Published in final edited form as:

J Phon. 2015 September ; 52: 13–25. doi:10.1016/j.wocn.2015.04.001.

Judgments of self-identified gay and heterosexual male speakers: Which phonemes are most salient in determining sexual orientation?

Erik C. Tracy[a,*], **Sierra A. Bainter**[b], and **Nicholas P. Satariano**[c]

[a]Department of Psychology, University of North Carolina at Pembroke, PO Box 1510, Pembroke, NC 28372, USA

[b]Department of Psychology, The University of North Carolina at Chapel Hill, 235 East Cameron Avenue, Chapel Hill, NC 27599, USA

[c]Department of Psychology, The Ohio State University, 1835 Neil Avenue, Columbus, OH 43210, USA

Abstract

While numerous studies have demonstrated that a male speaker's sexual orientation can be identified from relatively long passages of speech, few studies have evaluated whether listeners can determine sexual orientation when presented with word-length stimuli. If listeners are able to distinguish between self-identified gay and heterosexual male speakers of American English, it is unclear whether they form their judgments based on a phoneme, such as a vowel or consonant, or multiple phonemes, such as a vowel and a consonant. In this study, we first found that listeners can distinguish between self-identified gay and heterosexual speakers of American English upon hearing word-length stimuli. We extended these results in a separate experiment to demonstrate that listeners primarily rely on vowels, and to some extent consonants, when forming their judgments. Listeners were able to differentiate between the two groups of speakers for each of the vowels and three of the seven consonants presented. In a follow-up experiment we found evidence that listeners' judgments improved if they were presented with multiple phonemes, such as a vowel and /s/. These results provide important information about how different phonemes can provide discriminant information about a male speaker's sexual orientation.

Keywords

Indexical characteristics; Sexual orientation; Gay and heterosexual male speech; Vowels and consonants; Sociophonetics

1. Introduction

It has been established that upon hearing a spoken utterance, listeners are able to identify many of the speaker's personal, or indexical, characteristics. For example, listeners are able to distinguish between male and female speakers of American English (Bachorowski &

*Corresponding author. Tel.: +1 910 775 4512; fax: +1 910 521 6518. erik.tracy@uncp.edu (E.C. Tracy).

Owren, 1999) and British English (Whiteside, 1998). A similar result was also found for speakers of American English who were African-American and European-American (Thomas, Lass, & Carpenter, 2010; Thomas & Reaser, 2004; Walton & Orlikoff, 1994).

Additionally, listeners are able to identify more subtle indexical characteristics, such as sexual orientation. Numerous perceptual studies have discovered that listeners can accurately identify the self-stated sexual orientation of male speakers who speak American English (Gaudio, 1994; Linville, 1998; Munson, McDonald, DeBoe, & White, 2006), male speakers who speak Canadian English (Smyth, Jacobs, & Rogers, 2003), and female speakers who speak American English (Moonwomon-Baird, 1997). Specifically these early perceptual studies (Gaudio, 1994; Linville, 1998; Smyth et al., 2003) discovered that listeners distinguished between gay and heterosexual male speakers after hearing a relatively long speech segment that ranged in length from 15 to 90 s. A more recent investigation (Munson et al., 2006) demonstrated a similar result with spoken utterances that had a shorter duration of three monosyllabic words. This finding suggests that sexual orientation can be identified with a relatively small amount of acoustic information. It is unclear whether listeners are able to make this identification with even less acoustic information.

The first purpose of the current study was to determine whether listeners can distinguish between self-identified heterosexual male talkers of American English and self-identified gay male talkers of American English when presented with word-length stimuli. We expected that our findings would align with previous studies (Munson et al., 2006). The second purpose was to investigate which acoustic cues, such as vowels or consonants, listeners rely on when forming their judgments. Furthermore, this study investigated whether listeners rely on a single phoneme or multiple phonemes when differentiating between gay and heterosexual male speakers.

1.1. Vowels

Experimental evidence indicates that gay and heterosexual male talkers of both American English (Munson et al., 2006; Pierrehumbert, Bent, Munson, Bradlow, & Bailey, 2004) and Canadian English (Rendell, Vasey, & McKenzie, 2008) tend to produce certain vowels differently. These three investigations found production differences with /æ/, as in *gas*, whereas results for other vowels were inconsistent. Pierrehumbert et al. (2004) found that gay and heterosexual men produced /ɑ/, as in *box*, and /i/, as in *feet*, differently, while Rendall et al. (2008) found differences among /iː/, /ʌ/, as in *but*, /oʊ/, as in *boat*, /uː/, as in *boot*, and /ə/, as in *the*. Munson et al. (2006) found differences for /ɛ/, as in *bell*. Furthermore, it is hypothesized that listeners rely on these production differences when identifying a speaker's sexual orientation. Munson et al. (2006) discovered that listeners were better at differentiating between gay and heterosexual male speakers when they heard a series of words that contained low front vowels compared with a series of words that included back vowels. Moreover, the researchers posited that the *F*1 frequency of low front vowels and the *F*2 frequency of back vowels influenced listeners' judgments. Listeners' sexual orientation judgments may be influenced by a wide-range of vowels.

1.2. Consonants

Theorists have argued that while much of the work in the field of sociophonetics has focused on vowels, additional attention should be directed to consonants (Hay & Drager, 2007; Thomas, 2002). With respect to sexual orientation, numerous researchers have concluded that self-identified gay and heterosexual male speakers of American English tend to produce /s/ differently. The stereotypical gay male voice exhibits longer /s/ durations (Crist, 1997) and the spectra of /s/ produced by gay men is more negatively skewed compared with that of heterosexual men (Munson et al., 2006). It is presumed that listeners may also rely on these acoustic differences when determining the sexual orientation of male speakers. For example, listeners' identification of gay speakers is strongly predicted by higher peak /s/ frequency values and longer /s/ durations (Linville, 1998), and /s/ skewness has been shown to influence sexual orientation judgments (Munson et al., 2006). It has also been demonstrated that speakers are perceived as gay when utterances included non-canonical variants of /s/, such as a frontally misarticulated token of /s/ (Mack & Munson, 2012). While these investigations provide evidence that gay and heterosexual male speakers produce /s/ differently and listeners are relying on these acoustic differences when distinguishing between these speakers, it remains unclear whether listeners are relying on other consonants when forming their judgments.

1.3. Multiple acoustic cues

While listeners may rely on individual phonemes to identify a speaker's indexical characteristics (Linville, 1998; Mack & Munson, 2012; Munson et al., 2006), it has also been argued (Campbell-Kibler, 2007, 2011; Thomas, 2002; Thomas et al., 2010) that listeners tend to rely on several acoustic cues, such as segmental quality and prosody, and not a single cue, when determining a speaker's indexical characteristics. With respect to sexual orientation, Campbell-Kibler (2007, 2011) asserted that features such as pitch, differences in production of /s/ and /z/, and the English variable (ING) helped listeners distinguish between gay and heterosexual male talkers of American English. The *–ing* variant enhances the perceived strength of a gay-sounding accent (Campbell-Kibler, 2007), and utterances that contain fronted /s/ and /z/ tokens, compared with mid and backed tokens, increase the perception of gayness (Campbell-Kibler, 2011). Finally, a complex picture emerges when listeners describe speech containing fronted and backed tokens of /s/ along with *–ing*. When presented with utterances including backed /s/ tokens, listeners rate male speakers as unintelligent, masculine, and heterosexual. When presented with utterances including fronted /s/ tokens and the *–ing* variant, listeners rate male speakers as more intelligent, effeminate, and gay (Campbell-Kibler, 2011). It is likely that listeners are basing their sexual orientation judgments on several acoustic cues.

1.4. Research questions

The first research question we investigated in the present study was whether listeners can differentiate between self-identified gay and heterosexual male talkers of American English when presented with word-length stimuli. We addressed this question in Experiment 1. The second research question was to identify which acoustic cues listeners rely on when identifying the sexual orientation of the male speakers. Experiment 2 investigated whether

listeners could rely on a single phoneme, such as a vowel or consonant, when forming their judgments, while Experiment 3 addressed whether listeners relied on multiple phonemes when forming their judgments.

2. Experiment 1

Our purpose in Experiment 1 was to determine whether listeners can distinguish between self-identified gay and heterosexual male speakers of American English upon hearing word-length stimuli. To accomplish this objective, speech samples were collected from gay and heterosexual male speakers. Next, participants indicated whether the speaker sounded gay or heterosexual upon hearing word-length stimuli. We hypothesized that listeners would be able to make this determination based on findings from previous studies (Munson et al., 2006).

2.1. Method

2.1.1. Preparation of the stimuli

2.1.1.1. Speakers: Thirty-six male speakers were recruited (18 self-identified heterosexual speakers and 18 self-identified gay speakers) from a variety of locations, including the Ohio State University campus and the Columbus, Ohio metropolitan area. To control for regional dialects, all speakers indicated that they were native speakers of American English who lived primarily in the state of Ohio. None of the speakers reported a history of speech or hearing disorders. All of the heterosexual speakers and five gay speakers were selected from an introductory psychology course. In exchange for their participation, they received course credit. Six gay speakers enlisted because they were acquaintances of the researchers, and an additional seven gay speakers were recruited from local LGBT organizations after reading about the study in a regional LGBT publication. These 13 speakers each received $10.00 for their participation.

The mean age of the speakers was 20.0 years (Range=[18–24]). The mean age for heterosexual speakers was 18.8 years (Range=[18–21]) and the mean age for gay speakers was 21.1 years (Range=[18–24]). Furthermore, the mean height for all speakers was 176.8 cm (Range=[168–183]). The mean height for heterosexual speakers was 177.0 cm (Range=168–183]) and the mean height for gay speakers was 175.3 cm ([Range=170–183]). The speakers' heights in the current experiment were similar to the speakers' heights in Linville (1998).

2.1.1.2. Stimuli: A list of 100 words was created for speakers to read aloud. Of these 100 words, 20 were target items, which were common monosyllabic words that follow a CVC pattern. The target items for Experiment 1 appear in the first column of Table 1. The remaining 80 filler items consisted of 14 monosyllabic words, 33 bisyllabic words, and 33 trisyllabic words. Examples of filler items include *pipe*, *absent*, and *cigarette*.

2.1.1.3. Design: Prior to the experiment, the list of 100 items was randomized. The list of items was presented three times to each speaker. The order of the items was the same across the three repetitions, and each speaker read the entire list of items in the same order.

2.1.1.4. Procedure for speakers: Individual speakers read the list of words into a head-mounted microphone in a sound-treated room. Individual words appeared on a computer screen in front of the speakers and they were instructed to read the word aloud. After the experiment was finished, they were debriefed and allowed to ask questions. The experiment lasted approximately 30 min. The recordings were stored as individual speech files on a computer.

During the recording session, we discovered that speakers were initially nervous when speaking into the microphone, which resulted in unnatural-sounding speech tokens. However, after speakers became comfortable with the procedure, they produced more natural-sounding speech tokens. Therefore, most of the words presented to listeners in Experiment 1 were taken from the second or third time that the speaker produced the word.

2.1.2. Presentation of the stimuli

2.1.2.1. Participants: Eighty-four students who were taking an introductory psychology course at the Ohio State University participated in the study and received course credit. Their mean age was 18.9 years (Range=[18–30]). Every participant self-reported as a native speaker of American English and none reported a history of speech or hearing disorders. All but one of the participants self-identified as heterosexual and the remaining listener self-identified as bisexual.

2.1.2.2. Design: To accomplish the objective of Experiment 1, the 720 speech tokens (36 speakers×20 words) were divided among five different experimental lists, which each contained 144 items (36 speakers×4 words). Within each list, there was at least one /s/-initial word, one /s/-final word, and one word that did not contain /s/. For example, *back*, *niece*, *sad*, and *safe* were included in List 1. Additionally, five practice lists were paired with each of the experimental lists. The practice lists contained a single word from all 36 speakers and the words used in the practice list were not repeated in the paired experimental list. Both the practice and experimental items were presented in a random order. There were 17 or 18 participants assigned to each list.

2.1.2.3. Procedure for participants: Participants were brought to a sound-treated room and seated in front of a computer monitor and a button board with seven choices. They were instructed to listen carefully to the words over a set of headphones and, after hearing each utterance, to indicate the sexual orientation of the speaker by pressing one of the buttons. Responses ranged from 1 (which corresponded to *this speaker is heterosexual sounding*) to 7 (which corresponded to *this speaker is gay sounding*). Participants were encouraged to use the entire scale, even though only the end points of the scale were labeled, and to respond as quickly as possible. They were allotted 2.5 s to respond to each trial. If a participant did not respond in the allotted amount of time, the experiment continued on to the subsequent trial. At the conclusion of the experiment, they were debriefed and allowed to ask questions. The entire experiment lasted approximately 45 min. Previous researchers (Gaudio, 1994; Munson et al., 2006; Mack & Munson, 2012) employed a similar procedure.

2.2. Results

The data were analyzed to investigate whether listeners could distinguish between gay and heterosexual speakers upon hearing word-length stimuli. The average rating for the gay speakers was 4.42 (*SD*=0.45) and the average rating for the heterosexual speakers was 3.45 (*SD*=0.39). To evaluate group differences in ratings for all speakers, we used hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002) to predict listener ratings of each stimulus. The effect of speaker orientation (coded 0=heterosexual, 1=gay) was included as a fixed effect, and random effects for listener, speaker, and word were included to account for dependent ratings given by the same listener, for the same speaker, or for the same word. The random effects also allowed for different means for each word, speaker, and listener. Additionally, we included random effects of speaker orientation for listeners and words. The listener ratings were cross-classified by words and speakers, and this was accounted for in the analysis. Ratings were centered at 4, the midpoint of the scale, meaning a speaker sounds neither gay nor heterosexual. All models were run using Proc Mixed in SAS software version 9.3 using restricted maximum likelihood and the containment method for computing denominator degrees of freedom (SAS Institute Inc., 2012).

A model summary for Experiment 1 is displayed in Table 2. Because the ratings were on a seven-point ordinal scale and HLM assumes conditional normality of the model residuals as well as homogeneity of variance across levels of predictors, we examined residual plots for this model and all subsequent analyses in this paper. For all models, the residuals very closely approximated a normal distribution and we found no evidence of heterogeneous variance.

Using the heterosexual speakers as the reference group, the coefficient representing the difference of 0.97 between the gay and heterosexual speakers was significant, $t(15)=2.70$, $p<0.02$, consistent with our hypotheses. The intercept estimate $\beta=-0.55$ was also significant, reflecting that the mean rating of the heterosexual speakers was significantly less than 4, $t(15)=-2.15$, $p<0.049$.

Additionally, all of the random effects included were significant, meaning there was significant variability in ratings among speakers, among listeners, and among the different words. The significant random effects for gay versus heterosexual speakers at the level of listeners and at the level of words mean that the effect of speaker orientation differed among listeners and among words.

2.3. Discussion

The results confirmed our initial prediction: listeners could differentiate between self-identified gay and heterosexual speakers of American English upon hearing word-length stimuli. The present results, which support recent experiments (Munson et al. 2006), suggest that listeners need very little acoustic information to distinguish between gay and heterosexual speakers of American English. However, it is unclear which phonemes listeners use to form their judgments. Listeners may be able to distinguish based on single phonemes, such as a vowel or consonant. This idea was investigated in Experiment 2.

3. Experiment 2

The purpose of Experiment 2 was to determine which phonemes, such as a vowel or consonant, listeners rely on when forming their sexual orientation judgments. Furthermore, in this experiment, we investigated whether listeners could differentiate between self-identified gay and heterosexual male speakers of American English upon hearing a single phoneme. To accomplish this objective, participants heard a vowel or a consonant, and then indicated whether the speaker sounded gay or heterosexual. Prior studies have shown that gay and heterosexual male speakers tend to produce certain vowels (Munson et al., 2006; Pierrehumbert et al., 2004; Rendell et al., 2008) and /s/ differently (Crist, 1997; Linville, 1998; Munson et al., 2006). It has also been demonstrated that listeners rely on vowels (Munson et al., 2006) and /s/ (Linville, 1998; Munson et al., 2006) to form their sexual orientation judgments. Therefore, we hypothesized that listeners would be able to differentiate between highly characteristic gay speech and highly characteristic heterosexual speech upon hearing a phoneme, and listeners would rely on vowels and /s/ to form their decisions. Predictions about consonants other than /s/ were not clear in advance from the literature.

3.1. Method

3.1.1. Participants—Twenty-three students who were taking an introductory psychology course at the Ohio State University participated in the study and received course credit. Their mean age was 18.57 (Range=[18–21]). All of the participants self-reported as native speakers of American English and none reported a history of speech or hearing disorders. Twenty-two participants self-identified as heterosexual and the remaining participant declined to reveal their sexual orientation.

3.1.2. Stimuli—It is likely that listeners are better able to distinguish between gay and heterosexual male speakers from hearing word-length stimuli compared to hearing a single phone. Furthermore, as discussed in Kulick (2000), there is a wide range of gay speech. Some self-identified gay male speakers are easily recognized as gay and other self-identified gay speakers are primarily recognized as heterosexual. The same is likely true for self-identified heterosexual male speakers. Therefore, based on the results of Experiment 1, the stimuli that were used in Experiment 2 were utterances produced by the six gay speakers who had the highest average ratings (closest to the *this speaker is gay sounding* end of the scale) and the six heterosexual speakers who had the lowest average ratings (closest to the *this speaker is heterosexual sounding* end of the scale).

To identify those phonemes that listeners use to determine a speaker's sexual orientation, many of the phonemes included in the target items from Experiment 1 were used in this experiment. As shown in the second column of Table 1, seven consonants and seven vowels were selected. The consonants included approximants, fricatives, and nasals, which had relatively long durations. Plosives were not used because it was assumed the durations of these utterances were too short for listeners to be able to make a judgment.

To create the speech files, 14 different phones from the 12 selected speakers were cut from their respective words. One of two different methods was used to determine the boundaries

between vowels and sonorants. First, the researchers found a clear transition from where the sonorant ended and the vowel began (or vice versa). If a clear transition was not present, a second method was used. One speech segment was found that contained the entire sonorant and a second speech segment was found that contained the entire vowel. Portions of the two segments overlapped and we used the midpoint of the overlapping area to determine the boundary between the sonorant and vowel.

3.1.3. Design—To accomplish the objective of Experiment 2, we presented the 168 utterances (12 speakers X 14 phones) to participants. In addition, we presented 48 practice items and, to limit the tendency of participants to form preconceived notions about the selected speakers, the practice items were phones from the speakers not selected for Experiment 2. Both the practice and experimental trials were presented in a random order.

3.1.4. Procedure—The procedure for Experiment 2 was identical to the procedure for Experiment 1.

3.2. Results

The average ratings for gay speakers were 5.21 (*SD*=0.53) for vowels and 4.14 (*SD*=0.38) for consonants. For heterosexual speakers, the average rating for vowels was 3.15 (*SD*=0.56) and 3.50 (*SD*=0.37) for consonants. These results are presented in Fig. 1. To investigate whether listeners could distinguish between highly characteristic gay and heterosexual male speakers of American English upon hearing a phone, such as a consonant or vowel, we used an HLM approach similar to that used for Experiment 1.

We fit an HLM to predict ratings from speaker orientation, phoneme type (coded vowel=1, consonant=0), and the interaction between sexual orientation and phoneme type. As in Experiment 1, we centered ratings at 4 to provide an interpretable zero point. Fixed effects were also included to account for each of the specific phonemes. We included random effects for listener and speaker to allow variability among each of these levels. We also included random slopes for phoneme type (vowel versus consonant) at the level of listener and speaker. Additionally, a random slope for gay versus heterosexual speakers and the interaction of this effect with vowel were included at the level of listener. All of these random slopes allowed the respective effects to differ among speakers and listeners. This model is summarized in Table 3.

We found that the interaction between orientation and phoneme type was significant, $t(22)=4.31$, $p<0.001$. This interaction effect, which is evident in the data plotted in Fig. 1, demonstrates that the difference in ratings between gay and heterosexual speakers was more pronounced for vowels than for consonants. Consistent with our hypotheses that ratings would be consistently higher for vowels, but not necessarily for consonants, we first probed this interaction by examining the interaction between speaker orientation and phoneme separately for vowels and consonants. This contrast and all follow-up contrasts were done within the estimated model.

We found that the interaction was not significant for vowels, $F(6, 3681)=1.34$, $p=0.24$, while the main effect of speaker orientation, $F(8, 128)=19.58$, $p<0.001$, was significant. On

average, listener ratings were higher when the speaker was gay, and the nonsignificant interaction demonstrated that the listeners rated gay speakers higher consistently across vowels. This can be seen in Fig. 2.

Whereas listeners consistently gave gay speakers higher ratings when presented with vowels, this was not the case for consonants. The interaction between consonant and sexual orientation was significant, $F(6, 70)=7.13$, $p<0.001$. To understand this interaction, we performed follow-up contrasts to test for differences in ratings by speaker orientation for each individual consonant. These tests revealed marginally significant differences in ratings for gay and heterosexual speakers for three of the seven consonants, with *p*-values unadjusted for multiple comparisons: /l/ ($t(3787)=2.18$, $p=0.029$), /n/ ($t(3787)=2.12$, $p=0.033$), and /s/ ($t(3787)=2.62$, $p<0.009$). However upon using the Benjamini-Hochberg false discovery rate correction, these effects miss the threshold for significance (Benjamini & Hochberg, 1995). The remaining four consonants did not have significantly different ratings between the gay and heterosexual speakers: /m/ ($t(3787)=0.16$, $p=0.87$), /f/ ($t(3787)=-1.41$, $p=0.16$), /v/ ($t(3787)=-0.43$, $p=0.66$, and /w/ ($t(3787)=1.77$, $p=0.078$). As shown in Fig. 3, all noticeable differences reflected higher ratings for the gay speakers.

3.3. Discussion

The results confirmed that listeners differentiated between highly characteristic gay and heterosexual speakers upon hearing a phoneme. However, discriminability was strongest after hearing a vowel, but inconsistent after hearing a consonant. Consistent with this finding, other researchers (Munson et al., 2006; Pierrehumbert et al., 2004; Rendell et al., 2008) concluded that self-identified gay and heterosexual men tended to produce /æ/, /ɑ/, /i/, /iː/, /ʌ/, /oʊ/, /uː/, /ə/, and /ɛ/ differently. All of these vowels, except /i/, /ʌ/, and /ə/, were included in the present experiment. Moreover, Munson et al. posited that listeners' judgments were more accurate after hearing a series of words that included low front vowels compared to a series of words that included back vowels. Listeners in the current experiment were able to distinguish between gay and heterosexual speakers when presented with each of the seven vowels, which included high and low back vowels (/uː/ and /ɝ/ respectively). Therefore, the results of the current study extend the findings of Munson et al. Listeners relied on a wide-range of vowels when judging the sexual orientation of speakers. Furthermore, we hypothesize that if /i/, /ʌ/, and /ə/ were included in the experiment, listeners would be able to discriminate between gay and heterosexual speakers using these vowels.

Results for the consonants were not as consistent. Of the seven consonants investigated, there was some limited evidence that three consonants resulted in significant rating differences for gay and heterosexual speakers, /l/, /n/, and /s/. While previous studies (Linville, 1998; Mack & Munson, 2012; Munson et al., 2006) discovered that listeners rely on /s/ to differentiate between gay and heterosexual speakers, the present findings tentatively extend these past results and suggest that listeners might use additional phonemes, such as /l/ and /n/, to form their judgments. However, the four remaining consonants (/f/, /m/, /v/, and /w/) did not result in significant rating differences for gay and heterosexual speakers.

With respect to /s/, listeners' ratings tended to increase upon hearing /s/, whether it was produced by a gay or heterosexual speaker. For instance, the average rating for /s/ produced

by a gay speaker was 5.28 and the average rating for /s/ produced by a heterosexual speaker was 4.13. This suggests that listeners may associate the acoustic characteristics of /s/ with speech produced by gay male talkers.

We can summarize our results with two main conclusions. First, listeners can distinguish between highly characteristic gay and heterosexual speakers of American English upon hearing a phoneme. Second, listeners primarily rely on vowels to form their judgments, but they may also rely on some consonants to a lesser extent. While this experiment only investigated phonemes presented in isolation, other studies (Linville, 1998; Mack & Munson, 2012; Munson et al., 2006) investigated specific phonemes, such as /s/, in the context of a word. As suggested by Campbell-Kibler (2007, 2011), it is likely that listeners base their sexual orientation judgments on several acoustic cues, such as a vowel and a consonant. If they do, listeners' judgments should be able to better distinguish between gay and heterosexual speakers after hearing a consonant and vowel compared with hearing just a consonant. For example, when presented with /m/ from *mass*, listeners would likely not be able to differentiate between gay and heterosexual male speakers. However, when presented with the initial /mæ/, sexual orientation judgments should improve.

4. Experiment 3

The purpose of Experiment 3 was to determine whether listeners tended to rely on multiple acoustic cues when forming their sexual orientation judgments. To accomplish this objective, participants indicated the sexual orientation of a speaker after being presented with one of three variations of a spoken monosyllabic word: the initial consonant (IC), the initial consonant and vowel (ICV), and the entire word. This experimental design is a variation of the gating paradigm employed by Grosjean (1980).

Two hypotheses were tested in the experiment. First, we predicted that participants would primarily rely on vowels when forming their sexual orientation judgments of highly characteristic gay and heterosexual male talkers of American English. Thus, sexual orientation ratings should significantly improve from the IC condition to the ICV condition. Second, since other investigations (Linville, 1998; Mack & Munson, 2012; Munson et al., 2006) have shown that listeners tend to rely on /s/ within the context of a word, to distinguish between gay and heterosexual speakers, we predicted that if participants heard /s/ within the context of a word, judgments should improve.

More specifically, in the current experiment, we predicted that listeners should have an increased ability to distinguish between gay and heterosexual speakers if they heard a vowel and then /s/. Thus, we expected ratings to improve from the ICV condition to the entire word condition if participants were presented with a word-final /s/. For example, listeners' judgments should improve upon hearing /mæs/ compared to /mæ/. If participants were presented with a word-final consonant other than /s/, we did not expect ratings to significantly improve from the ICV to the entire word condition. For instance, a listener's ability to distinguish between gay and heterosexual speakers should not change whether the listener heard /bæ/ or /bæk/.

4.1. Method

4.1.1. Participants—Forty-two students who were taking an introductory psychology course at the Ohio State University participated in the study in exchange for course credit. Their mean age was 19.69 (Range=[18–46]). All of the participants self-reported as a native speaker of American English and none reported a history of speech or hearing disorders. Thirty-six participants self-identified as heterosexual, three participants self-identified as gay, and three participants declined to reveal their sexual orientation.

4.1.2. Stimuli—Utterances produced by the 12 speakers selected for Experiment 2 were included in the present experiment, along with utterances produced by one additional gay and heterosexual speaker. These two additional speakers were chosen based on the results from Experiment 1. After the 12 selected speakers, listeners were best at identifying the sexual orientation of these two speakers.

Eight words from Experiment 1 were selected: *loose*, *mass*, *niece*, *safe*, *sell*, *soon*, *tone*, and *vein*. Note that the eight words include /s/-initial words, /s/-final words, and non-/s/ words. To create the IC condition, the initial consonant was cut from the original word and stored as a separate speech file. Similarly, the initial consonant and vowel were cut from the original word and stored as a separate speech file for the ICV condition. We used the same method to determine the boundary between vowels and sonorants used in Experiment 2. There were a total of 336 utterances (14 speakers×8 words×3 conditions).

4.1.3. Design—Stimuli were divided into two separate lists, similar to the design employed in Experiment 1. List 1 included all of the variations of *mass*, *sell*, *soon*, and *vein*, and List 2 included all of the variations of *loose*, *niece*, *safe*, and *tone*. Each list contained 168 items and 21 participants were assigned to each list. Furthermore, 48 practice items were created for the experiment, and to limit the tendency of participants to form preconceived notions about the selected speakers, the practice items were utterances from the speakers not selected for Experiment 3. Both the practice and experimental items were presented in a random order to participants.

4.1.4. Procedure—The procedure for Experiment 3 was identical to the procedure used in Experiments 1 and 2.

4.2. Results

The results demonstrated that listener responses improved as they heard larger and larger portions of the word if the utterances were produced by heterosexual speakers. For example, the ratings for the IC, ICV, and the entire word condition were 3.54 (*SD*=0.51), 2.65 (*SD*=0.60), and 2.24 (*SD*=0.64) respectively. With regard to the utterances produced by gay speakers, responses improved from the IC to the ICV condition, but the ratings were nearly identical in both the ICV condition and the entire word condition. The ratings for the IC, ICV, and the entire word condition were 4.56 (*SD*=0.42), 5.36 (*SD*=0.43), and 5.35 (*SD*=0.50) respectively. These results are shown in Fig. 4.

To test the two research hypotheses, we used HLM to test the effects of speaker orientation (gay and heterosexual), word variant (IC, ICV, and whole word conditions), and each of the eight words on ratings provided by each listener. Ratings were centered at 4 once again for an interpretable zero point, and the dependence of ratings provided by the same listener or for the same speaker were captured by random intercept effects of listener and speaker. Additionally, we included a random slope effect of speaker orientation at the level of listener. Other random slope effects were tested in the model, however all additional random slopes resulted in estimation problems due to nonsignificant variance. In this model, we included main effects of speaker orientation, word variant, and word, as well as the three-way interaction and all two way interactions between these three variables. The three way interaction was significant, $F(14, 920)=2.46$, $p<0.002$, indicating that the relationship between word variant and speaker orientation depended on the word spoken. This model is summarized in Table 4.

To probe this three-way interaction, we estimated contrasts of the two-way interaction of word variant by speaker orientation for each of three word groups: (1) words that begin with /s/, (2) words that end with /s/, and (3) words that do not contain /s/. All three of these interactions were significant, suggesting that the effect of word variant on ratings depended on speaker orientation in each of the three groups: /s/-initial utterances, $F(2, 920)=75.4$, $p<0.001$, /s/-final utterances, $F(2, 920)=102.85$, $p<0.001$, and non-/s/ utterances, $F(2, 920)=64.4$, $p<0.001$. To understand these effects further, we compared the change in ratings from the IC to the ICV conditions and from the ICV to the entire word conditions separately for gay and heterosexual speakers by word group. To control for multiple comparisons, *p*-values were adjusted using the Benjamini-Hochberg false discovery rate correction (Benjamini & Hochberg, 1995).

As shown in Fig. 5, changes in ratings among word variant conditions (IC, ICV, and whole word) were consistent for heterosexual speakers. The ratings became significantly lower (less gay sounding) from the IC to the ICV conditions for all three groups (/s/-initial utterances, $t(6880)=11.89$, $p<0.001$, /s/-final utterances, $t(6880)=7.52$, $p<0.001$, and non-/s/ utterances, $t(6880)=7.12$, $p<0.001$). The comparison between the ICV and the entire word conditions again revealed significantly improved ratings for all three word groups (/s/-initial utterances, $t(6880)=3.28$, $p<0.013$, /s/-final utterances, $t(6880)=5.12$, $p<0.001$, and non-/s/ utterances, $t(6880)= 4.24$, $p<0.001$). These results are consistent with our first hypothesis. Sexual orientation judgments significantly improved when participants heard a vowel. However, contrary to our expectation, sexual orientation judgments significantly improved from the ICV condition to the entire word condition regardless of whether the word ended in /s/ or another consonant.

For gay speakers, the pattern of ratings across word variant condition was different for each group of words, as shown in Fig. 6. Ratings for /s/-initial utterances improved from the IC to the ICV condition, $t(6880)=-6.30$, $p<0.001$, but ratings did not significantly change upon hearing the word-final consonant, $t(6880)=1.94$, $p=0.052$. For /s/-final utterances, improved between the IC and ICV conditions, $t(6880)=-8.53$, $p<0.001$, and after hearing the word-final /s/, $t(6880)=-4.09$, $p<0.001$. In contrast, ratings for non-/s/ utterances increased from the IC to the ICV conditions, $t(6880)=-9.81$, $p<0.001$, but significantly decreased from the

ICV to the entire word conditions, $t(6880)=3.05$, $p<0.002$. This suggests that listeners' judgments improved when they heard the vowel, but their judgments did not continue to improve upon hearing the word-final consonant.

4.3. Discussion

Our results suggest that listeners in this experiment primarily relied on vowels when forming their sexual orientation judgment. These results are consistent with the results from both Experiment 2 and the work of Munson et al. (2006). It can be argued that listeners primarily rely on vowels, either individually or within the context of an utterance, to distinguish between gay and heterosexual male speakers.

Furthermore, the findings provide additional support to the argument that listeners rely on multiple phonemes when they identify a speaker's sexual orientation (Campbell-Kibler, 2007, 2011). For heterosexual speakers, listener responses improved as they heard greater portions of the utterance. Each additional phone provided the listener with more information that helped to form their sexual orientation judgment. While listeners primarily relied on vowels, the word-final consonant, whether it was /s/ or another consonant, influenced responses.

The pattern of responses for the utterances produced by gay speakers is more complicated. Listeners' responses improved from the IC condition to the ICV condition for the /s/-initial, /s/-final, and non-/s/ utterances. However, for the /s/-initial utterances, our results suggest that upon hearing an /s/ and a vowel, listeners were able to identify the sexual orientation of the speaker, and the word-final consonant did not change their judgment. For non-/s/ utterances, sexual orientation judgments did not improve from the ICV condition to the entire word condition. One possible interpretation of these results is that by forcing listeners to listen to the word-final consonant, this effectively delayed their response. For example, listeners may have formed a judgment concerning the sexual orientation of the speaker after they heard the vowel, but they could not indicate their response until after they heard the consonant. This delay may have caused participants to doubt their initial judgment and thus change their rating upon hearing the word-final consonant. A similar result was found by Rule, Ambady, and Hallett (2009). Here, participants who made relatively quick sexual orientation judgments were more accurate than participants who made relatively slow judgments.

For /s/-final utterances produced by gay speakers, responses improved as listeners heard more of the word. Listeners used the word-final /s/ to distinguish between gay and heterosexual speakers. Previous investigations (Linville, 1998; Mack & Munson, 2012; Munson et al., 2006) came to a similar conclusion. Based on the findings of Experiments 2 and 3, listeners tended to rely on /s/ to distinguish between gay and heterosexual speakers whether /s/ was presented individually or within the context of a word. Furthermore, the results of the present experiment indicate that listeners relied on multiple phonemes, such as vowels and /s/, when they formed their sexual orientation judgments.

It should be noted, however, that there is a confound between the addition of the vowel and the addition of acoustic information in general. It is unclear if listeners' judgments improved

upon hearing the second phone because it was specifically a vowel or because it was an additional phone. Based our findings as a whole, we would predict that the improved judgments were due to the phone being a vowel, but future experiments could provide further insight. For example, if listeners were presented with larger and larger portions of the word *clam* (/k/, /kl/, /klæ/, and /klæm/), we would predict that the addition of the vowel (/æ/) would be more salient to listeners' sexual orientation judgments compared to the addition of the second consonant (/l/).

5. General discussion

5.1. Summary of Experiments 1–3

The first purpose of the present study was to determine whether listeners can distinguish between self-identified gay and heterosexual male speakers of American English upon hearing word-length stimuli, and the results of Experiment 1 indicate that listeners were able to accomplish this task. The second purpose was to identify which phonemes listeners use when forming their sexual orientation judgments. The findings of Experiment 2 demonstrated that listeners relied primarily on vowels when distinguishing between highly characteristic gay and heterosexual speakers. The data from Experiment 3 indicated that listeners relied on multiple phonemes, such as a vowel and /s/, when forming their judgments.

5.2. Implications

The present study builds upon the findings of previous perceptual studies (Gaudio, 1994; Linville, 1998; Munson et al., 2006; Smyth et al., 2003) and extends the findings of Munson et al. who discovered that listeners' sexual orientation judgments were more accurate after hearing a series of words that included low front vowels compared to a series of words that included back vowels. The current results demonstrated that listeners also used both high and low back vowels to form their sexual orientation judgments.

Furthermore, findings from the present study are similar to the results of other sociophonetics investigations (Bachorowski & Owren, 1999; Whiteside, 1998), which found that listeners could accurately identify a speaker's gender upon hearing a single vowel. The current results add to a number of studies that found that listeners tended to rely on vowels to determine a speaker's indexical characteristics.

In addition, the present results are similar to findings from a related line of research. Researchers (Rule & Ambady, 2008; Rule, Ambady, Adams, & Macrae, 2008; Rule et al., 2009) investigated how viewers are able to identify an individual's sexual orientation upon seeing an image of the individual. Rule and Ambady (2008) discovered that viewers accurately distinguished between gay and heterosexual male faces when a still photograph was presented to them for 50 ms. Moreover, viewers relied on specific cues, such as a man's hair (Rule et al., 2008) or a woman's eyes (Rule et al., 2009), to identify an individual's sexual orientation. Considered collectively, the current results and the work of others (Rule & Ambady, 2008; Rule et al., 2008, 2009) suggest that participants are able to identify an individual's sexual orientation when presented with small samples of either visual or acoustic information, relying on certain acoustic and visual cues to form their judgments.

5.3. Future research directions

The results of the current study point to several areas for future experiments. One avenue could investigate which acoustic properties of the vowel are most salient when listeners form their judgments. For example, listeners might rely on vowel duration to distinguish between gay and heterosexual speakers. Utilizing a procedure similar to the one employed by Levon (2006), future investigations could manipulate the duration of a vowel within a word and then test whether listeners identify the speaker as gay or heterosexual. Moreover, it is possible that listeners rely on certain vowel formant frequencies to determine a speaker's sexual orientation. Munson et al. (2006) concluded that listeners relied on the *F*1 frequency of low front vowels and the *F*2 frequency of back vowels when forming their sexual orientation judgments. Future experiments could synthetically manipulate vowel formant frequencies in a series of vowels to determine if listeners' judgments are primarily influenced by one of the two formants or if both formants contribute equally to listeners' decisions.

A second avenue of research could further investigate how listeners use multiple acoustic cues to distinguish between gay and heterosexual speakers. For example, future studies could examine whether listeners are better able to distinguish between gay and heterosexual speakers when presented with a multisyllabic word, which contains more vowels, compared to a monosyllabic word, which contains one vowel. For example, listeners' performance on this task might be better upon hearing *above* compared to *tone*. Furthermore, based on our findings, it is probable that words containing numerous vowels and multiple instances of /s/ (*upsets*) would result in improved judgments compared to words containing a single vowel and no instances of /s/ (*back*).

5.4. Summary

The present study investigated how listeners were able to distinguish between self-identified gay and heterosexual male speakers of American English. We found that listeners were able to distinguish between these two groups of speakers upon hearing word-length stimuli. Furthermore, we found evidence that listeners primarily rely on vowels when forming their judgments. Finally, listeners also used multiple phonemes, such as a vowel and /s/, to identify a speaker's sexual orientation.

Acknowledgments

The authors are indebted to Kelly Charlton, Jen Hay, Keith Johnson, Benjamin Munson, Mark Pitt, Jeff Parise, Shilpa Regan, Corey White, Chris Wiesen and four anonymous reviewers for their assistance and suggestions during various phases of this project.

References

Bachorowski J, Owren MJ. Acoustic correlates of talker sex and individual talker identity are present in a short vowel segment produced in running speech. Journal of the Acoustical Society of America. 1999; 106:1054–1063. [PubMed: 10462810]

Benjamini Y, Hochberg Y. Controlling the false discovery rate: A practical and powerful approach to multiple testing. Journal of the Royal Statistical Society Series B (Methodological). 1995; 57(1): 289–300.

Campbell-Kibler K. Accent, (ing), and the social logic of listener perceptions. American Speech. 2007; 82(1):32–64.

Campbell-Kibler K. Intersecting variables and perceived sexual orientation in men. American Speech. 2011; 86(1):52–68.

Crist S. Duration of onset consonants in gay male stereotyped speech. U. Penn working papers in linguistics. 1997; 4.3:53–69.

Gaudio RP. Sounding gay: Pitch properties in the speech of gay and straight men. American Speech. 1994; 69(1):30–57.

Grosjean F. Spoken word recognition processes and the gating paradigm. Perception & Psychophysics. 1980; 28(4):267–283. [PubMed: 7465310]

Hay J, Drager K. Sociophonetics. Annual Review of Anthropology. 2007; 36:89–103.

Kulick D. Gay and lesbian language. Annual Review of Anthropology. 2000; 29:343–385.

Levon E. Hearing “gay”: Prosody, interpretation, and the affective judgments of men’s speech. American Speech. 2006; 81(1):56–78.

Linville SE. Acoustic correlates of perceived versus actual sexual orientation in men’s speech. Folia Phoniactrica et Logopaedica. 1998; 50:35–48.

Mack S, Munson B. The influence of /s/ quality on ratings of men’s sexual orientation: Explicit and implicit measures of the ‘gay lisp’ stereotype. Journal of Phonetics. 2012; 40:198–212.

Moonwomon-Baird, B. Toward the study of lesbian speech. In: Livia, A.; Hall, K., editors. Queerly phrased. New York: Oxford University Press; 1997. p. 202-213.

Munson B, McDonald EC, DeBoe NL, White AR. The acoustic and perceptual basis of judgments of women and men’s sexual orientation from read speech. Journal of Phonetics. 2006; 34:202–240.

Pierrehumbert JB, Bent T, Munson B, Bradlow AR, Bailey JM. The influence of sexual orientation on vowel production. Journal of the Acoustical Society of America. 2004; 116(4):1905–1908. [PubMed: 15532622]

Raudenbush, SW.; Bryk, AS. Hierarchical linear models: Applications and data analysis methods. 2. Thousand Oaks, CA: Sage Publications, Inc; 2002.

Rendall D, Vasey PL, McKenzie J. The Queen’s English: An alternative, biosocial hypothesis for the distinctive features of “gay speech”. Archives of Sexual Behavior. 2008; 37:188–204. [PubMed: 18085431]

Rule NO, Ambady N. Brief exposures: Male sexual orientation is accurately perceived at 50 ms. Journal of Experimental Social Psychology. 2008; 44:1100–1105.

Rule NO, Ambady N, Adams RB, Macrae CN. Accuracy and awareness in the perception and categorization of male sexual orientation. Journal of Personality and Social Psychology. 2008; 95(5):1019–1028. [PubMed: 18954191]

Rule NO, Ambady N, Hallett KC. Female sexual orientation is perceived accurately, rapidly, and automatically from the face and its features. Journal of Experimental Social Psychology. 2009; 45:1245–1251.

SAS Institute Inc. SAS/STAT user’s guide: Version 9. Vol. 3. Cary, NC: SAS Institute, Inc; 2012.

Smyth R, Jacobs G, Rogers H. Male voices and perceived sexual orientation: An experimental and theoretical approach. Language in Society. 2003; 32:329–350.

Thomas ER. Sociophonetic applications of speech perception experiments. American Speech. 2002; 77(2):115–147.

Thomas, ER.; Lass, NJ.; Carpenter, J. Identification of African American speech. In: Preseton, DR.; Niedzielski, N., editors. A reader in sociophonetics. New York, NY: Walter de Gruyter, Inc; 2010. p. 265-285.

Thomas ER, Reaser J. Delimiting perceptual cues used for the ethnic labeling of African American and European American voices. Journal of Sociolinguistics. 2004; 8(1):54–87.

Walton JH, Orlikoff RF. Speaker race identification from acoustic cues in the vocal signal. Journal of Speech and Hearing Research. 1994; 37:738–745. [PubMed: 7967558]

Whiteside SP. Identification of a speaker’s sex: A study of vowels. Perceptual and Motor Skills. 1998; 86:579–584. [PubMed: 9638758]

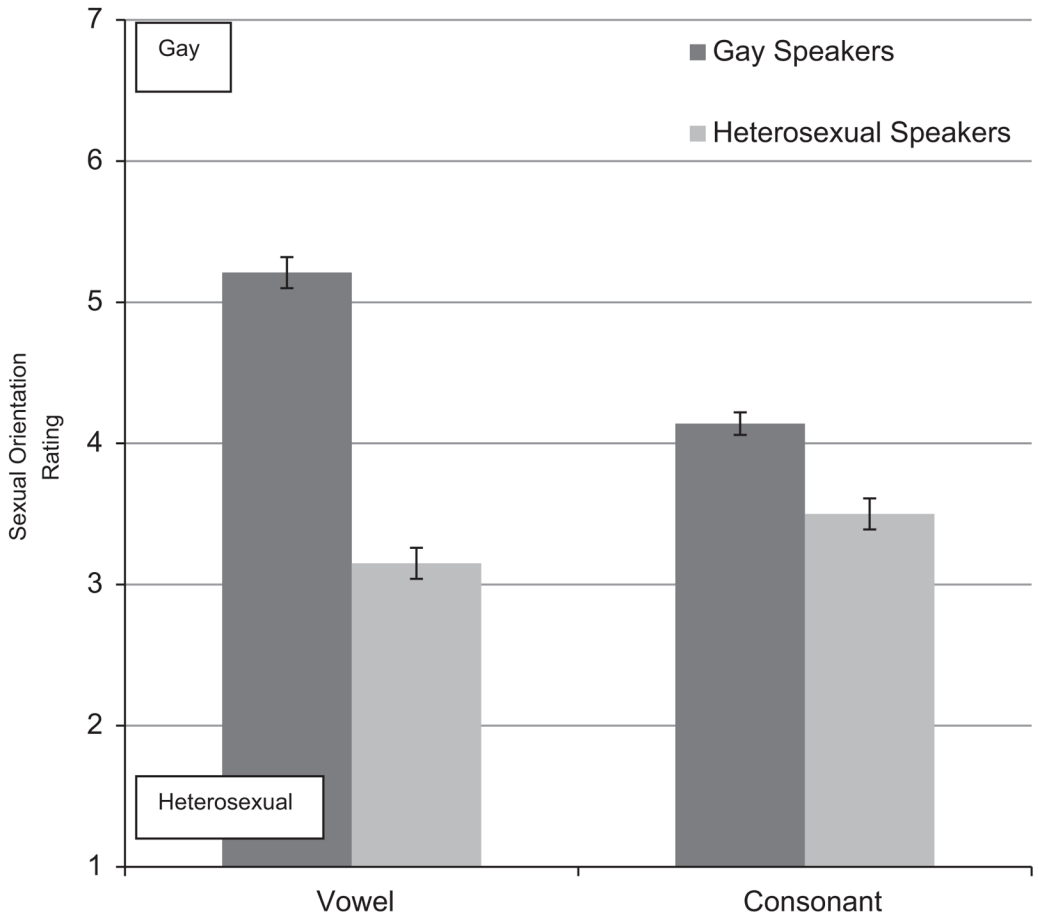

Fig. 1.

Confidence ratings represent how listeners identified the sexual orientation of a speaker upon hearing either a vowel or consonant in Experiment 2. A rating of 7 indicates that the listener identified the speaker as sounding gay and a rating of 1 indicates that the listener identified the speaker as sounding heterosexual. Error bars represent one standard error of measurement.

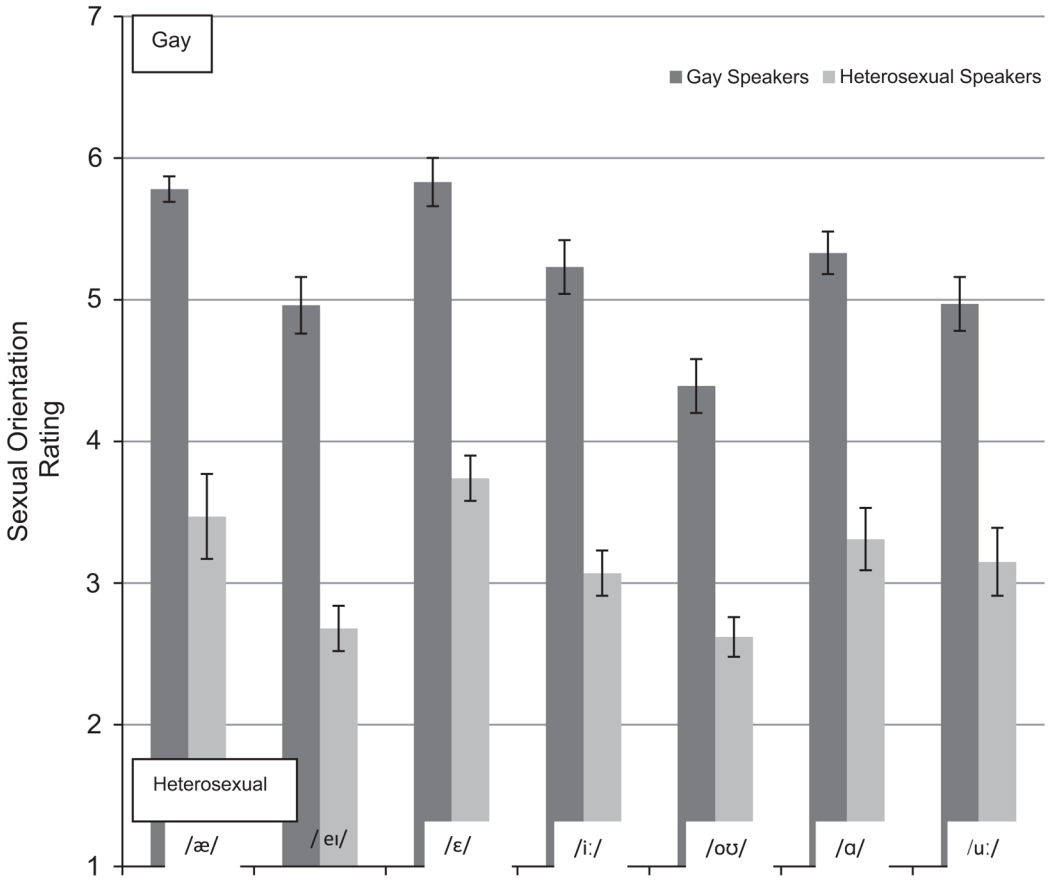

Fig. 2.

Confidence ratings represent how listeners identified the sexual orientation of a speaker upon hearing a vowel in Experiment 2. For each of the seven vowels, there was a significant difference in the rating for the gay and heterosexual speakers. A rating of 7 indicates that the listener identified the speaker as sounding gay and a rating of 1 indicates that the listener identified the speaker as sounding heterosexual. Error bars represent one standard error of measurement.

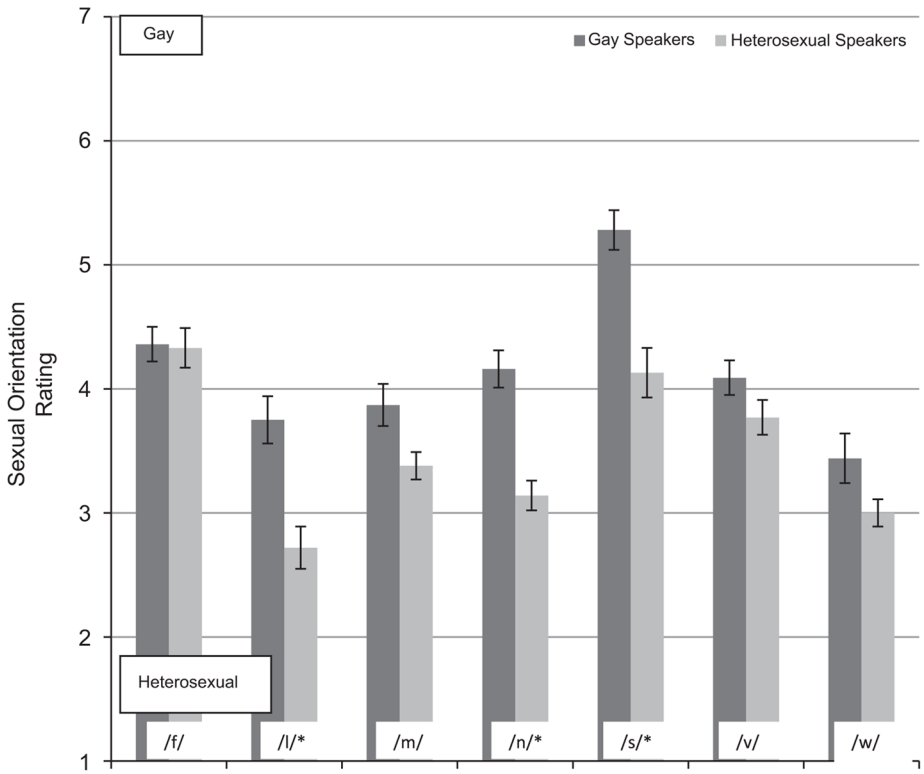

Fig. 3.

Confidence ratings represent how listeners identified the sexual orientation of a speaker upon hearing a consonant in Experiment 2. An asterisk represents that there is a significant difference in the rating for the gay and heterosexual speakers. A rating of 7 indicates that the listener identified the speaker as sounding gay and a rating of 1 indicates that the listener identified the speaker as sounding heterosexual. Error bars represent one standard error of measurement.

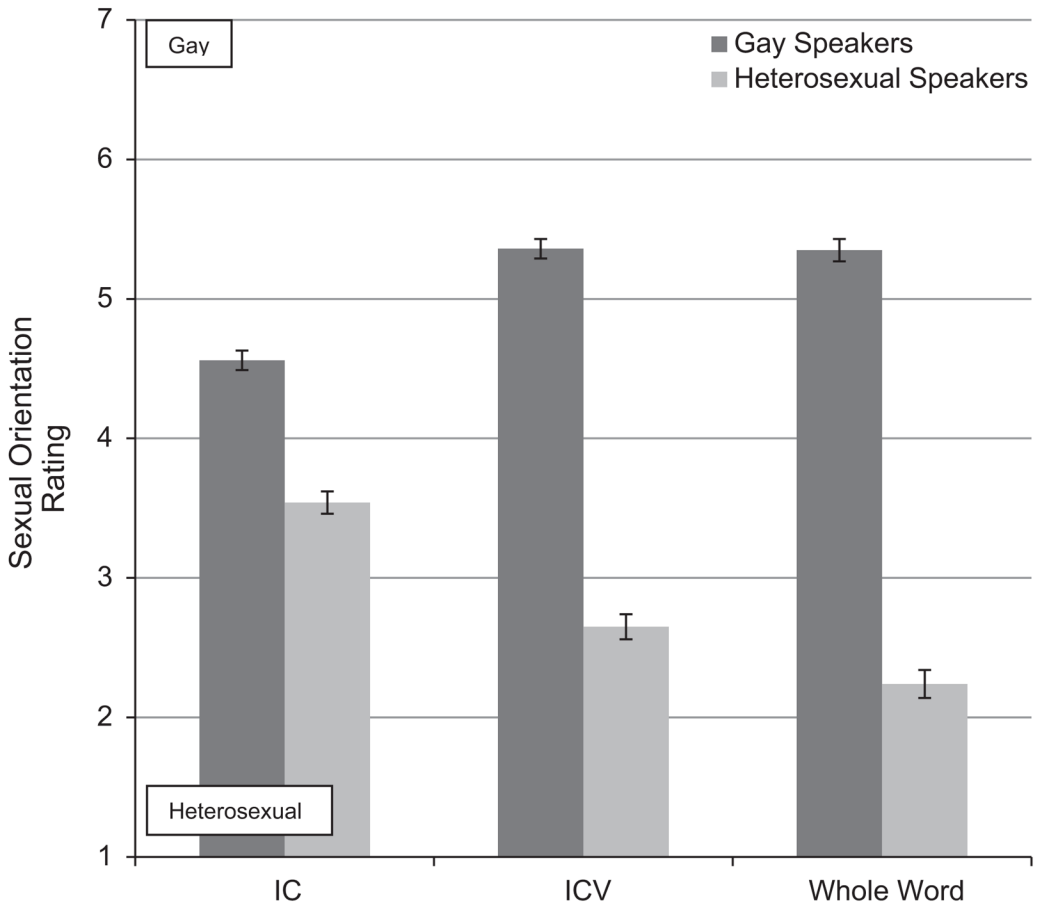

Fig. 4.

Confidence ratings represent how listeners identified the sexual orientation of a speaker upon hearing either an initial consonant (IC), initial consonant and vowel (ICV), or whole word in Experiment 3. For each of the three conditions, there was a significant difference in the rating for the gay and heterosexual speakers. A rating of 7 indicates that the listener identified the speaker as sounding gay and a rating of 1 indicates that the listener identified the speaker as sounding heterosexual. Error bars represent one standard error of measurement.

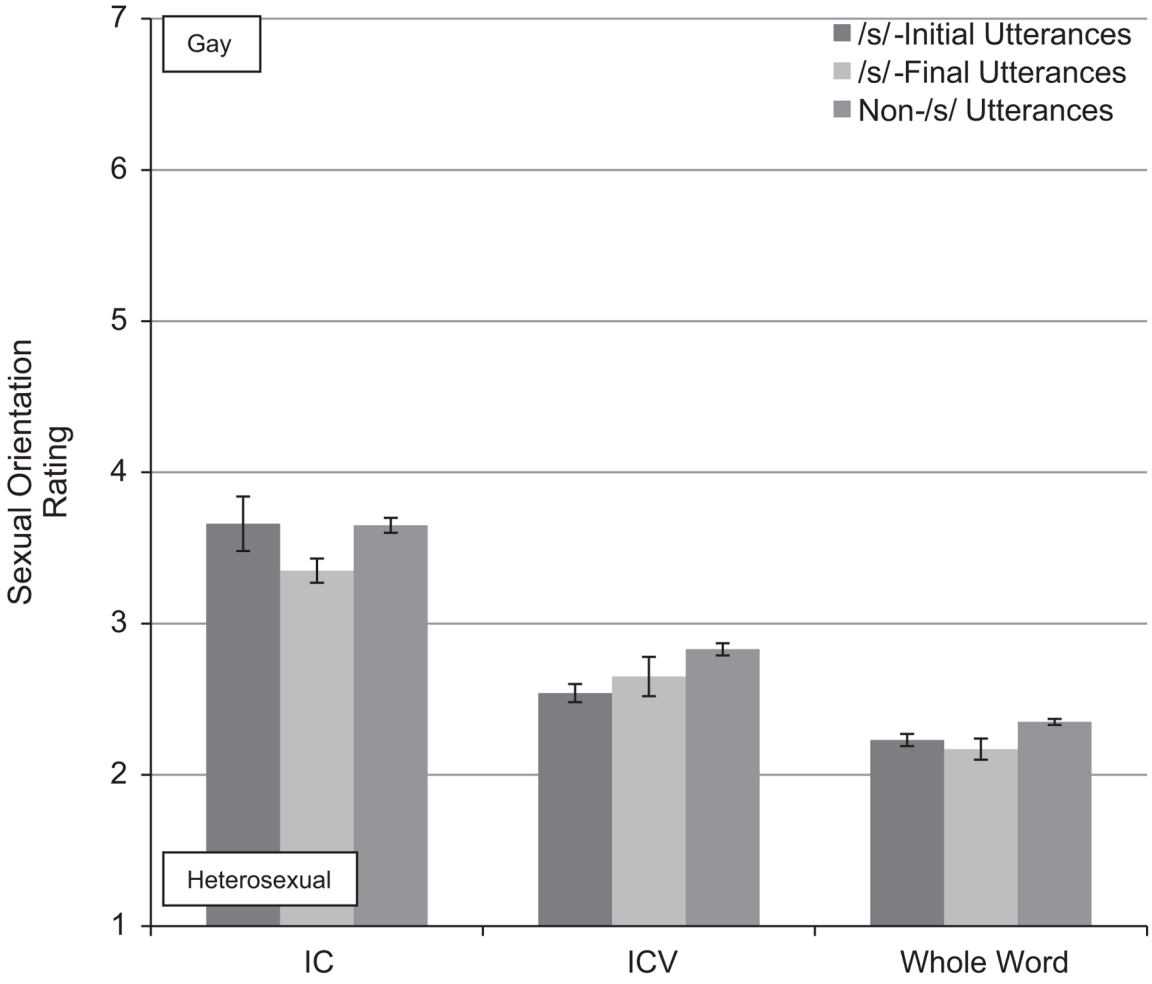

Fig. 5.

All utterances were produced by heterosexual speakers. Confidence ratings represent how listeners identified the sexual orientation of a speaker upon hearing either an initial consonant (IC), initial consonant and vowel (ICV), or whole word in Experiment 3. The utterances were grouped as to whether they contained an initial /s/, a final /s/, or no /s/. A rating of 7 indicates that the listener identified the speaker as sounding gay and a rating of 1 indicates that the listener identified the speaker as sounding heterosexual. Error bars represent one standard error of measurement.

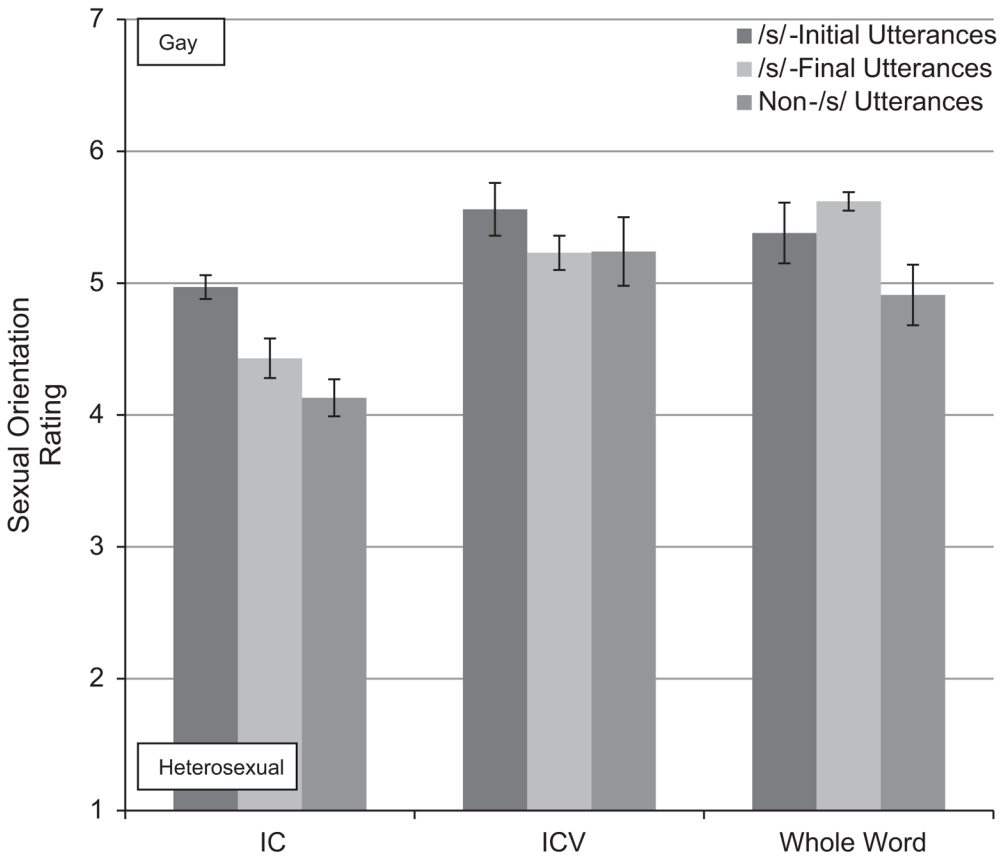

Fig. 6.

All utterances were produced by gay speakers. Confidence ratings represent how listeners identified the sexual orientation of a speaker upon hearing either an initial consonant (IC), initial consonant and vowel (ICV), or whole word in Experiment 3. The utterances were grouped as to whether they contained an initial /s/, a final /s/, or no /s/. A rating of 7 indicates that the listener identified the speaker as sounding gay and a rating of 1 indicates that the listener identified the speaker as sounding heterosexual. Error bars represent one standard error of measurement.

Table 1

Target items used in Experiments 1 and 2.

Experiment 1 items	Experiment 2 items
BACK	/f/ from “food”
CASE	/l/ from “loose”
DEAL	/m/ from “mass”
DOSE	/n/ from “niece”
FOOD	/s/ from “sad”
GUESS	/v/ from “vein”
LOOSE	/w/ from “wet”
MASS	/æ/ from “sad”
NIECE	/eɪ/ from “safe”
NOT	/ɛ/ from “wet”
SAD	/iː/ from “niece”
SAFE	/oʊ/ from “soap”
SEED	/ɑ/ from “sock”
SELL	/uː/ from “soon”
SOAP	
SOCK	
SOON	
TONE	
VEIN	
WET	

Table 2

Model summary for Experiment 1.

Fixed effects	Estimate (SE)	df	*t*-Value	*p*-Value
Intercept	−0.55 (0.26)	15	−2.15	0.0485
Gay	0.97 (0.36)	15	2.70	0.0165

Variance/covariance parameters	Estimate (SE)	*Z*-value	*p*-Value
Intercept (speaker)	1.11 (0.27)	4.09	<0.0001
Intercept (listener)	0.09 (0.02)	4.74	0.0045
Gay (listener)	0.09 (0.03)	3.58	0.0002
Intercept (word)	0.06 (0.025)	2.62	0.0045
Gay (word)	0.09 (0.04)	2.52	0.0058
Residual	2.86 (0.04)	76.62	<0.0001

Table 3

Model summary for Experiment 2

Fixed effects	Estimate (SE)	df	*t*-Value	*p*-Value
Intercept	−0.51 (0.12)	10	−4.06	0.0023
Gay	0.64 (0.17)	22	3.79	0.0010
Vowel	−0.35 (0.24)	10	−1.47	0.1733
Gay* Vowel	1.41 (0.33)	22	4.30	0.0003

Variance/covariance parameters	Estimate (SE)	*Z*-value	*p*-Value
Intercept (speaker)	0.06 (0.03)	1.79	0.0370
Vowel (speaker)	0.27 (0.13)	2.02	0.0215
Intercept (listener)	0.07 (0.03)	2.12	0.0169
Gay (listener)	0.08 (0.05)	1.69	0.0458
Vowel (listener)	0.14 (0.06)	2.23	0.0133
Gay* Vowel (listener)	0.15 (0.09)	1.66	0.4870
Residual	2.52 (0.06)	42.90	<0.0001

Table 4

Model summary for Experiment 3

Fixed effects	Estimate (SE)	df	*t*-Value	*p*-Value
Intercept	−0.3505 (0.20)	6973	−1.75	0.0808
Gay	0.4780 (0.28)	6973	1.69	0.0909
ICV	−0.8168 (0.11)	6973	−7.12	<0.0001
Whole word	−1.3040 (0.11)	6973	−11.37	<0.0001
S-Initial	−0.0092 (0.11)	6973	−0.09	0.9308
S-Final	−0.2872 (0.11)	6973	−2.71	0.0067
Gay*ICV	1.9411 (0.16)	6973	11.97	<0.0001
Gay*Whole word	2.0771 (0.16)	6973	12.80	<0.0001
S-Initial*Gay	0.8631 (0.15)	6973	5.82	<0.0001
S-Final*Gay	0.5786 (0.15)	6973	3.91	<0.0001
S-Initial*ICV	−0.2979 (0.15)	6973	−2.01	0.0443
S-Final*ICV	0.1122 (0.15)	6973	0.76	0.4487
S-Initial*Whole word	−0.1176 (0.15)	6973	−0.79	0.4272
S-Final*Whole word	0.1191 (0.15)	6973	0.81	0.4208
Gay*S-Initial*ICV	−0.2365 (0.21)	6973	−1.13	0.2589
Gay*S-Final*ICV	−0.4374 (0.21)	6973	−2.09	0.0368
Gay*S-Initial*Whole word	−0.2474 (0.21)	6973	−1.18	0.2376
Gay*S-Final*Whole word	0.2913 (0.21)	6973	1.39	0.1643
Word 1[a]	−0.0121 (0.05)	6973	−0.25	0.8058
Word 2	0.0091 (0.07)	6973	0.12	0.9012
Word 4	0.0278 (0.07)	6973	0.38	0.7032
Word 5	0.1773 (0.05)	6973	3.60	0.0003
Word 7	0.0929 (0.06)	6973	1.62	0.1048

Variance/covariance parameters	Estimate (SE)	*Z*-value	*p*-Value
Intercept (speaker)	0.21 (0.09)	2.41	0.0081
Intercept (listener)	0.01 (0.03)	0.46	0.3241
Gay (listener)	0.16 (0.04)	3.94	<0.0001
Residual	1.92 (0.03)	58.65	<0.0001

[a]The fixed effects for the eight words were captured by word type effects (S-Initial and S-Final versus No-S as the reference) and five additional dummy-coded effects for the remaining words (e.g., Word 1).