



# The Perception of Sexual Orientation, Masculinity, and Femininity in Formant-Resynthesized Speech

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- This handout will be available on my blog (the top Google hit for “Benjamin Munson” *and* “Ben Munson”) on Sunday night
  - Save a tree—read it electronically



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## Sexual Orientation and Speech

- A widespread, long-standing popular-culture stereotype holds that a person's sexual orientation can be discerned from audio-only samples of content-neutral speech
- This is observable largely in popular-culture sources, in which GLB speech styles are often portrayed negatively
- (Interestingly, there are relatively few scientific studies of how widespread and entrenched these beliefs are)



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## Sexual Orientation and Speech

- Recent research suggests that people indeed can convey sexual orientation through distinctive patterns of pronunciation
  - Gaudio (1994), Schuler (1996), Crist (1997), Linville (1998), Smyth, Jacobs, and Rogers (2003, and related papers and presentations), Carahaly (2000), Podesva et al. (2001, and related papers and presentations), Waksler (2001), Pierrehumbert et al. (2004), Levon (2006), and various works by Munson and colleagues
    - (Apologies for omissions)



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## Sexual Orientation and Speech

- Methods in these studies have varied
  - Naturalistic speech versus laboratory speech
  - Reading versus free conversation
- Moreover, the theoretical frameworks have varied
  - Sociolinguistics versus laboratory phonology



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## Sexual Orientation and Speech

- These studies have found that...
  - Many people's sexual orientation can be identified at greater-than-chance levels
  - Most (if not all) popular-culture stereotypes about GLB people cannot be substantiated
- Interpretations of these differences vary (and are, by and large, complementary), but one thing is pretty clear: they are likely learned, socially and culturally conventional differences



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## Sexual Orientation and Speech

- *What* is learned? What are the elements of this style?
- The answer to this will likely come from multiple disciplines
- One possibility is that people learn to convey differences in overall stature



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## Perceived Height

- There is a predictable relationship between vocal-tract length and resonant frequencies: the longer the vocal tract, the lower the resonant frequencies
- However, correlations between *actual* overall stature and resonant frequencies is relatively weak
- In contrast, correlations between *perceived* overall stature and resonant frequencies are more robust
- These findings suggests that people can (and do) modify their articulation to convey differences in stature



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## Perceived Height

- Munson et al. (2006) reported that perceived sexual orientation was strongly correlated with independent measures of perceived height.
- The correlation was stronger for women than for men ( $r = 0.58$  vs  $r = 0.84$ )
- The correlation was statistically significant even when actual height was controlled for



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## Perceived Height

- Munson (in press) examined judgments of masculinity and femininity (which we collectively call *sex typicality*) in the same cohort of talkers
- Though not reported in that study, correlations between perceived height and perceived masculinity/femininity were extremely high ( $r > 0.90$ ) for both men and women



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## Perceived Height

- This finding suggests that one way to convey sex typicality through speech is to make articulatory maneuvers that project a larger or smaller stature
  - Women convey both sex typicality and sexual orientation through these manipulations
  - Men convey sex typicality through these manipulations; sexual orientation is conveyed through these manipulations in combination with other articulatory maneuvers (such as maneuvers to increase speech clarity)
- This is consistent with research on vocal emotion (e.g., Ohala) and on animal vocalizations (especially our higher-primate cousins' vocalizations)



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## The Current Study

- All of these analyses were *post hoc*
- We can examine the associations among perceived stature, perceived sexual orientation, and perceived masculinity/femininity prospectively by examining listener judgments of the latter two categories in stimuli that have been acoustically modified to give the illusion of larger or smaller stature
  - This is easily accomplished by using the PSOLA algorithm in Praat (Boersma & Weenink, 2006)



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## The Current Study

- The hypotheses
- 1. Men will be rated as sounding more masculine and less gay when formants are lowered (i.e., when they are made to sound taller), and more feminine and less heterosexual sounding when formants are raised (i.e., they are made to sound taller); the opposite pattern is predicted for women
- 2. Formant-frequency manipulations will have a stronger influence on perceived masculinity/femininity than perceived sexual orientation
  - This asymmetry should be particularly strong for men
- 3. Differences between GLB and heterosexual people should be attenuated in the conditions in which the formants are scaled higher or lower



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## Listeners

- 21 University of Minnesota Undergraduate students
- No attempt to stratify the listeners by sexual orientation
- Given the student demographics, it is likely that their dialect was similar to that of the talkers.



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## Stimuli

- Stimuli were 12 single words, spoken in isolation. Groups of three words were presented together.
- The talkers were 44 individuals (11 each GLB and heterosexual men and women)
- Stimuli were created by scaling the formant frequencies of the original stimuli to 90%, 100%, or 110% of their original values (in Hz)
- A Woman
  - 90% 🗣️
  - 100% 🗣️
  - 110% 🗣️
- A Man
  - 90% 🗣️
  - 100% 🗣️
  - 110% 🗣️



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## Procedures

- Listeners provided ratings on 9-point scales
- E.g., for perceived sexual orientation, they were as follows:
  - Press 9 if this man's voice is definitely gay sounding
  - Press 7 if this man's voice is somewhat gay sounding
  - Press 5 if this man's voice is neither gay sounding nor heterosexual sounding
  - Press 3 if this man's voice is somewhat heterosexual sounding
  - Press 1 if this man's voice is definitely heterosexual sounding
  - 2, 4, 6, and 8 represent intermediate values
- The experiment was blocked by listener and rating type
- Listeners never rated the same talkers on both scales



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## Analyses

- Averages for each measure were calculated separately for GLB and heterosexual people for each level of formant-frequency scaling
- These were subjected to separate two-factor fully within-subjects analyses of variance, with talker sexual orientation (2 levels: GLB, Heterosexual) and formant-frequency scaling (3 levels: 90%, 100%, 110%) as the within-subjects factors
- A measure of effect size, partial  $\eta^2$ , is reported for significant findings



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## Orienting you to the next few pages

- Over here, you will see ratings averaged by *listener*. GLB people are dark bars, heterosexual people are grey bars
- Over here, you will see average ratings for *individual talkers*. GLB people are in the top panel (men are in pink, women are in lavender)
- Heterosexual people are in the bottom panel (men are in blue, women are in red)



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# Women's PSO

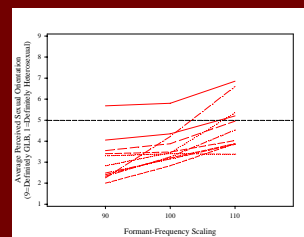
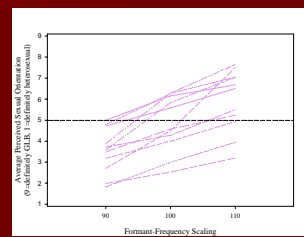
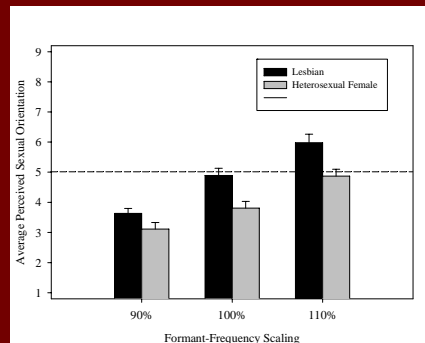
- Significant main effects of formant-frequency scaling,  $F[1.3, 24.4] = 38.2, p < 0.001, \text{partial } \eta^2 = 0.67$
- ...and talker sexual orientation,  $F[1,19] = 43.1, p < 0.001, \text{partial } \eta^2 = 0.69.$
- ...and an interaction,  $F[1.6, 30.6] = 11.2, p = 0.001, \text{partial } \eta^2 = 0.37.$ 
  - The two groups differed significantly at all three formant-frequency scaling levels ( $t[19] = \{3.0 - 7.8\}, \text{all } p\text{'s} < 0.001$ ).
  - The influence of formant-frequency scaling was significant for both groups ( $F[2,38] = \{24.5, 46.4\}, \text{both } p\text{'s} \leq 0.001$ ), and all pairwise comparisons between levels of formant-frequency scaling were significant for both groups.
  - The interaction appears to be due to the difference between heterosexual and lesbian/bisexual talkers being smaller in the 90% scaling condition than in the other two conditions.



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# Women's PSO



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# Men's PSO

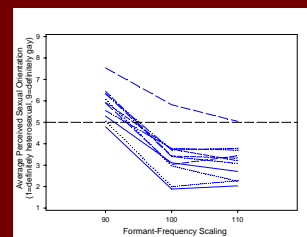
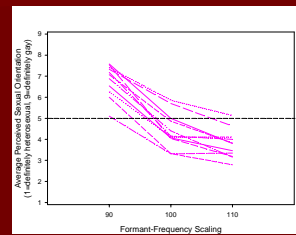
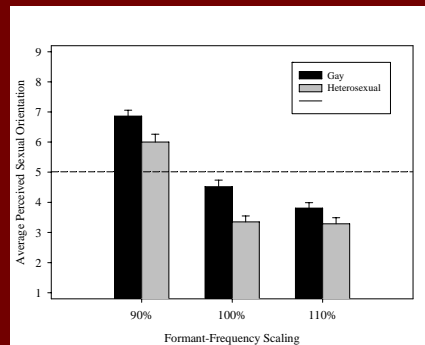
- Significant main effects of formant-frequency scaling,  $F[1.5,28.1] = 91.24, p < 0.001$ , partial  $\eta^2 = 0.83$
- ...and talker sexual orientation,  $F[1,19] = 65.8 p < 0.001$ , partial  $\eta^2 = 0.78$ .
- These factors interacted significantly,  $F[1.9,35.8] = 5.9, p = 0.007$ , partial  $\eta^2 = 0.24$ .
  - The two groups differed significantly at all three formant-frequency scaling levels ( $f[19] = \{3.8-7.4\}$ , all  $p$ 's  $\leq 0.001$ ).
  - Within-subjects ANOVAs for formant-frequency scaling were significant for both groups ( $F[2,38] = \{24.5, 46.4\}$ , both  $p$ 's  $\leq 0.001$ ).
  - The two groups differed from one another least on the listener ratings for the 90% scaling condition.



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# Men's PSO



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# Femininity

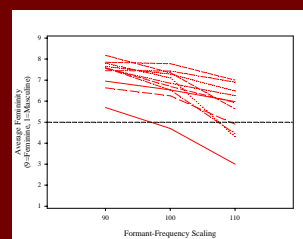
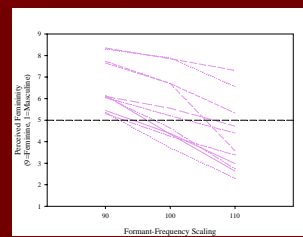
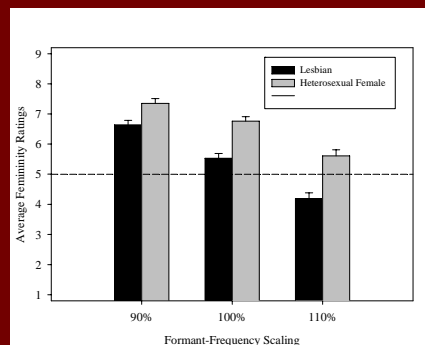
- Significant main effects were found for formant-frequency scaling,  $F[1.7, 31.6] = 89.6, p < 0.001$ , partial  $\eta^2 = 0.83$
- ...and talker sexual orientation,  $F[1,19]=152, p < 0.001$ , partial  $\eta^2 = 0.89$ .
- These two variables interacted significantly,  $F[1.7, 31.6] = 9.9, p = 0.001$ , partial  $\eta^2 = 0.34$ .
  - The two groups differed significantly at all three formant-frequency scaling levels ( $t[19] = \{-7.3 - -10.9\}$ , all  $p$ 's  $< 0.001$ ).
  - Within-subjects ANOVAs for formant-frequency scaling were significant for both groups ( $F[2,38] = \{135.9, 39.1\}$ , both  $p$ 's  $< 0.001$ )
  - The interaction appears to have arisen because the difference between heterosexual and lesbian/bisexual talkers was smaller in the 90% scaling condition than in the other two conditions.



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# Femininity



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# Masculinity

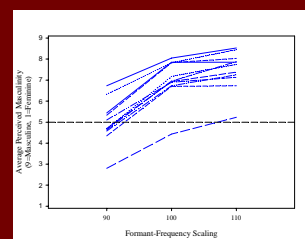
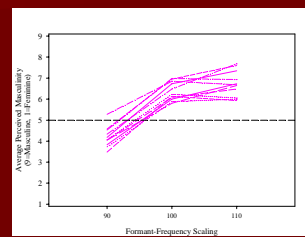
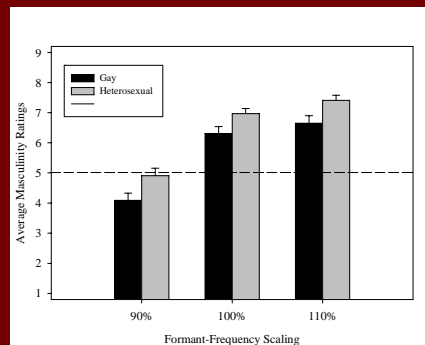
- Significant of formant-frequency scaling,  $F[1.4,26.8] = 93.5, p < 0.001, \text{partial } \eta^2 = 0.83$
- ...and talker sexual orientation,  $F[1,19] = 61.84, p < 0.001, \text{partial } \eta^2 = 0.77.$
- These factors did not interact significantly.



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# Masculinity



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## Summary

- The influence of illusory stature was strong (all partial  $\eta^2$  values were very high—0.67 to 0.83)
- The predicted asymmetries were *not* found: illusory stature had an equally strong influence on judgments of the PSO and masculinity of male voices
- Moreover, the effect of illusory stature was larger for men than for women.



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## Summary

- These results don't support the previous claim that masculinity and perceived sexual orientation of men's voices are distinct perceptual parameters
  - Further research manipulation  $f_0$  is needed to confirm this
- However, they do confirm that it is entirely possible to convey sexual orientation and sex typicality through manipulations conveying differences in stature



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# Questions?



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