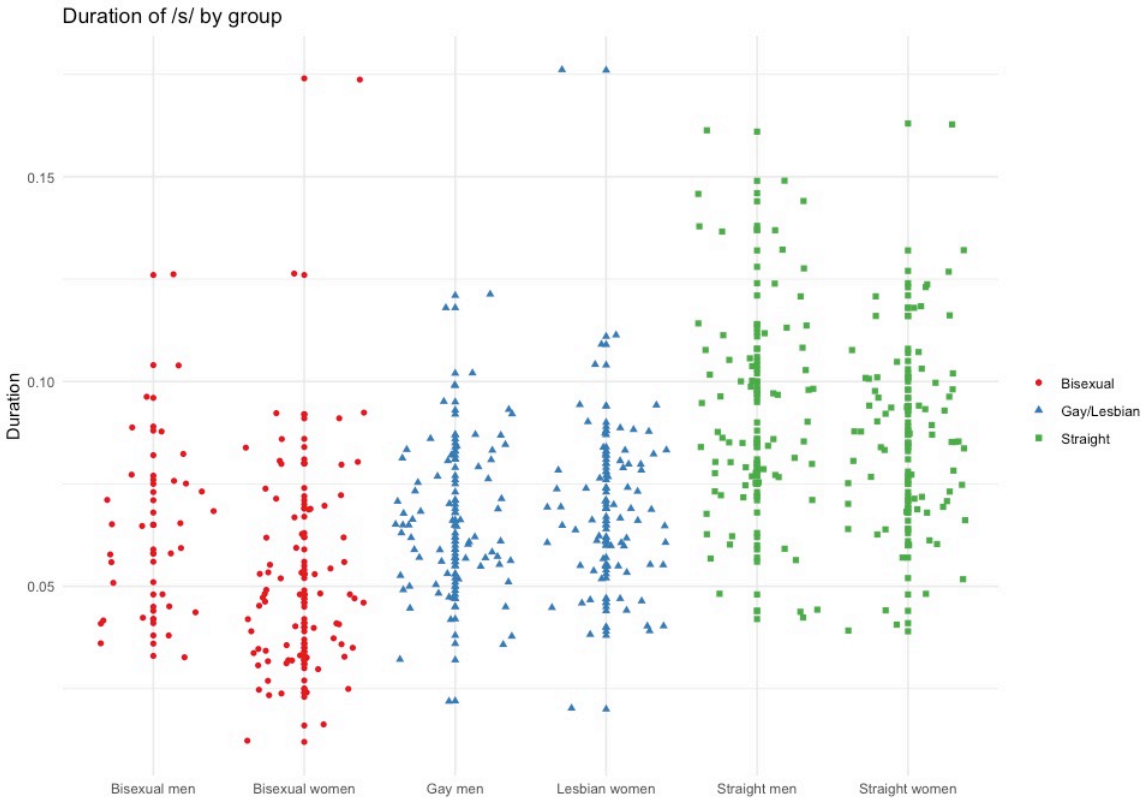


**Figure 4:** Duration of /s/ by group vis-à-vis sexuality

Bisexual speakers have the shortest estimate duration (60 milliseconds). Lesbian/gay speakers have a significantly longer estimated duration (70 ms, $p < 0.03$). Likewise, the estimate duration for straight speakers (90 ms) is significantly longer than that of bisexual speakers ($p < 0.001$). The results indicate a cline of duration, with bisexual speakers at the short end and straight speakers at the long end of the spectrum (Figure 5). Viewed holistically with the COG results described above, these results suggest that bisexual speakers are not easily categorized with either lesbian/gay or straight speakers.

| **Fixed effects** | **Estimate** | **Standard error** | **t-value** | **Pr(>\|t\|)** |
|---|---|---|---|---|
| Intercept (bisexual speakers) | 0.058644 | 0.005800 | 10.111 | 1.99e-11*** |
| Sexuality:Lesbian/gay | 0.011949 | 0.005031 | 2.375 | 0.0259* |
| Sexuality:Straight | 0.034088 | 0.005032 | 6.774 | 5.20e-07*** |

**Table 4:** Linear mixed effects regression model results for duration

It is important to note that /s/ duration may also be a function of speech rate, the position of the token at the word, clause, sentence, or passage level, or some combination of these two factors. Neither speech rate nor token position were controlled for. Moreover, variance in the position of the tokens is likely related to how the random effect WORD accounts for much more of the variance in duration (43%) compared to COG (7%) and skew (1%). Given these confounds, it is it is unclear whether the results in this section are entirely explained by /s/ duration or rhythmic/durational properties more broadly.

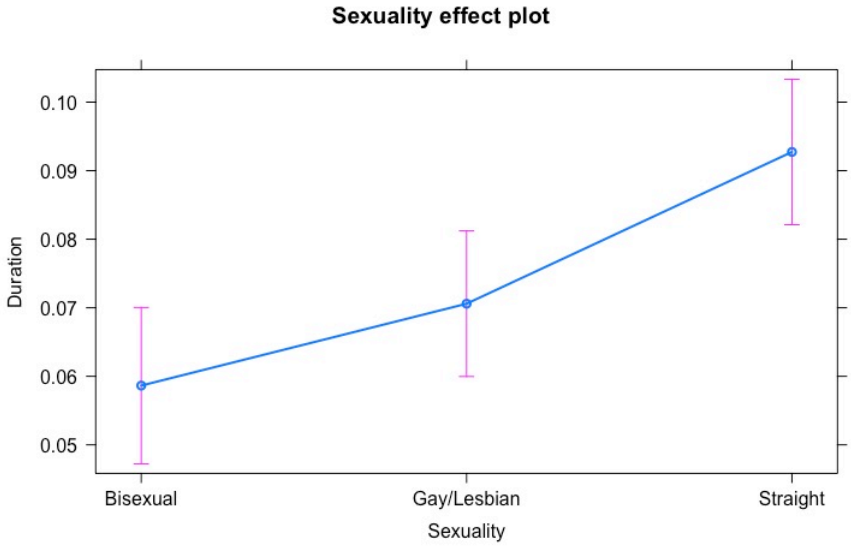


**Figure 5:** Duration regression model effect plot vis-à-vis sexuality

4.3.2. Duration post-hoc pairwise comparisons

The duration model was releveled using the procedure described at the beginning of the Analysis section in order to calculate pairwise comparisons between lesbian/gay speakers and straight speakers (Table 5). The Bonferroni correction was used to compensate for evaluating the model a second time.

The noteworthy finding here is that the duration of /s/ produced by lesbian/gay speakers is significantly different from straight speakers, even with the adjustment ($p < 0.001$), such that lesbian/gay speakers produce /s/ with shorter duration. This aligns with the results for COG, in which lesbian/gay speakers also differed significantly from their straight counterparts,

corroborating claims made by Munson and colleagues (2006a) that lesbian/gay speech styles are not wholesale adoptions of straight ones.

| **Sexuality comparison** | | **Raw p-value** | **Bonferroni-corrected p-value** |
|---|---|---|---|
| Bisexual | Lesbian/gay | 0.0259* | 0.0518* |
| Bisexual | Straight | 5.20e-07*** | 0.00000104*** |
| Lesbian/gay | Straight | 6.09e-05*** | 0.0001218*** |

**Table 5:** Gender:Sexuality group comparisons with p-values from releveled duration lmer model

## 5. Discussion

In this section, I discuss the results of the statistical analyses presented above in more detail. First, I discuss the within-sexuality, cross-gender comparisons. Next, I discuss the within-gender, cross-sexuality comparisons, drawing on post-test gender stereotypicality ratings in my discussion.

| **Groups** | | **COG** | | **Skew** | **Duration** | |
|---|---|---|---|---|---|---|
| | | No adjustment | Bonferroni adjustment | | No adjustment | Bonferroni adjustment |
| Bisexual women | Bisexual men | * | | NA | NA | NA |
| Lesbian women | Gay men | | | NA | NA | NA |
| Straight women | Straight men | ** | * | NA | NA | NA |

**Table 6:** Summary of within-sexuality, cross-gender comparisons
*** p < 0.001, ** p < 0.01, * p =< 0.05

| **Gender** | **Cross-sexuality comparison** | | **COG** | | **Skew** | **Duration** | |
|---|---|---|---|---|---|---|---|
| | | | No adjustment | Bonferroni adjustment | | No adjustment | Bonferroni adjustment |
| Men | Bisexual | Gay | | | NA | NA | NA |
| | Bisexual | Straight | | | NA | NA | NA |
| | Gay | Straight | * | | NA | NA | NA |
| Women | Bisexual | Lesbian | ** | * | NA | NA | NA |
| | Bisexual | Straight | | | NA | NA | NA |
| | Lesbian | Straight | ** | | NA | NA | NA |

**Table 7:** Summary of within-gender, cross-sexuality comparisons
*** p < 0.001, ** p < 0.01, * p =< 0.05

| Cross-sexuality comparison | | COG | | Skew | Duration | |
|---|---|---|---|---|---|---|
| | | No adjustment | Bonferroni adjustment | | No adjustment | Bonferroni adjustment |
| Bisexual | Gay | NA | NA | NA | *** | *** |
| Bisexual | Straight | NA | NA | NA | *** | *** |
| Gay | Straight | NA | NA | NA | *** | *** |

**Table 8:** Summary of cross-sexuality comparisons, not accounting gender
*** $p < 0.001$, ** $p < 0.01$, * $p =< 0.05$

### *5.1. Within sexuality, cross-gender comparisons*

Comparing within sexuality but across gender (Table 6), this study has three main findings. First, bisexual women's and men's /s/ production differs only in terms of center of gravity (and only before the Bonferroni correction is made), such that bisexual women produce /s/ with a higher COG than bisexual men. Second, lesbian and gay speakers do not significantly differ from each other for any measure. Finally, straight speakers significantly differ from each other only for COG, such that straight women produce /s/ with significantly higher COG, before and after the Bonferroni correction is made. In short, the specific way in which the within-sexuality, cross-gender groups of women and men differ with respect to /s/ production depends on their sexuality. Moreover, when accounting for the Bonferroni correction, bisexual women and men behave more similarly to lesbian and gay speakers in that they do not differ significantly from each other for any measure. However, bisexual speakers are found to be significantly different from each other, similar to straight speakers, in the first evaluation of the model (i.e., before the correction is made), in which bisexual women are the intercept/baseline. These findings illustrate that bisexual speakers are not easily categorized with either lesbian/gay or straight speakers and therefore should be treated as distinct.

### *5.2. Within gender, cross-sexuality comparisons*

Group-by-group comparisons across sexuality and within gender (Table 7) indicate that bisexual women differ from lesbian and straight women in /s/ production in a way that is distinct from how bisexual men differ from gay and straight men. Compared to lesbian women, bisexual women produce /s/ with significantly higher COG, whereas the difference between bisexual women and straight women's COG is not significant. In other words, the quality of bisexual women's /s/ production is more similar to straight women's than lesbian women's with respect to center of gravity. Bisexual men's COG, on the other hand, does not differ significantly from gay men's or straight men's. However, there is a significant difference in /s/ duration as a function of sexuality for all sexuality pairwise comparisons (Table 8). Considering these findings, bisexual men's /s/ production differs from that of the other groups of men in the same way, regardless of the sexuality of the other men; bisexual men do not differ from other men for COG, but do for duration. In contrast, the way bisexual women differ from other groups of women is dependent on sexuality. Bisexual women's COG is significantly different from lesbian women but not straight women, whereas bisexual women differ from both groups in terms of duration. Not only do these results suggest that bisexual speakers are not easily categorized with either straight or lesbian/gay speakers, similar to the results discussed above, but they also indicate that bisexual women and men do not pattern uniformly as a group in terms of /s/ production.

Given the small sample size (only two bisexual men participated in this study) and the lack of ethnographic grounding, I can only tentatively speculate why bisexual women and men differ from their straight and lesbian/gay counterparts in distinct ways. Non-statistical analyses of self-reported gender stereotypicality ratings suggest that the differences between how bisexual women and men compare to their straight and lesbian/gay counterparts are potentially explained by the distinct ways that bisexual women and men experience the intersection of gender normativity and sexuality.

In a post-test survey, participants were asked to rate themselves on two odd-point scales of gender stereotypicality. Responding with a number between 1 (not at all) and 7 (very), they

answered the questions "How stereotypically feminine do you consider yourself?" and "How stereotypically masculine do you consider yourself?" Distributions of the ratings for all groups are presented in Figures 6 and 7 below. Bisexual women often rated themselves on the more extreme ends of the scale (Table 9); one bisexual women (Speaker 14) rated herself a 6 for femininity while another (Speaker 16) rated herself a 1 for masculinity. It is notable, however, that only one of the five bisexual women reported a higher masculinity rating than femininity rating, whereas one of the two bisexual men surveyed provided a higher femininity rating than masculinity rating.

| Speaker | Gender | Femininity rating | Masculinity rating | Difference |
|---|---|---|---|---|
| 1 | Man | 5 | 3 | More feminine |
| 2 | Man | 3 | 5 | More masculine |
| 13 | Woman | 5 | 3 | More feminine |
| 14 | Woman | 6 | 2 | More feminine |
| 15 | Woman | 5 | 2 | More feminine |
| 16 | Woman | 5 | 1 | More feminine |
| 17 | Woman | 3 | 5 | More masculine |

**Table 9:** Bisexual speakers' self-reported femininity and masculinity ratings)

Earlier in this thesis, I argued that bisexual people's gender normativity may be constructed differently across contexts. Here, I argue that the construction of cisgender bisexual women's and men's gender normativity is also distinct from that of lesbian/gay people and heterosexual people. Bisexual women and men are not stereotyped in the same way as lesbian women and gay men and they also experience different kinds of prejudice. On the one hand, female bisexuality is criticized as attention-seeking behavior that exists for the male gaze (Alarie & Gaudet, 2013; Hartman, 2013; Hertlein, Hartwell & Munns, 2016). On the other hand, male bisexuality is criticized as a stepping stone to homosexuality (Alarie & Gaudet, 2013; Brewster & Moradi, 2010; Hertlein, Hartwell & Munns, 2016). Although bisexuality is delegitimized for both women and men, the key difference is that bisexual women are ideologically positioned as actually straight while bisexual men are positioned as secretly gay. In other words, bisexual

women are positioned as straight and therefore gender normative whereas bisexual men are positioned as gay and therefore gender deviant. The particular brand of skepticism directed at bisexual men may be a factor in the difficulty I experienced when recruiting bisexual male participants for this study. Indeed, gender theorists such as Butler (1990) have argued that gender identities are matched with sexualities: for example, a part of being masculine is being heterosexual. Moreover, the maintenance of hegemonic heterosexual masculinity is dependent upon the subordination of marginalized masculinities, with homosexual masculinity being a key subordinate masculinity (Talbot, 2010: 169). It is possible that cisgender men in the community in which this study is situated are reluctant to identify as bisexual because openly identifying as such positions them as gender deviant, similar to gay men.

Stereotypes about sexuality and gender normativity, of course, do not necessarily determine how one enacts or feels about one's gender typicality. However, all of the straight men in this sample identified as more masculine than feminine and all of the straight women identified as more feminine than masculine. Moreover, many of the extreme ratings (i.e., 1, 2, 6, and 7) came from straight women and men relative to the other groups. Gay men and lesbian women's ratings were more mixed, with some gay men identifying as more feminine than masculine and some lesbian women identifying with stereotypical femininity and masculinity equally or declining to answer. Their answers also tended to be less extreme (i.e., close to the middle of the scales) than those provided by straight women, straight men, or bisexual women.

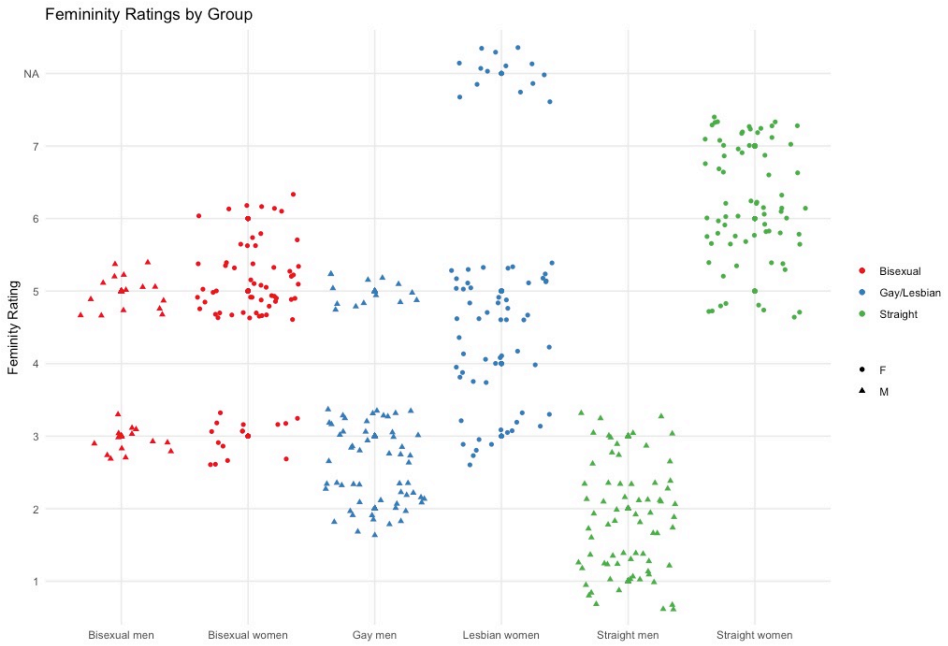


**Figure 6:** Femininity ratings by group vis-à-vis gender and sexuality

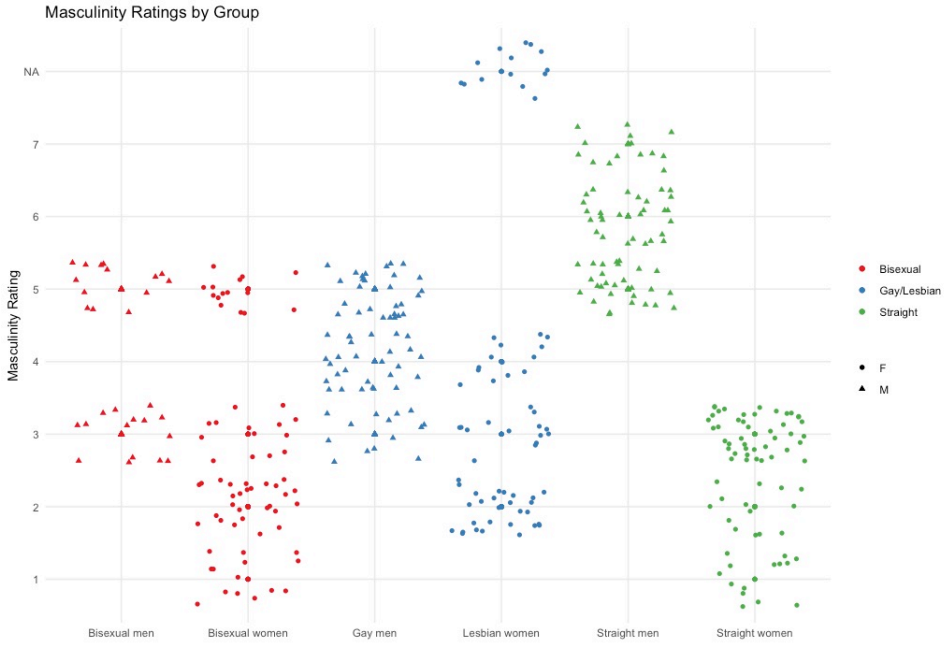


**Figure 7:** Masculinity ratings by group vis-à-vis gender and sexuality

It is possible that the lack of differences between bisexual and straight women's /s/ production relative to the differences between bisexual and lesbian women's /s/ production is rooted

in orientations towards gender normativity. The gender stereotypicality ratings provided by bisexual women in this sample are impressionistically more similar to those provided by straight women than lesbian women. Bisexual women's femininity ratings are often higher than their masculinity ratings and their ratings are more often extreme. This pattern indicates that the bisexual women in this study orient towards gender norms in a way that is more similar to the straight women than the lesbian women in this sample. On the other hand, the ratings provided by bisexual men are more similar to those of gay men than straight men. Specifically, the bisexual men's masculinity ratings are not consistently higher than their femininity ratings and both ratings are less extreme. This pattern suggests that bisexual men orient towards gender norms in a way that is more similar to gay men. It follows that this gender normativity hypothesis would predict that these bisexual men's /s/ productions would be more similar to that of the gay men. However, the results of the statistical analyses show that bisexual men's /s/ production differs from gay men and straight men in the same way, namely in terms of duration but not center of gravity. Given that only two bisexual men participated in this experiment, the explanatory power of either the statistics or the gender normativity hypothesis remains to be seen.

The second major finding when comparing within genders and across sexualities is that differences in duration are highly significant for all cross-sexuality comparisons (Table 5, Table 8). Duration has received far less attention than COG or skew, so it is significant that it is the most consistent and robust across group-by-group comparisons. However, it is important to acknowledge that duration is complicated by speech rate and position of the token at the word, phrase, sentence, and passage level, none of which were controlled for in this study. The differences found here may be part of broader prosodic practices related to speech rate or token position, rather than to /s/ production specifically. Regardless, it is difficult to speculate what exactly is being indexed through variation in duration without detailed ethnographic information and/or more empirical evidence. Variation in duration vis-à-vis gender and sexuality certainly warrants further research.

### *5.3. Lesbian/gay speakers' versus straight speakers' /s/ production*

Numerous studies have examined lesbian/gay styles vis-à-vis the speech of straight speakers. Many of these studies investigate the notion that lesbian/gay speakers talk like the "opposite gender" in a binary gender model. The current study suggests that lesbian women produce /s/ with significantly higher COG and shorter duration compared to straight men. Likewise, the study suggests that gay men produce /s/ with significantly lower COG and shorter duration compared to straight women. However, the differences in COG between lesbian women and straight men and gay men and straight women fail to maintain significance after the Bonferroni correction. Regardless, these findings challenge the notion that lesbian/gay styles are wholesale imitations of straight women's or men's styles, corroborating a similar argument made by Munson and colleagues (2006a). In short, the findings presented here supply further evidence that both lesbian/gay styles are not imitations of heterosexual normativity.

### *5.4. Reflections on data collection and methodology*

When I started this project as a first-year graduate student, I committed to doing everything by the book. I trusted in the knowledge and expertise of those who came before me (for good reason!) and strove to emulate the methodologies they employed. As the study unfolded, however, I found that many of the methods I emulated were not working for me or for my participants. The methodological quandary that caused the most stress involved the ways in which researchers typically document participants' personal information, especially their sexual orientation.

One aspect that makes bisexuality so elusive is the array of terms used to describe non-monosexual identities and behaviors. People who identify as non-monosexual may use terms other than bisexual depending on the context. On the one hand, non-monosexual people may use terms such as gay, lesbian, or queer to indicate political solidarity with lesbian and gay people. On the other hand, non-monosexual people may use terms such as pansexual, polysexual, queer, or bisexual interchangeably in their personal lives depending on how they perceive the immediate interactional context and/or political leanings or in-group knowledge of their inter-

locutor(s)[2]. For example, one individual who participated in this study wrote 'queer[3]' rather than choosing one of the pre-selected terms to describe their sexuality. Another individual wrote 'asexual biromantic[4]', and yet another wrote 'straight demisexual[5]'. In the end, I chose to not use any of these individuals' data because I could not easily categorize them as bisexual or otherwise in accordance with the conventions of the field. However, I also did not interview the participants whose data I did use about why they chose specific terms for themselves; it is entirely possible that they use a number of terms to describe themselves and simply chose a particular term because the situation required it. Reflecting on this possibility, the fluidity of sexual identity raises the question of whether individuals categorized as gay or straight use those terms all the time or if there are other terms they believe are more accurate. To be clear, I am certainly not arguing that researchers should be skeptical of how their participants self-identify. Rather, my intention is to draw attention to the processes, and the ideologies embedded in those processes, that researchers use to elicit personal information from their participants. In a community as understudied in linguistics as bisexuals, it is critical to understand not only what terms individuals use to categorize themselves but also why they select certain terms over others, because this informs how they experience life as non-monosexual people, and in turn, informs our understanding of their social practice.

## 6. Conclusion

This thesis makes three important contributions to the language, gender, and sexuality literature: (1) bisexual speakers are not easily categorized with lesbian/gay or straight speakers, and as such bisexuals should occupy a distinct category, (2) bisexuals' /s/ production does not pattern uniformly amongst themselves, and (3) the lack of uniformity among the bisexual speak-

[2]However, these terms may also be used to differentiate between distinct non-monosexual identities.

[3]The term *queer* is used to capture multiple aspects of various LGBTQIA+ identities (LGBTQIA Glossary, n.d.). It is not clear how this particular participant understands queer or why they identify with that term.

[4]The term *asexual* describes a sexual orientation characterized by the lack of sexual desire or attraction, whereas *biromantic* refers to a romantic orientation characterized by attraction to two or more genders (LGBTQIA Glossary, n.d.).

[5]*Demisexual* refers to a sexual orientation in which "someone feels sexual attraction only to people with whom they have an emotional bond" (LGBTQIA Glossary, n.d.).

ers is potentially explained by the different ways in which bisexual women and men experience the intersection of sexuality and gender normativity. In addition, I have cast a bisexual lens on methods for data collection and experimental design, drawing attention to practices that erase speakers who are not categorized as lesbian/gay or straight. There is a great need for further investigation beyond this thesis, particularly in regards to the role of speech rate and token position in analyses of duration vis-à-vis gender and sexuality, as well as the speech production of bisexual men. My hope for this thesis is that it will increase the visibility and inclusion of bisexual people in linguistics, not only through a description of bisexuals' speech, but also by attending to the ways in which bisexual people are marginalized by the methodological and theoretical underpinnings of the field.

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