Sexual orientation, phonetic variation and the roots and accuracy of perception in the speech of Northern England English-speaking men

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This thesis is submitted in partial fulfilment of the
requirements for the degree of
MA in Sociolinguistics
in the Department of Language and Linguistic Science

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October 2016

Abstract

The vast majority of previous studies of sexual orientation and phonetic variation have been based on speakers and listeners from North America, playing into the tendency of social scientific theory to be founded solely on people from western, educated, industrialised, rich and democratic societies (Henrich *et al.* 2010). This study takes a small step away from such practice, with speakers of Northern England English and listeners from a variety of cultural and linguistic backgrounds spanning multiple continents.

The study explores (1) the effect of sexual orientation on speech production and how this interacts with style and exposure to LGBT people (2) the accuracy of perceptions of sexual orientation from the voice and how this interacts with style, exposure to LGBT people, listener linguistic and cultural background, segmental features and judgemental constraints. The first point of exploration was based on the speech of four gay and four straight men in conversation and read passage environments. The second point was explored using this data in a perceptual experiment.

The results simultaneously support and go against previous findings. The lack of an effect of sexual orientation on /s/ duration and /s/ spectral skew and the presence of an effect on global pitch contradict North American findings (Gaudio 1994; Linville 1998; Munson *et al.* 2006b; Rendall *et al.* 2008; Smyth *et al.* 2003), whilst the effect on /s/ peak frequency offers them support (Linville 1998). /s/ standard deviation - previously unexplored - is found to be a good correlate. The effect of style on speech production is inconclusive and exposure makes no difference.

Global pitch is the best correlate with perceptions of sexual orientation, going against Levon (2006) but supporting the more recent Levon (2007). /s/ duration is a correlate but in the opposite direction to North American findings (Levon 2006; Levon 2007; Smyth and Rogers 2002). /s/ spectral skew and /s/ peak frequency, both significant correlates, support previous findings (Mack and Munson 2012; Munson *et al.* 2006b; Smyth and Rogers 2002). Previously unexplored variables found to be good correlates are /s/ centre of gravity, /s/ standard deviation and /s/ kurtosis. Perceptual accuracy is a little greater than chance and, like most previous findings (Carahaly 2000; Linville 1998; Smyth *et al.* 2003), is much higher when judging straight speakers. Segmental features and forced-choice questions also significantly increase perceptual accuracy. Style and listener linguistic and cultural background have no effect and the effect of speaker and listener exposure is inconsistent.

Keywords: sexual orientation, perception, sociophonetics, sociolinguistics, language variation and change

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Acknowledgements

It has been a long (and tiring) road to reach the completion of this project and of my master's degree, but the experience has been truly priceless in both my personal and academic development and given me yet another passion to pursue. I genuinely would not have managed to reach completion without the support of a number of people, whom I would like briefly to show my appreciation for here. So, my thanks go out to:

- Dom Watt, whose extensive expertise and intriguing ideas helped to refine and further shape the direction of this study from an initial proposal, along with...
- Andrew Euan MacFarlane, who went over and above what would be expected, providing timely support, ever-thoughtful feedback and answers to queries and invaluable insight into current statistical methodology;
- Paul Kerswill, whose lectures and seminars provided the foundations upon which this study was built, and whose contributions to this study no doubt enhanced its structure;
- peers at the Postgraduate Presentation Day who provided constructive comments and fruitful leads at an early stage;
- my boss, Jon Owen, and employer for allowing me the flexibility to manage both full-time work and a part-time master's;
- my parents *et al.* for their support and patience as my availability dropped even further, and also for the bike that got me in between work and lectures!
- my friend and fellow linguist Dasha Zhurauskaya for providing the Russian translations for this study and forever a fresh, intelligent and challenging perspective.

My greatest level of appreciation is expressed to my partner, Harry Radzuan, who, alongside providing the Malay translations for this study, kept me marginally sane and demonstrated an immense level of patience as I inevitably had much work left to do when his own final project was completed, bound and submitted. That, and some damn-good food to keep me going! The kindness will be repaid!

Chapter 1

Introduction

1.1 Background

Zwicky's (1997) influential chapter in *Queerly phrased: language, gender and sexuality* went some way making researchers treat sexual orientation as a valuable area of sociolinguistic inquiry, which, before the 1990s, scarcely existed at all (Butters 1989). Zwicky brought to the fore two ill-examined topics: the lexical items used to talk about sexual orientation and to refer to specific orientations and differences in the language and speech of people based on their orientation. The chapter preceded the emergence of a new generation of researchers observing both how actual speech production varies according to sexual orientation and on what basis perceptions of sexual orientation are made. However, whilst there has been a steady post-Zwicky body of research into sexual orientation and the voice, when compared with other sociodemographic characteristics such as region, race and gender, the level of observation and explanation of variation based upon sexual orientation remains distinctly low (Munson *et al.* 2006b).

Despite the paucity of research into speech production and sexual orientation, Munson and Babel (2007) note that the topic is unlike others in sociolinguistics in that non-linguists including non-academics usually have something to say about the matter, though their observations are often off the mark. The topic has even permeated the domain of popular interest recently with a documentary, *Do I Sound Gay?* (Thorpe 2015a), which received coverage in mainstream media articles (Fallon 2015; Thorpe 2015b). Given the clear interest in how sexual orientation and the voice interact and the lack of popular understanding around the matter, it is important that studies are conducted that enable people to appreciate and accurately articulate this issue.

Henrich, Heine and Norenzayan (2010:1) note that claims made in "the world's top journals [are routinely] based on samples drawn entirely from Western, Educated, Industrialized, Rich, and Democratic (WEIRD) societies [... and i]n particular [...] Western, and more specifically American, undergraduates". Whilst their specific focus is on behavioural science, this issue is common to the vast majority of - if not all - academic disciplines, and the study of gay men's speech is no exception. They go on to state that assumptions are made that either there is little variation between different societies or that such samples are representative of the entire species (implicitly or explicitly). Though there has been a recent increase in the ethnolinguistic diversity of speakers represented in studies of the voice and sexual orientation (Levon 2009; Levon 2010; Pharao *et al.* 2014; Piccolo 2008; Van Borsel *et al.* 2009), the vast majority of research in the area is based on speakers of North American English - specifically American English and Canadian English - and therefore reliable cross-linguistic generalisations are not possible. This study will further the diversity of the literature by

observing Northern England English as defined by Wells (1982) - British English as a whole appears to be completely absent from the literature - and also by using listeners from both inside and outside of the United Kingdom and of different first languages.

Regardless of the need to diversify the literature, it is both interesting and no doubt important to revisit the study of identity and particularly that of sexual orientation both to keep observations current and to enable the study intergenerational (diachronic) variation. Negative reactions to stereotypical representations of gay men on mainstream television programmes over the last few years (Itzkoff 2014) reveal a discontent at such singular narratives where in the past there may have been contentment that such representation existed at all (Gaudio 1994). One question that might be of interest to sociolinguists is whether the generational shift in acceptance of and subsequently exposure to openly LGBT people has lead to a shift in or diversification of the way gay men express their identity and concurrently to language change. Exposure will crop up in the literature review and forms one of the foci of this study.

Note that there are a number of studies on gay men's speech outside of the phonetic domain, including on the lexical level (Leap 1996), however this study is solely interested in phonetic variation.

1.2 Research questions

The literature review as presented in Chapter 2 identified a clear gap for United Kingdom-based studies of phonetic variation by sexual orientation and perceptions of sexual orientation through the voice, with previous studies having focused on speakers from the United States of America and a small number of other countries including Belgium, Denmark and Israel. Another gap in the literature was work that considered the impact of listener linguistic and cultural background, as well as speaker and listener exposure to lesbian, gay, bi and trans (LGBT) people ('LGBT' shall be used in this dissertation as an umbrella term referring to anyone belonging to a gender and/or sexual minority - anyone non-cisgender and/or non-heterosexual - and 'LGB' to refer specifically to sexual minorities). This study sought to plug these and other gaps by addressing the following two research questions:

1. How does sexual orientation affect phonetic variation in Northern England English and how does this interact with style and exposure to LGBT people?

2. How accurate are perceptions of sexual orientation based on Northern England English speech and how does this interact with phonetic variables, style, speaker and listener exposure to LGBT people, listener linguistic and cultural background, segmental features and judgemental constraints?

Although pitch and fundamental frequency are technically distinct, with the former relating to perceptions of sound and the latter to acoustic characteristics (Howard 1992; McKinney 1965), they will henceforth be used synonymously as is standard in the literature reviewed in Chapter 2.

1.3 Overview

Chapter 2 will provide a review of the literature relating to sexual orientation and men's voices, first covering actual phonetic variation and then perceived sexual orientation. Chapter 3 will explore the methodology used in this study, including a look at the variables and hypotheses used to test the research questions outlined above, detail

on the speakers the study observed and the listeners and an outline of the process (recording the speech data; phonetic analysis; the perceptual experiment; statistical analysis). Chapter 4 will present the results hypothesis by hypothesis and Chapter 5 will bring everything together, summarising and discussing the significant results, returning to the research questions to explore the implications of the findings and making suggestions for future research.

Chapter 2

Literature review

This chapter is divided into two sections. The first will examine studies that look at actual phonetic variation by sexual orientation and the second studies exploring the perception of sexual orientation from the voice. Like this one, a number of studies have explored both actual and perceptual variation - these will be presented in both sections, but details such as the number of speakers and their origins will only be given when they are first discussed. A number of studies have correlated perceptions of sexual orientation with perceptions of masculinity and femininity (Campbell-Kibler 2011; Gaudio 1994; Levon 2006; Levon 2007; Munson *et al.* 2006a; Munson 2007; Smyth *et al.* 2003) but in the interest of space, this will not be explored here. Studies will be presented chronologically except where they are interlinked, in which case they will be presented together.

2.1 Actual phonetic variation by sexual orientation

Munson and Babel (2007) note that whilst variation in phonetic production can often be attributed to physical differences that usually hold true between different groups of people, such as men having longer vocal tracts than women (leading to different pitch and resonant frequencies), the majority if not all of the effects of the anatomy on speech production can be countered, for instance through certain articulatory movements. Munson and Babel (2007:426) point to the fact that differences between the speech of specific men and women are not necessarily always accounted for by their biological makeup - i.e. their sex - and perhaps "that we should characterize them as gender differences instead, as gender differences reflect learned, socially and culturally specific behaviors". In other words, we must acknowledge that identity - of which the voice forms a part - is at least to some extent socially-constructed, rather than simply biologically constrained. This is backed up by the observation (Johnson 2006) of an interaction between language and sex as independent variables to the dependent variable of phonetic variation: sex differences are greater in some languages than others; the level of phonetic variation by sex fluctuates whilst the level of sex variation remains constant. Further, Munson (2005) found the level of phonetic variation by sex to correlate with two properties of words - frequency of use and phonological neighbourhood density - further suggesting that biology alone is not an adequate explanation. Specifically, men sacrifice clarity in words that are common and relatively unique - Munson and Babel (2007) argue this could be a reflection of women's tendency to use more standard forms. Thus differences between speakers may be the result of the possession of a different vocal instrument or they may be due to the way a speaker uses that instrument - most likely a combination of the two. It can be deduced then that a

gay-sounding voice is likely to some extent to be socially constructed, not simply biologically determined. Even if we were to consider an element of biological determinism, it must be acknowledged that gay men come in as many shapes and sizes as straight men - however, whether the subset of gay men who are deemed to be gay-sounding share certain biological characteristics is less apparent.

Moving onto studies of sexual orientation, Gaudio (1994) noted that in the time of his study there was a distinct lack of sociolinguistic research into the speech of gay men. Noting this and the common but so-far unscientific characterisation of gay men's speech as more dynamic and womanly (Lakoff 1975; McConnell-Ginet 1983; Travis 1981), Gaudio set upon observing the speech of four straight and four openly gay men reading two passages - one from a relatively formal, non-fiction text and the second from a more fiery, emotionally-charged fiction monologue with the potential to bring out a more performative element. In excluding closeted gay men, Gaudio was acknowledging the social factors that in part constitute gay men's identities - that being a gay man is more than a biological disposition to seek out sex with other men.

Whilst Gaudio's (1994:31) study did include one black speaker, he acknowledges that his speakers were from a "predominantly white, educated, middle- and upper-middle-class segment of American society", in line with the WEIRD tendency (Henrich *et al.* 2010). Gaudio's (1994) findings must therefore be put in context. Further, his study observed postgraduate students in the San Francisco Bay area. San Francisco, nicknamed the "gay capital of the world" (Kompes 2005:66), has long been something of a haven for LGBT and particularly LGB people, with a strong LGBT community having existed for around a century (Ormsbee 2010; Sibalis 2004). It would therefore not be bold to assume that Gaudio's speakers were likely to have a higher-than-average exposure to LGBT people, and it follows that in such contexts straight speakers would have a higher-than-average amount of face-to-face interaction with LGB speakers. Face-to-face interaction leads to accommodation, a form of language change in which the speech characteristics of two groups converge (Britain and Trudgill 1999) "in order to promote a sense of common identity" according to Tuten (2003:29) - note that Tuten's claim was contested by (Trudgill 2008a) and subsequently debated (Bauer 2008; Coupland 2008; Holmes and Kerswill 2008; Schneider 2008; Trudgill 2008b; Tuten 2008). Therefore, it would be unsurprising to observe lower-than-average phonetic variation by sexual orientation in San Francisco. Indeed, Gaudio (1994) found no significant difference in pitch and pitch range between gay and straight speakers. Comparing lesbian and straight women in San Francisco recounting the plot of *The Wizard of Oz* (Fleming 1939), Waksler (2001) found similar results.

Crist (1997:53) asked four gay and two straight educated white American English speakers to read a passage in their "ordinary" voice and then in "the queeniest, most flaming gay stereotype" they could do. He found significant differences in the duration of onset consonants between the two contexts, however due to the methodology it is questionable what this serves to evidence. First, the study looked at perceived phonetic cues, not actual variation. Second, the assumption is made that a queeny or stereotyped gay man's voice is somewhat indicative of the speech of gay men as a whole rather than just a subset. Crist (1997:54) explained that his approach was a way of looking for exaggerated tokens of phonetic variants - "searching where the light is best" - which may then be observable on a more subtle level in the natural speech of gay men. So whilst the study's results are essentially an illustration of perceived phonetic cues of queeny speech, it *could* be argued that they can be taken as an indication of a good avenue for sociolinguistic inquiry into the speech of gay men, one which *might* prove fruitful.

Linville (1998) recorded five gay and four straight American English speakers reading a monologue and found that gay men on average had higher peak frequencies and longer durations for tokens of /s/.

Pierrehumbert *et al.* (2004) recorded 103 speakers of American English comprising LGB and straight men and women from the Chicago area reading a set of sentences. They found that whilst in general gay and bisexual men did not shift towards the vowel patterns of straight women and LGB women to the vowel patterns of straight men, the adoption of such shifts was present in a few speech characteristics, with gay and bisexual men producing a more expanded vowel space than straight men, a difference generally observed between men and women.

Munson *et al.* (2006b) recorded 44 speakers of American English from the Minneapolis-Saint Paul metropolitan area divided equally between lesbian and bisexual women (combined), straight women, gay men and straight men, speaking individual words. Comparing gay and straight men, they found the former to have higher first-formant frequencies for /æ/ and /ɛ/, a slightly higher second-formant frequency for /u/ and a more negative spectral skew for /s/. Munson and Babel (2007) believe the vowel qualities of gay men from this study are reflective of an incipient or ongoing sound change in the area, which would place gay men as the innovators (Denis 2011; Rogers 2003) or leaders (Labov 2001) of language change ahead of straight men. Such an observation would back up the characterisation of the speech of gay men as woman-like, given that women are generally observed to be the leaders of language change (Kerswill and Williams 2005; Tagliamonte and D'Arcy 2009).

Podesva (2007, 2008) took a somewhat different approach to the studies detailed above, focusing primarily on the speech of just one gay man, Heath, and in uncontrolled environments. At the time of recording, Heath was a young, educated white man from and residing on the East Coast of the USA. Podesva (2007:483) asked his subject to record himself in conversation wherever and whenever he and his fellow interlocutor(s) felt comfortable and in the absence of the researcher, with the aim of producing "more naturalistic, less self-conscious recordings". Whilst Podesva's small sample size leaves any broad generalisations made from his studies susceptible to an increased likelihood of type I error, the sample combined with the use of uncontrolled, non-laboratory speech enabled him to conduct a close and detailed ethnographic analysis of speech as it is produced in everyday life, with the potential to reveal more novel findings. Podesva (2008) found that Heath exhibited elision of word-final alveolar plosives more amongst friends than at work but the tokens that he did produce in the presence of friends had a longer duration. He suggested that the longer-duration word-final alveolar plosives indexed prissiness, a gay stereotype. Podesva (2007) found that amongst friends, Heath tended to exhibit falsetto more often and with a higher average and wider-ranging fundamental frequency, which he suggested was used to create a diva persona and potentially a gay identity.

Rendall *et al.* (2008) recorded 125 speakers of Canadian English from the Alberta area, mixed between LGB and straight men and women, speaking isolated vowels, single-syllable words and short sentences. Pitch again proved a poor indicator of sexual orientation, but formant frequencies of certain vowels were observed to be significant correlates.

Van Borsel *et al.* (2009) recorded 175 gay men, 100 straight men and 100 straight women who were speakers of Dutch from Flanders in Belgium, reading a short passage. Two clinicians, at the time unaware of the study's focus, determined whether speakers were lisping, defined as the production of anterior alveolar fricatives. They found that gay men were significantly more likely than the other two groups to lisp at 42.3% of

all tokens compared with 18% for straight men and 20% for straight women. However, Munson (2010b) refuted the claims made in the study, questioning the methodological approach. Whilst he praised the large sample size, the lack of acoustic analysis led him to suggest that the clinicians' responses could have been biased by a perception of sexual orientation stemming from other variables. As Campbell-Kibler (2011) points out, though, the study does at least indicate an association, even it is a perceptual rather than acoustic one.

Like Podesva (2007, 2008), Levon (2009, 2010) took an ethnographic approach, conducting long-term observation of lesbian and gay activist groups in Israel. He interviewed 18 gay speakers of Hebrew involved in these groups and found that when discussing gay topics, pitch range was wider, pitch slope steeper and mean pitch higher. He also found the same was true of speakers when expressing opinions, as contrasted with recounting narratives. An interaction existed between these two independent variables and mean pitch, but not pitch range and pitch slope. Levon (2010) showed that the gay/non-gay topic-based variation does not exist in radical groups, as contrasted with mainstream groups. He argues that the absence of distinction in the radical group is reflective of how they view their sexual orientation as a fundamental part of who they are, distinct from the mainstream group who have a much greater impulse to assimilate with Israeli tradition and values and therefore a greater tendency to compartmentalise their identities. Levon suggests that the intraspeaker variation or lack thereof displayed by the speakers in his studies reflects a relationship between how they conceptualise their sexual orientation and the language attitudes of Israeli society.

Munson (2010a), noting previous findings that associated perceptions of gay speech and precision or clarity, posited that speech-motor fluency could be a contributory factor in hyperarticulate (or clear) speech. In order to test this hypothesis, he used data from a diadochokinetic rate task recorded for Munson *et al.* (2006b). Diadochokinetic rate correlated with neither actual nor perceived sexual orientation.

Podesva (2011a, 2011b) again explored the speech of just one gay man using a similar methodology to Podesva (2007), looking at intraspeaker variation and how it relates to the construction of a gay identity. In Podesva (2011a) his speaker was Regan, an Asian American speaker of American English from California and born of Vietnamese immigrants (he also speaks Vietnamese). He argues that Regan makes use of advanced markers of the California Vowel Shift (also known as the Northern California Vowel Shift (Eckert 2008b)), which create the impression of being laid back and fun, in turn indexing for a partier-type gay identity. He therefore suggests that regional accent features can be used indirectly to index for sexual orientation (and possibly other forms of identity) on account of the traits they index for more directly.

In Podesva (2011b), Heath, Regan and also Jack, all recorded for Podesva (2006) and close friends of the researcher for many years, were taken as the subjects. Jack is Heath's partner and is an Asian American speaker of American English. Three contexts were analysed for each speaker - a group social situation, a one-to-one social situation and a one-to-one professional situation - all in the absence of the researcher. Podesva observed variation in utterance-final nuclear pitch accent (where the prosodic head or primary stress of an utterance falls at its end (Beckman 1986; Ladd 1996). Podesva found that extreme falls in intonation used by two of his speakers indexed for animation, creating partier and diva personas and in turn gay identities.

2.2 Perceiving sexual orientation in the voice

Munson and Babel (2007:420) note that "there are very few published experimental studies of listeners' beliefs about the content of [LGB] speech styles despite the fact that these are seen widely in popular media". They highlight two areas into which studies of perceptions of sexual orientation through the voice can be categorised: the accuracy of listeners' perceptions and the phonetic cues upon which these perceptions are based. They also raise the question of whether listeners perceive sexual orientation categorically (LGB versus straight) or on a continuous scale (more or less LGB-sounding).

Returning to Gaudio (1994), his study also observed perceptions of sexual orientation using a seven-point scale from straight to gay. Based on mean ratings, he found that in the more formal passage straight men were all on the straight side of the scale and gay men were all rated as sounding gayer than the straight men with only one rated on the straight side (close to neutral). In the more dramatic passage, all straight men were rated on the straight side and all gay men on the gay side, though the speaker who rated just on the straight side in the formal text again rated close to neutral. Gaudio found speaker sexual orientation to be a significant factor in perception of sexual orientation in both contexts - in other words, listeners exhibited accuracy in their perceptions at levels greater than chance. Gaudio did not find a significant correlation between mean pitch and ratings of sexual orientation, however there was a suggestive (but not significant) correlation with pitch range.

Madon (1997) found that a soft voice was one of the main stereotypes based on asking participants how characteristic of gay men various attributes (not specific to langauge) were. Inversely, a deep voice was viewed as counterstereotypical. Madon (1997:679) showed that "gay males are perceived to exhibit positive female sex-typed qualities and to violate acceptable male gender roles". However, as Munson and Babel (2007) note, the labels "soft" and "deep" as applied to the voice do not have clear, definitive translations into phonetic terminology (or rather, there are multiple possible translations) and so the specific linguistic phenomena observed here to be stereotypical or counterstereotypical of gay men are not easy to pinpoint.

Linville's (1998) study, mentioned in the previous section, found that listeners were considerably more accurate in perceiving straight speakers than gay speakers, getting 93.5% and 68.4% of judgements correct respectively for the two groups. Could this suggest that roughly two-thirds of gay speakers speak in the manner or manners that people expect of them - perhaps stereotypically - whilst the remaining one-third are little or no different to their straight counterparts?

Carahaly (2000) recorded 40 white monolingual speakers of American English from the Columbus area divided equally between lesbian women, straight women, gay men and straight men, once in conversation with someone from the same speaker group and once in conversation with someone of the same gender but different sexual orientation. The 80 listeners were also divided equally between lesbian women, straight women, gay men and straight men and were also monolingual speakers of American English. The overall accuracy of perceiving sexual orientation was 70.7% with no significant differences based on listener sexual orientation, however gay/lesbian listeners were more accurate in their perceptions of women speakers. Like Linville (1998), accuracy was significantly greater for straight speakers than gay/lesbian speakers, standing at 73.2% and 68.4% respectively. However, this effect can be attributed to a large difference in straight and lesbian women at 76.1% and 63.7% accuracy respectively; the difference in accuracy by speaker sexual orientation for men actually ran in the opposite direction, with straight men at 70.1%, 3% lower than gay speakers at 73.1%. Listeners were

also more accurate in perceiving sexual orientation when the conversation partner was gay/lesbian at a rate of 72.6% compared with 68.9% for straight conversation partners. This also held true in each of the speaker subgroups except lesbian women.

Smyth *et al.* (2003) recorded 17 gay and eight straight speakers of Canadian English from the Toronto area aged between 25 and 50 reading a scientific paragraph, reading a dramatic paragraph and responding to an open-ended question. A number of the gay speakers were selected on account of the researchers believing they sounded gay. They found that listener identity, which was divided into three groups (gay men, men of unknown sexual orientation and women of unknown sexual orientation), did not significantly correlate with the likelihood of rating speakers as gay (regardless of their actual orientation), though the difference between gay men and men of unknown sexual orientation did approach significance. Gay speakers were much more likely to be rated as gay at 55% compared with 22% for straight speakers, but the biased sample should be taken into account here. Listeners were significantly more likely to rate speakers as gay in the scientific paragraph - the most formal of the three styles. A significant interaction between speaker sexual orientation and context showed that straight speakers were more likely to be rated as gay in this context. Smyth *et al.* (2003) poist a relationship between gay-sounding speech and formal speech and that gay speakers exhibit this in all contexts. This would reinforce the characterisation of the speech of gay men as more woman-like, given that women are observed to speak more standard varieties (Eckert 2008a; Gordon 1997; Labov 1972; Labov 2001; Ladegaard 2000; Ladegaard 2003; Milroy 1987; Trudgill 1972). Babel and Johnson (2006) built on Smyth *et al.* (2003) by having listeners rate the reading ability exhibited in the scientific passage recordings. They found that listeners rated gay-sounding speakers as better readers, further suggesting a link between perception of precision, competence and standardness and perception as gay.

Smyth *et al.* (2003:338-340) also observed the quality of listeners' "gaydars" and how this correlated with their identity, speaker sexual orientation and context ("discourse type"). "Gaydar" here is used to refer to the ability to correctly perceive sexual orientation. There was no relationship between accuracy and listener identity, ranging from 62-66% for the three groups. However, both context and speaker sexual orientation were found to significantly correlate with accuracy of perceptions and also to interact with each other. Accuracy was lowest in the scientific passage at 60%, and significantly higher in both the dramatic passage at 64% and the spontaneous speech at 68%. Straight speakers were identified correctly at 72% compared with gay speakers at 55% - it is perhaps surprising to see the accuracy for gay speakers to be lower than in Linville (1998) and Carahaly (2000) given this study purposefully chose gay speakers they perceived to be particularly gay sounding. They concluded that "most gay men do not sound gay, and that a substantial number of straight men do sound gay". Perhaps a more accurate analysis of the results would be that many or most gay speakers do not exhibit the cues listeners tend to associate with such an identity and that there is significant overlap between gay and straight speakers in their speech production.

Looking at specific phonetic cues, Smyth *et al.* (2003) found no significant relationship between voices perceived as sounding gay and mean pitch. Further, they found that mean pitch correlated with the difference in ratings of sexual orientation and masculinity/femininity in both read passage contexts and overall. In other words, listeners were more likely to rate a lower-pitched voice as gay-sounding than feminine-sounding, reinforcing the finding that listeners do not use pitch as a cue for sexual orientation. Using the same speech data, Rogers and Smyth (2001) found a correlation between voices perceived as sounding gay and the production of more peripheral vowels and

Smyth and Rogers (2002) found a correlation with longer voice onset time in plosives, longer duration and higher peak frequency of /s/ and /z/ and /l/-fronting.

Returning to Munson *et al.* (2006b), they had 40 listeners judge the sexual orientation of their speakers on a five-point scale. They found that words with non-high font vowels or non-low back vowels, higher average frequency of first formants and second formants in vowels and more negatively skewed /s/ increased the likelihood of being perceived as gay. They did find overlap between gay and straight men, however, with the two speakers rated as most gay-sounding being one gay and one straight man. In a separate experiment, Munson *et al.* (2006b) had listeners rate the same speakers on relative height and, with pairs of words, identify the clearest. Men who were rated as more gay-sounding were rated as sounding shorter and clearer.

Munson *et al.* (2006a) used /æk/ and /ɪp/ tokens from the stimuli in Munson *et al.* (2006b) and preceded them with a nine-point /s/-/ʃ/ continuum. The ten listeners participated in a fricative identification task. For speakers who were men, no relationship was found between the speakers' perceived sexual orientation (taken from Munson *et al.* (2006b)) and the perceived fricative.

Levon (2006) took a different approach to previous studies, using only one speaker - a white man from the New York area rated as extremely gay sounding in a pre-test - and digitally altering his speech according to the variables he wished to observe. This allowed Levon to control for all other variables, ensuring that the results reflected the effects of the single researcher-manipulated variable, unlike in other studies where listeners could be responding to any number of differentiating phonetic variables which were unable to be controlled for as a result of using multiple speakers and speech recordings. Levon created four stimuli by manipulating sibilant length (creating a shortened version) and pitch range (creating a narrowed version). The 121 listeners were all from the New York area. Like Gaudio (1994), Levon found no significant correlation between pitch range and ratings of sexual orientation, and he also found no significant correlation with sibilant duration. Levon (2007) built upon Levon (2006) by adding a speaker rated straight in a pre-test - again a white man from the New York area - and manipulating his speech in the opposite direction to that of the speaker in the previous study (elongated sibilants and widened pitch range). This time, there were 123 listeners again from the New York area. Levon did find that a wider pitch range correlated with perception of the gay-rated speaker as gay, but this was not true of the straight-rated speaker, and again sibilant duration had no effect.

Piccolo (2008) recorded six gay and six straight speakers of Hawai'i English. There were 24 listeners divided equally between lesbian women, straight women, gay men and straight men, all of whom were speakers of American English. In contrast with previous studies (Carahaly 2000; Linville 1998; Smyth *et al.* 2003), Piccolo found listeners to lack accuracy in perceiving sexual orientation. The previous studies that observed this relationship used speakers of varieties that collectively fall under North American English (Labov *et al.* 2005) - all based in mainland North America - whereas this study's observations were based on speakers of an island creole language. Could this, and also the use of listeners who speak a different variety of English to the speakers, have impacted on the results? Piccolo (2008) did find that perception as gay correlated with /i/- and /u/-fronting.

Campbell-Kibler (2011) recorded four speakers of American English, two each from California and North Carolina, in informal interviews. The stimuli were digitally-manipulated using post-interview recordings of the speakers producing alternative tokens of [ɪm] or [ən] and [ɪŋ], further cutting and splicing of /s/ and /z/ and pitch transformation. 175 listeners, mostly from the USA, were presented with a single clip

of each speaker and nine six-point scales on which to rate them, including one on sexual orientation. Campbell-Kibler found that /s/-fronting increased the likelihood of speakers being perceived as gay. /s/-fronting, as observed in Van Borsel *et al.* (2009), detailed above, is the feature associated with the gay lisp stereotype. Indeed, in an initial phase where a different set of listeners were asked to describe the stimuli, one listener recounted how they initially believed they had identified a lisp before supposedly realising that the speaker was in fact gay. Campbell-Kibler (2011) also found that the interaction between /s/-fronting and the use of [ɪŋ] correlates with perceptions of speakers as smart, effeminate and gay.

Mack and Munson (2012) used the speakers from Munson *et al.* (2006b) and Munson *et al.* (2006a) with additional manipulation and tokens from a trained phonetician. The study was split into two experiments. The first was split into three tasks each with 15 listeners and the second had 20 listeners; all listeners were speakers of American English from the Minnesota area. They found that various non-canonical variants of /s/ correlated with perceptions of gay speech: anterior production including frontal misarticulation and dentalisation; high peak frequency; negative spectral skew. They also carried out a voice recognition task incorporating priming techniques as in Niedzielski (1999) and Hay *et al.* (2006), presenting listeners with a gay- or straight-sounding voice prior to the task. This showed that non-canonical variants increased reaction time and that this held true regardless of priming scenario.

Pharao *et al.* (2014) observed how the same variable can have a different meaning in different contexts through looking at the meanings indexed by standard and fronted /s/ in two registers which are associated with two different speech communities. They carried out two matched-guise perceptual experiments using identical stimuli except for tokens of /s/, produced by Danish-speaking adolescent boys. The first experiment, which featured open questions, had 116 listeners, all school pupils. The second experiment used scalar questions and had 234 listeners. They found that in the register associated with modern Cophenhagen speech, fronted /s/ increased the likelihood of being perceived as gay, but this effect in the register associated with street language is different and less significant.

Chapter 3

Methodology

This chapter will outline the variables and hypotheses used to answer the research questions, provide a description of the speakers and listeners, detail the recording and processing of the speech data and look at the approach to phonetic analysis, the design of the perceptual experiment and statistical analysis.

3.1 Variables and hypotheses

The two research questions outlined in Section 1.2 were broken down into a number of hypotheses based around various independent variables (IVs) and dependent variables (DVs). The first research question was addressed through observing how phonetic variation (DV1) correlates with speaker sexual orientation (IV2), style (IV3) and exposure to LGBT people (IV4). The second research question was addressed through observation of how perceptions of sexual orientation (DV2) - both the specific orientation perceived and the accuracy of that perception - correlate with phonetic variation (IV1), IV2, IV3, IV4, listener exposure to LGBT people (IV5), listener linguistic and cultural background (IV6), segmental information (IV7) and question style/judgemental freedom (IV8).

The independent and dependent variables are mapped in Table 3.1.

	Phonetic variation	Perceptual variation
Phonetic variation		X
Speaker sexual orientation	X	X
Style	X	X
Speaker exposure to LGBT people	X	X
Listener exposure to LGBT people		X
Listener linguistic and cultural background		X
Segmental information		X
Question style/judgemental freedom		X

Table 3.1: Mapping of independent and dependent variables

The study set out to observe phonetic variation specifically with regard to the sociophonetic variable /s/, global pitch and prevalence of falsetto. The specific measures of /s/ used are detailed in Section 3.4.3.

Labov (1966) showed that the scale of variation between speech communities correlates with style. This study observed this effect using two points on Labov's (1972) style continuum: read speech and careful/casual speech.

Exposure to LGBT people was broken down into two categories: when growing up and now. The first category, henceforth "early exposure", included openly LGBT role models whether known to the individual, famous or fictional. The second category, henceforth "current exposure", was focused on social activity: the proportion of friends that are LGBT, how close they are in relation to non-LGBT friends, how many LGBT colleagues or peers are regularly interacted with for non-work matters and so on.

Listener cultural and linguistic background took account of listeners' sexual orientation, first language, country of origin and whether they had ever lived in the United Kingdom (including everything but holidays and short business trips).

The effect of segmental information was measured by removing it using low-pass filtration, a process in which all frequencies beyond a cut-off point - usually between 0Hz and 300-500Hz - are removed from the speech signal. This leaves only suprasegmental information such as intonation, pitch, rhythm and stress (Szakay 2008).

The hypotheses composed of these variables were largely informed by the literature reviewed in Chapter 2. These are outlined below and are prefaced with references to their component interacting variables:

1. IV2-DV1: phonetic variation will correlate with sexual orientation, but the gay and straight speakers will not be completely distinct groups - there will be a level of overlap

2. IV3-DV1: phonetic variation by sexual orientation will be greater in conversation than in the read passage environment

3. IV4-DV1: phonetic variation will correlate with speakers' exposure to LGBT people, accounting for some of the overlap in hypothesis one

4. IV1-DV2: perceptions of sexual orientation will directly correlate with phonetic variation

5. IV2-DV2: perceptions of sexual orientation will correlate with actual sexual orientation, but with some overlap due to lack of complete phonetic distinctiveness between the two groups, and accuracy will be greater for straight speakers

6. IV3-DV2: perceptions of sexual orientation will more accurately reflect actual sexual orientation in conversation than in the read passage environment

7. IV4-DV2: perceptions of sexual orientation will correlate with speakers' exposure to LGBT people (more likely to be perceived as gay if more exposed to LGBT people), accounting for some of the overlap in hypothesis five

8. IV5-DV2: accuracy of perceptions of sexual orientation will be greater for listeners with higher exposure to LGBT people

9. IV6-DV2: accuracy of perceptions of sexual orientation will be greater for listeners who are LGB and/or from the United Kingdom and/or have lived in the United Kingdom and/or speak English as their first language (as the speakers are from the United Kingdom and speak English as a first language)

10. IV7-DV2: accuracy of perceptions of sexual orientation will be greater with segmental information than without, but a positive correlation between actual and perceived sexual orientation will be present in the latter

11. IV8-DV2: accuracy of perceptions of sexual orientation will be greater when in a forced-choice scenario where speakers must identify which of two speakers is gay than in a scalar judgment scenario with greater freedom

3.2 Speakers

The speakers were two pairs of straight and two pairs of openly gay men (similar to Gaudio (1994) and Linville (1998)) recruited from existing contacts (as in Podesva (2007, 2008, 2011a, 2011b)). Speakers were not recruited on the basis of how they sounded (unlike Smyth *et al.* (2003)). Whilst the data from each speaker would be presented in isolation - meaning the potential for a clear intra-pair contrast would be small - speakers were still paired by sexual orientation in order to avoid any identity-reaffirming linguistic adjustment that could have resulted from mixed-sexual-orientation pairings. The speakers in each pair were already acquainted so as to improve the likelihood of recording natural, flowing conversation. Speakers were controlled for physique (around 5 feet 10 inches plus or minus 2 inches), region (described below), age (24-32), gender identity (cisgender - the opposite of transgender), ethnicity (White British) and class (middle class) to mitigate against confounding variables. One pair was actually comprised of twins who were originally from Norfolk but had moved to Yorkshire at the age of three, similar to Gaudio (1994) who used two brothers one year apart except in his case they were of different sexual orientations. Another speaker was from Lancashire. All other speakers were from Yorkshire. The Lancastrian speaker was not noticeably rhotic, one key feature that can typically be used to differentiate between Lancashire and Yorkshire dialects (Wells 1982). The recordings were checked by professional sociophoneticians to ensure they were fit for purpose, including that no speaker had an accent or dialect that was markedly distinct from the others.

Though the use of a British English provides a new dimension to this area of sociolinguistics by taking a step away from the American sample tendency observed by the WEIRD study (Henrich *et al.* 2010), by modern definitions and most importantly by cultural and sociological definitions (Thompson and Hickey 2011), the United Kingdom is Western and so it does not stray away from WEIRD territory in a broader sense.

It is worth noting that three of the gay speakers have been involved in local LGBT activism through the pride movement. As Levon (2010) found, the expression of an individual's gay identity through linguistic practice varies according the way they conceptualise it, which can in turn correlate with the kind of groups with which they associate. The type of gay men who are involved in LGBT activist groups may be less likely to wish to assimilate with heteronormative society than other gay men, and therefore observations made of such individuals are best taken to be representative of a subset rather than the whole.

3.3 Listeners

In total, there were 45 participants who took part in the perceptual experiment (excluding four that the survey platform failed to record properly and therefore had to be discarded), henceforth "the listeners". The experiment asked listeners to provide various sociodemographic details about themselves, but each question was optional and therefore full details are not known about each of them.

15 listeners identified as men and thirty as women. Only one listener identified as trans - three did not provide a response and the remaining 41 identified as cis (not

trans). Four identified as bisexual, five as gay men, two as gay women/lesbian, thirty as heterosexual and two as something else, with the remaining two not providing a response. Age was recorded in standard groupings (Engel *et al.* 2015; Hale and Napier 2013), with 21 aged 18-25, 14 aged 26-35, three aged 36-45, five aged 46-55 and two over 55. Ethnicity used standard census categories (note there were four versions of the experiment as detailed in Section 3.4.4, each of which had different categories for this variable), with eight identifying as Belarusian, five as Bumiputera (native Malay), nine as White - any other White background, 16 as White - English/Welsh/Scottish/Northern Irish/British and seven identifying outside of these categories.

Three listeners stated their first language was Belarusian, 22 English, six Malay, four Russian and eight something else, with the remaining two not providing a response. Eight listeners originated from Belarus, another eight from Malaysia, 17 from the United Kingdom and nine from somewhere else, with the remaining three not providing a response. 27 listeners had lived in the United Kingdom - defined as inclusive of everything except holidays and short business trips - and 18 had not.

3.4 Methods

3.4.1 Recording the speech data

The read passages and conversations were recorded at 44,100 Hz using a Zoom H4n in a quiet university room. The Zoom H4n is an audio recorder with two cardioid condenser microphones in a coincident pair configuration. These properties combine to enable a recording with a high level of detail (in terms of frequency) and a wide field of reception (Owsinski 2014; Rumsey and McCormick 2014; Savage 2011). In the case of the Zoom H4n, the field of reception is 90° or 120° depending on the rotation of the microphones.

Speakers were asked to read an information sheet and fill out sociodemographic data and consent forms before being recorded. The information sheet made clear the focus of the study, which could potentially have primed certain forms of speech production.

After reading the information sheet and completing the two forms, each pair was asked to nominate a first speaker, with the other speaker leaving the room. The recorder was placed on the table at which the speaker was sitting, faced towards them on a tripod. The speaker was shown a short extract from the first chapter of *The Curious Incident of the Dog in the Night-time* (Haddon 2003) - chosen for its emotive content (as in Gaudio (1994)) and therefore the potential for bringing out character in the speakers' voices - and asked to read it in their head as many times as they liked before indicating that they were ready to read it aloud (as in Gaudio (1994)). The recorder was then started and the speaker read through the passage. Once finished, the recorder was stopped and the process was repeated for the second speaker in the pair.

After both speakers had been recorded reading the passage, they were brought together to record the conversation. The recorder was positioned so that it pointed in between them and they were sat on the corner of a table at a slight angle in order to be within the two microphones' field of reception. The pair was asked to talk about politics until they reached a natural conclusion. This specific subject was chosen as it was particularly topical given the proximity of the recordings to the 2015 general election in the United Kingdom (and local elections in York). Three of the pairs were recorded in the lead up to the election and one shortly after. Although the first pair protested that they did not "do politics", only the last pair had an issue talking for more than one minute (and their conversation featured frequent pauses). Given that

the aim was to produce 30-second clips of each speaker in each of the two environments (read passage and conversation), they were given gentle encouragement to continue in order to ensure that enough content would be recorded. This did not in any way constitute a contribution or steer to the discussion from the recordist.

3.4.2 Processing the speech data

The speech data was prepared for phonetic analysis and the perceptual experiment using Audacity 2.1.0 (The Audacity Team 2015), Adobe Premiere Pro CC 2014.2 (Adobe Systems 2014) and Praat 5.4.12 (Boersma and Weenink 2015). The following steps outline the process.

1. Read passage
    (a) The read passage from one of the speakers was opened in Audacity.
    (b) The time marker was placed just beyond the last audible word.
    (c) The start of the selection was set to 30 seconds prior to the point set in step 1b (the same length as used by Smyth *et al.* (2003)).
    (d) The selection was checked for any unwanted audio - in one case a phone notification sound had gone off, so this was cut out and step 1c was repeated.
    (e) The selection was exported.
    (f) The process was repeated for the rest of the speakers' read passages.
2. Conversation
    (a) The conversation from one of the pairs was opened.
    (b) All of the audio from one speaker was cut out.
    (c) The remaining audio was checked for any content that would clearly reveal the speaker's sexual orientation (as in Smyth *et al.* (2003)), as well as references to political parties and politicians to avoid confounding variables biasing judgement in the perceptual task. Any such content was cut.
    (d) Isolated laughter and speech to the recordist such as "good natural end for you?" was cut as the focus was on speech and the conversation was to be between speakers only.
    (e) Pauses over two seconds in length were trimmed by one second to maximise the amount of speech and therefore the potential number of tokens for phonetic analysis and the stimuli for the perceptual experiment.
    (f) The processes outlined in step 1 were followed.
    (g) The process was repeated for the other speaker in the pair, then the rest of the pairs.
3. Low-pass filtration
    (a) The conversation stimuli created in step 2 were opened in Praat.
    (b) A simple script was created and run to process the speech data using the pass Hann band filter with a frequency range of 0-500 Hz and smoothing of 100 Hz.
    (c) The resulting files were exported.

(d) As the resulting files were considerably less audible than the unfiltered files, the volume was boosted:

i. The files were opened in Adobe Premiere Pro CC 2014.2.

ii. An effect was applied to give them a 6dB universal boost plus a 6dB boost on each channel - effectively a 12dB boost overall.

4. Conversion to video

(a) As the perceptual experiment was to be conducted on a survey platform that did not allow direct embedding of audio files, video files were created:

i. The audio files were opened in Adobe Premiere Pro CC 2014.2.

ii. The first audio file was added to the timeline.

iii. With the video channel left blank, the file was exported using H.264 video encoding and AAC audio encoding at the same sample rate as the original audio files.

iv. Steps 4(a)ii-4(a)iii were repeated for all of the audio files.

5. Randomising the order

(a) The order that the clips would appear within the scalar sections of the perceptual experiment and the pairings of speakers in the forced-choice questions were randomly determined in Microsoft Excel for Mac 15.13.1 (Microsoft Corporation 2015) using a combination of functions including RAND.

(b) As the name of the video files would be visible on the survey platform, they were changed to a letter followed by a number, the letter indicating the type of stimulus (passage, unfiltered conversation or low-pass-filtered conversation) and the number indicating the order in which they would appear.

6. Removing pauses

(a) Pauses were trimmed for the analysis of global pitch:

i. The audio files created in steps 1 and 2 were opened in Praat.

ii. The files were selected and the 'Cut Pauses' script from the Praat vocal toolkit (Corretge 2012) was run.

iii. The resulting files were exported.

3.4.3 Phonetic analysis

The use of the same 30-second audio clips (created in steps 1 and 2 outlined in Section 3.4.2) for both the phonetic analysis and perceptual experiment guaranteed that any phonetic bases to the responses the listeners were making would be those observed, providing a good level of validity when making any correlational assertions.

Whilst the original intention was to observe the prevalence of falsetto via auditory analysis as per Podesva (2007), it quickly became clear that there were very few tokens and therefore this line of inquiry was abandoned. This is perhaps unsurprising given the very different approach taken to gathering speech data than that of Podesva. As detailed in Chapter 2, Podesva had his subject record himself in conversation as and when he and his fellow interlocutors felt comfortable. By contrast, the context of speech data gathering for this study was relatively formal, with the focus very much on getting the data in constructed environments (reading a passage and discussing a topic both of

the researcher's choosing) and in the presence of the researcher. Indeed, falsetto does not appear as a variable in studies of sexual orientation and the voice that observe laboratory-based or controlled speech. Further, the three recordings Podesva chose to analyse were each 30 minutes in length, providing far more potential to find falsetto tokens than in the two 30-second clips per speaker that were used in this study's analysis. Alternatively, the lack of falsetto found in this study could be indicative of Podesva's observations being characteristic of his single subject rather than a larger proportion of gay men (indeed, his focus was on how Heath constructed *his* gay identity), or of speakers of American English/Americans, but this would require further investigation.

This left /s/ and global pitch as measures of phonetic variation. A number of measures were taken to observe /s/ variation. These included single spectral measures taken in the centre of each /s/ token as per Stuart-Smith *et al.* (2003) and measures taken over the central 80% of each /s/ token including duration, intensity as per Mack and Munson (2012) and spectral moments as per Forrest *et al.* (1988) and more recently Fecher (2014) and Kavanagh (2012). Spectral moments are centre of gravity (the point on the spectrogram at which the level of energy on either side is equal), standard deviation (how dispersed the energy is from the centre of gravity), skewness (negative skewness means more energy at a higher frequency and positive skewness the opposite) and kurtosis (the peakedness of the spectrogram). Single spectral measures included peak frequency (the middle of the strongest band of energy on the spectrogram) and low-cut-off frequency (where the main band of energy becomes visible). Measures were taken over the central 80% rather than the whole duration of each /s/ token so as to avoid the coarticulatory effects of adjacent sounds and therefore the accidental inclusion in the analysis of the transitions in and out of each /s/ token.

The audio files created in steps 1 and 2 of Section 3.4.2 (the unfiltered data) were opened in Praat (Boersma and Weenink 2015). The locations of /s/ tokens were then recorded onto text grids using interval markers. /s/ tokens that were particularly unclear or indistinguishable from surrounding vowels or laughter were discarded. /s/ tokens preceding rounded vowels were discarded so as to avoid the impact of anticipatory rounding. Table 3.2 breaks down the number of /s/ tokens by speaker and environment. Once all /s/ tokens were marked up, the text grids were exported to the same directory that held the audio files. The time averaging for fricatives script (DiCanio 2013) was run on the files in Praat in order to output the spectral moment, duration and intensity measures. Single spectral measures were taken manually in Praat through observation of the spectrogram (as in Stuart-Smith *et al.* (2003)).

Speaker	Conversation	Passage
1	13	10
2	12	11
3	14	11
4	15	11
5	15	11
6	14	13
7	15	13
8	9	14

Table 3.2: Number of /s/ tokens by speaker and environment

For measuring global pitch, the audio files with pauses removed as created in step 6 of Section 3.4.2 were opened in Praat. For each file, the entire waveform was selected in the view and edit window and then a measurement of pitch was taken.

3.4.4 Perceptual experiment

The perceptual experiment was conducted in Google Forms (Google 2015), allowing for an unlimited number of questions and easy export of the data into Microsoft Excel for Mac (Microsoft Corporation 2015) or comma-separated values format.

Before the experiment, listeners were presented with information about the study but only told that the focus was on language, rather than specifically on sexual orientation or even identity (as in Munson *et al.* (2006b)). Revealing such information in advance of the experiment itself can lead to priming and the accentuation of stereotyping (Marsh *et al.* 2006).

The main body of the experiment - the part where the perceptual judgements were recorded - was structured into four sections. The first three sections asked listeners to rate their perception of each speaker's sexual orientation on a seven-point semantic-differential scale (Osgood *et al.* 1975) with "definitely gay" on one end and "definitely not gay" on the other. This approach is similar to Gaudio (1994), except that his study problematically treated gay and straight identities as the polar ends of a single continuum, when in fact they are more accurately conceptualised as combinations of points on independent continua or perhaps points on a spectrum (Fisher *et al.* 2011; Killermann 2013; Sedgwick 1990; Storms 1980). In order to further obfuscate the precise focus of the study, listeners were also asked to provide judgements of age, ethnicity, height, masculinity and trustworthiness using a mixture of free-text, multiple-choice and semantical-differential question types. The first section presented the low-pass-filtered audio files for each speaker in the randomised order determined in step 5a of Section 3.4.2. The second section presented the read passage audio files and the third section presented the unfiltered conversation audio files. The fourth section presented listeners with all the unfiltered audio files for two speakers - one gay and one straight - and asked them to determine which speaker was gay, utilising a forced-choice question type and making the precise topic of interest more apparent.

The final questions asked for information on listeners' own identities, including sociodemographic characteristics (age, ethnicity, gender, gender identity and sexual orientation), cultural and linguistic background (first language, country of origin and having lived in the United Kingdom or not) and exposure to LGBT people (broken down and with the examples as in Section 3.1. Once the experiment had been completed, listeners were given full information on its focus.

Four versions of the experiment were created, all using the same stimuli but translated questions, pre- and post-amble and so on: one in English, one in Malay (targeted at Malay speakers) and two in Russian (one targeted at Russians and one at Belarusians, the only difference being the ethnicity categories to which the listeners could identify as belonging). The purpose of the multiple versions was to test hypothesis nine. The specific languages and countries used provided a means of countering the WEIRD tendency (Henrich *et al.* 2010).

Listeners were recruited via university administrators and Facebook groups (as in Campbell-Kibler (2011)) - mostly those linked to universities. Initially the target was linguistics students (as they would likely be the most interested), but this was later broadened to maximise the response rate. LGBT groups were consciously not targeted so as to avoid priming.

Two of the data points were corrected where participants had put their country of origin as the United Kingdom but then stated that they had never lived in the United Kingdom.

3.4.5 Statistical analysis

After initial processing and structuring of the data from the phonetic measurements and perceptual experiment data in Microsoft Excel for Mac (Microsoft Corporation 2015), statistical analysis was conducted using a linear mixed-effects regression model in RStudio 0.99.467 (RStudio Team 2015) (as in Campbell-Kibler (2011)), a front-end to the statistical programming language R (R Core Team 2015). A mixed-effects model was used in order to take account of both random and fixed effects on the data, reducing the likelihood of type I error and enabling findings to be applied to the wider population and not just the small sample observed within the study (Baayen *et al.* 2008). The fixed effects comprised the independent variables outlined in Section 3.1 - the factors manipulated by the researcher and which remain constant (Kreft and de Leeuw 1998). Random effects are the factors that might cause unpredictable variance in the data (Kreft and de Leeuw 1998) and usually represent a sample from a wider population (Green and Tukey 1960) - the speaker for the phonetic data and the listener for the perceptual data. The lme4 R package (Bates *et al.* 2015) was used to run the mixed-effects model (as in Campbell-Kibler (2011)).

For comparison of accuracy of perceptions between semantic-differential and forced-choice judgement questions, the responses to the former were converted to a value between 0 and 1, respectively the equivalent of not accurate and accurate for the binary forced-choice judgements. For gay speakers, a perceived sexual orientation value of 1 (definitely gay) would be coded as 1 for accuracy, while a value of 7 (definitely not gay) would be coded as 0 for accuracy. Values in between were coded as incremental, equidistant steps between the two extremes, as per Table 3.3. For straight speakers, an inverse conversion was made.

Perceived sexual orientation	Accuracy
1 (definitely gay)	1
2	0.83
3	0.67
4	0.5
5	0.33
6	0.17
7 (definitely not gay)	0

Table 3.3: Conversion of scalar perceived sexual orientation to accuracy for gay speakers

Chapter 4

Results

The output of the lme4 R package (Bates *et al.* 2015) when running the linear mixed-effects regression model on the data includes t-statistics, but not p-values as the author argues that there is no robust means of conversion between the two. Further, the reliability of p-values as a measure of significance is increasingly coming under scrutiny (Baayen *et al.* 2008; Cumming 2008; Kline 2004; Plonsky 2015). However, there do exist various means of conversion such as those used by Campbell-Kibler (2011) and Hay *et al.* (2015). As a matter of convenience to the reader, p-values are provided alongside t-statistics throughout, generated using the lmerTest R package (Kuznetsova *et al.* 2015) which uses Satterthwaite's (1946) denominator degrees of freedom approximation. For t-statistics, an α-level of an absolute value of 2 or above (greater than 2 or less than -2) will be used, which is roughly equivalent to a p-value of 0.05 of less (Mulhern and Greer 2011), however there are some instances where the t-statistic would suggest significance where the p-value would not. Due to the imperfect conversion and the debate around the reliability of p-values, the t-statistics should be taken to be the more reliable indicator of significance.

4.1 Phonetic variation

4.1.1 Hypothesis one

Hypothesis one predicted that phonetic variation would correlate with sexual orientation, but that gay and straight speakers would not be completely distinct groups - there would be a level of overlap.

The effect of sexual orientation on /s/ duration went in the opposite direction to Linville (1998), however there was considerable overlap and the effect was not found to be significant (t=1.046; p=0.302). Also non-significant were /s/ intensity (t=1.043; p=0.336) and /s/ low-cut-off frequency (t=-1.143; p=0.297). /s/ centre of gravity was even further from significance (t=0.481; p=0.647) and /s/ spectral kurtosis further still (t=-0.332; p=0.7520). /s/ spectral skew by sexual orientation was also non-significant (t=0.373; p=0.722), unlike the findings of Munson *et al.* (2006b), however it did trend in the same direction with the linear mixed-effects regression model predicting gay speakers to be more negatively skewed than straight speakers by 0.1215.

/s/ standard deviation did significantly correlate with sexual orientation, as shown in Table 4.1. The model predicted gay speakers to have an /s/ standard deviation 583.692 Hz greater than straight speakers. As hypothesised, however, there was overlap between the gay and straight speakers, as shown in Figure 4.1. Three gay speakers (1, 2 and 8) are grouped closely together, with one gay speaker (7) more aligned with

the straight speakers and one straight speaker (4) having a slightly greater standard deviation than the others. Notable, however, is that the gay speakers and the straight speaker with the greatest standard deviation have larger ranges and interquartile ranges than the other straight speakers (3, 5 and 6).

	Estimate	Std. error	*t*-statistic	*p*-value
(Intercept)	2969.095	165.551	17.935	1.62e-06
Straight	-583.692	233.666	-2.498	0.0462

Table 4.1: Effect of sexual orientation on /s/ standard deviation

/s/ peak frequency was also significant, as shown in Table 4.2. The model predicted gay speakers to have a peak frequency 1595.257 Hz greater than straight speakers. This measure appears to be a better correlate with sexual orientation than /s/ standard deviation with very high significance and, as shown in Figure 4.2, there is much less overlap between the gay and straight speakers with the former closely grouped and all predicted higher than all of the straight speakers. Unlike /s/ duration, this finding is in alignment with those of Linville (1998).

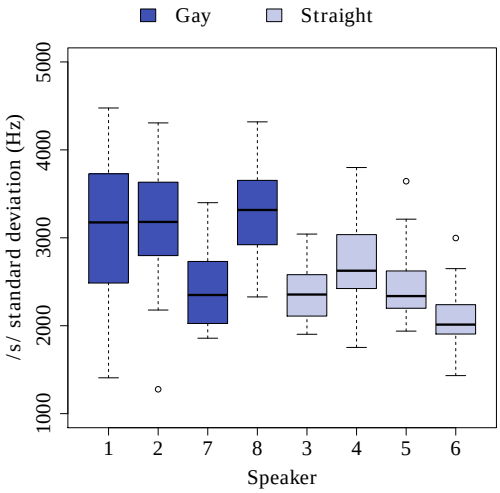

Figure 4.1: /s/ standard deviation by speaker

Also unlike previous studies (Gaudio 1994; Rendall *et al.* 2008; Smyth *et al.* 2003), pitch was found to be a significant correlate with sexual orientation, as shown in Table 4.3. The model predicted gay speakers to have a global pitch 18.616 Hz greater than straight speakers. As shown in Figure 4.3, like /s/ peak frequency, there is very little overlap between gay and straight speakers.

	Estimate	Std. error	*t*-statistic	*p*-value
(Intercept)	9996.989	165.551	37.125	2.07e-08
Straight	-1595.257	233.666	-4.208	0.00567

Table 4.2: Effect of sexual orientation on /s/ peak frequency

	Estimate	Std. error	*t*-statistic	*p*-value
(Intercept)	120.680	3.660	32.974	5.18e-08
Straight	-18.616	5.176	-3.597	0.0114

Table 4.3: Effect of sexual orientation on global pitch

4.1.2 Hypothesis two

Hypothesis two predicted that phonetic variation by sexual orientation would be greater in conversation than in the read passage environment. This was not true of /s/ duration, which did not significantly correlate in conversation (t=1.215; p=0.27) but did

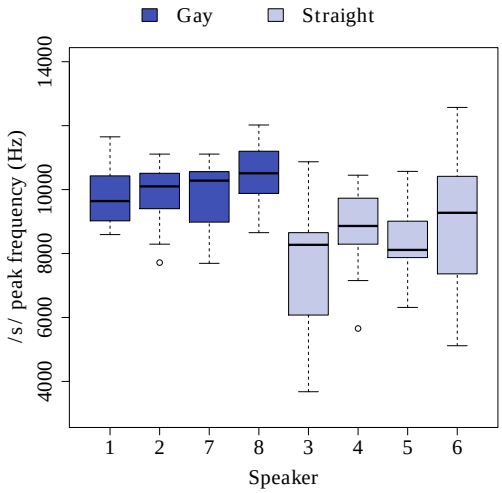

Figure 4.2: /s/ peak frequency by speaker

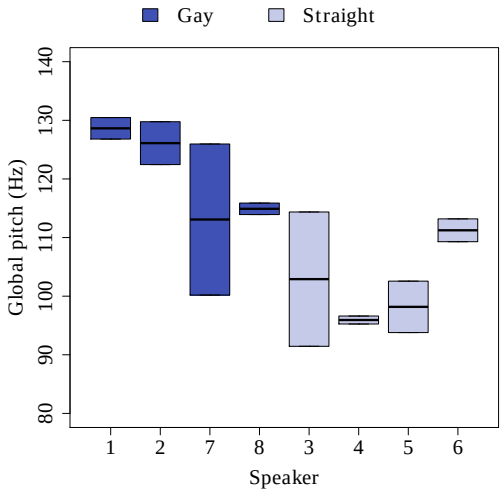

Figure 4.3: Global pitch by speaker

in the passage environment as shown in Table 4.4. As per the overall trend noted in Section 4.1.1, the correlation between sexual orientation and /s/ duration in the read passage environment (and also the trend in the conversation environment) went in the opposite direction to the findings of Linville (1998), with gay speakers producing shorter /s/ tokens. Figure 4.4 illustrates the interaction between sexual orientation and environment for /s/ duration.

Similarly, /s/ standard deviation went against the hypothesis with a significant correlation present only in the read passage environment (conversation: t=-1.775; p=0.125), as shown in Table 4.5. Figure 4.5 illustrates this.

	Estimate	Std. error	t-statistic	p-value
(Intercept)	0.071792	0.004928	14.569	9.65e-06
Straight	0.015389	0.007013	2.194	0.0714

Table 4.4: Effect of sexual orientation on /s/ duration in the read passage environment

	Estimate	Std. error	t-statistic	p-value
(Intercept)	2922.635	137.318	21.284	5.2e-07
Straight	-691.647	194.526	-3.556	0.0113

Table 4.5: Effect of sexual orientation on /s/ standard deviation in the read passage environment

Supporting the hypothesis is /s/ peak frequency, which was non-significant in the passage environment (t=-1.802; p=0.122), but was significant in conversation as shown in Table 4.6. Figure 4.6 illustrates the interaction between sexual orientation and environment for /s/ peak frequency.

As there was only one measurement for global pitch per speaker per environment, it was not possible to run a linear mixed-effects regression model by environment with speaker as a random effect, so instead a linear regression model was run. As shown in Tables 4.7 and 4.8, the model predicted the effect of sexual orientation on global pitch to be significant in both environments, with the effect slightly greater in the passage environment, but further beyond the α-level in conversation. Figure 4.7 illustrates this.

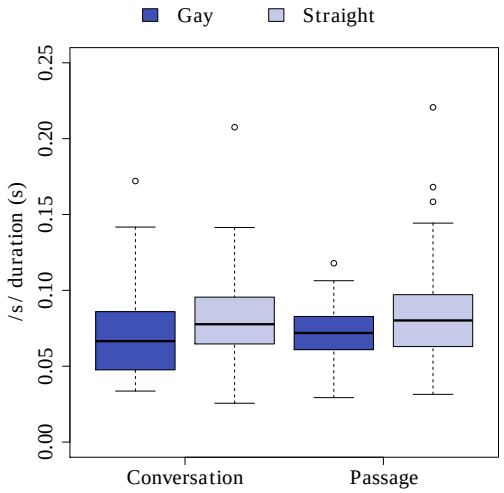

Figure 4.4: /s/ duration by sexual orientation and environment

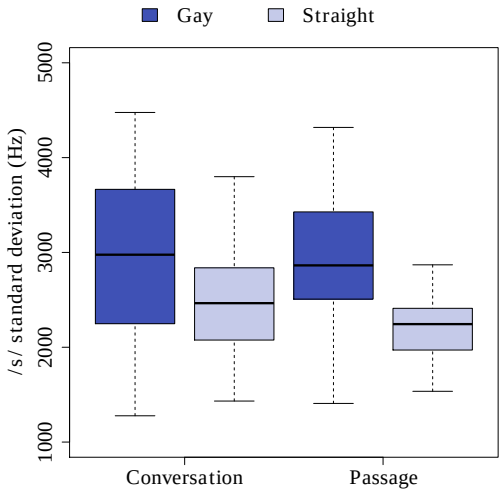

Figure 4.5: /s/ standard deviation by sexual orientation and environment

	Estimate	Std. error	*t*-statistic	*p*-value
(Intercept)	9702.050	381.787	25.412	1.12e-07
Straight	-1962.505	534.515	-3.672	0.00994

Table 4.6: Effect of sexual orientation on /s/ peak frequency in conversation

	Estimate	Std. error	*t*-statistic	*p*-value
(Intercept)	122.773	3.665	33.50	4.71e-08
Straight	-16.432	5.183	-3.17	0.0193

Table 4.7: Effect of sexual orientation on global pitch in conversation

	Estimate	Std. error	*t*-statistic	*p*-value
(Intercept)	118.587	5.831	20.337	9.19e-07
Straight	-20.801	8.247	-2.522	0.0451

Table 4.8: Effect of sexual orientation on global pitch in the read passage environment

The effect of sexual orientation was non-significant in both environments for /s/ intensity (conversation: t=0.937; p=0.385; passage: t=0.946; p=0.381), /s/ centre of gravity (conversation: t=1.118; p=0.306437; passage: t=-0.10; p=0.924), /s/ spectral skew (conversation: t=-0.320; p=0.7607; passage: t=0.789; p=0.460), /s/ kurtosis (conversation: t=-1.028; p=0.3571; passage: t=0.375; p=0.721) and /s/ low-cut-off frequency (conversation: t=-0.987; p=0.361912; passage: t=-1.012; p=0.35).

4.1.3 Hypothesis three

Hypothesis three predicted that phonetic variation would correlate with speakers' exposure to LGBT people, accounting for some of the overlap in hypothesis one. This was overwhelmingly disproven. Models were run to test the effect of early exposure, current exposure and total exposure (the aggregate of early and current exposure, creating a six-point scale low to high) on each of the phonetic variables. Only three out of the 27 models showed any significance and two of these had inconsistent effects across

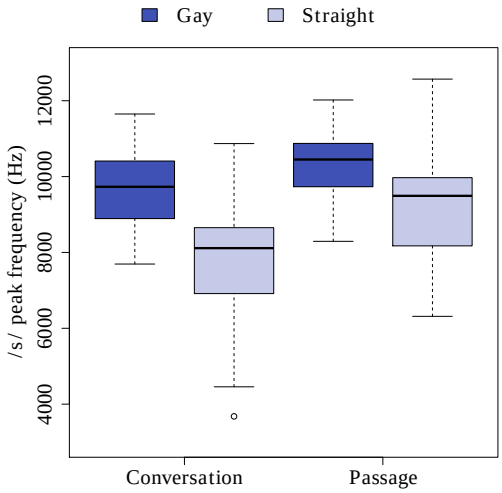

Figure 4.6: /s/ peak frequency by sexual orientation and environment

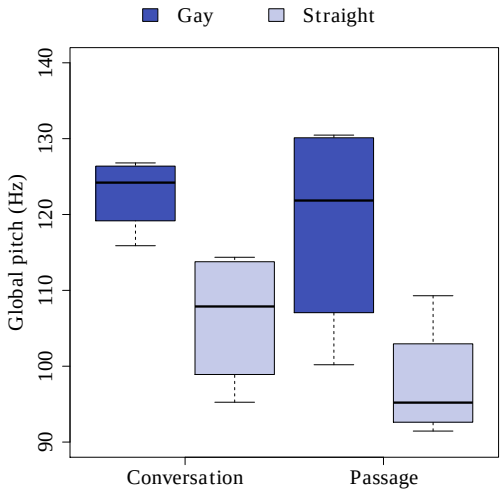

Figure 4.7: Global pitch by sexual orientation and environment

different levels of exposure, suggestive of a confounding variable. One model predicted high early exposure to produce a significantly higher /s/ centre of gravity than low early exposure by 2095.328 Hz (t=3.483; p=0.0186). Another predicted medium early exposure to produce a significantly lower /s/ peak frequency than low early exposure by 1510.603 Hz (t=2.020; p=0.0992), but the effect was smaller and non-significant for high early exposure at 280.271 Hz lower (t=-0.376; p=0.7227). Another predicted a total exposure value of 5 to produce significantly more intense /s/ than the intercept of 3 by 5.1652 dB (t=2.467; p=0.0677), however the size of the effect was again inconsistent across different values, with a value of 6 differing from the intercept to a much lesser degree at 0.5748 dB more intense (t=0.226; p=0.8322).

4.2 Perceptual variation

4.2.1 Hypothesis four

Hypothesis four predicted that perceptions of sexual orientation would directly correlate with phonetic variation. This was true of /s/ duration, as shown in Table 4.9. However, as illustrated by Figures 4.8 and 4.9, this is in the opposite direction to the findings of Smyth and Rogers (2002) with a longer duration decreasing the likelihood of being perceived as gay, which also goes against the acceptance of the null hypothesis in Levon (2006, 2007).

	Estimate	Std. error	t-statistic	p-value
(Intercept)	2.3266	0.2979	7.810	2.13e-14
Mean /s/ duration	25.4611	3.5781	7.116	2.85e-12

Table 4.9: Effect of /s/ duration on perceived sexual orientation

As shown in Table 4.10, also significant was the effect of /s/ centre of gravity on perceived sexual orientation, a correlation which has not previously been explored. However, as shown in Figures 4.10 and 4.11, it follows the direction that would be expected given previous findings on /s/ peak frequency (Mack and Munson 2012; Smyth

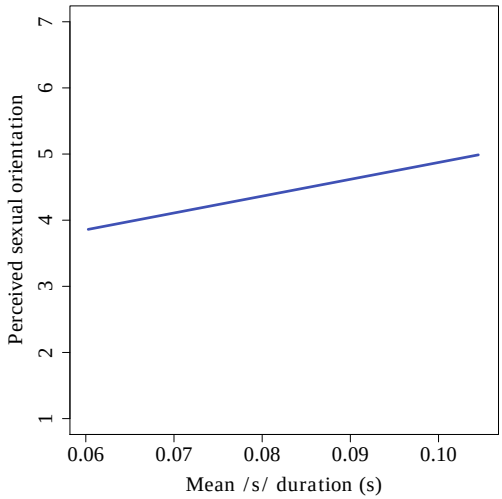

Figure 4.8: Perceived sexual orientation by mean /s/ duration based on model prediction

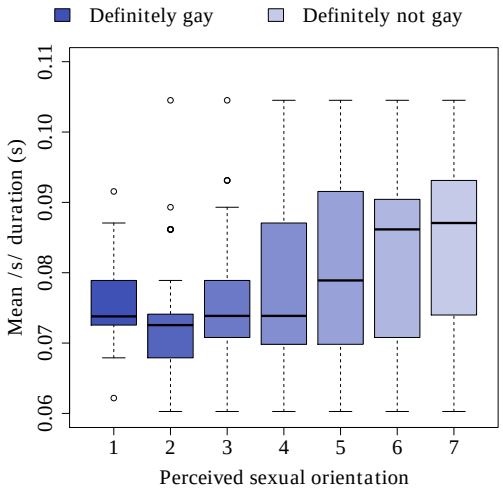

Figure 4.9: Mean /s/ duration by perceived sexual orientation

and Rogers 2002) and the likelihood of crossover with this measure.

/s/ standard deviation was also a significant correlate, as shown in Table 4.11 and illustrated in Figures 4.12 and 4.13. The greater the standard deviation, the greater the likelihood of being perceived as gay.

	Estimate	Std. error	t-statistic	p-value
(Intercept)	5.248	2.285e-01	22.967	<2e-16
Mean /s/ centre of gravity	-1.535e-04	3.423e-05	-4.485	8.55e-06

Table 4.10: Effect of /s/ centre of gravity on perceived sexual orientation

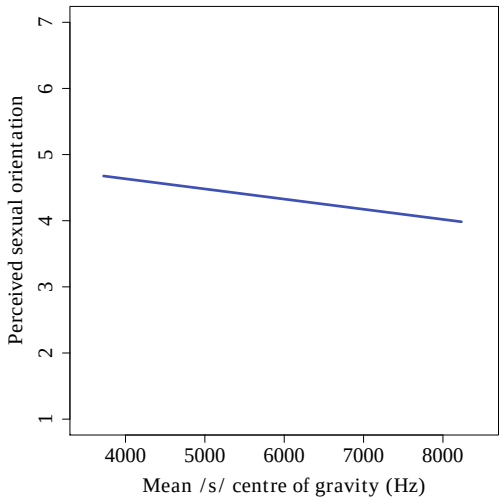

Figure 4.10: Perceived sexual orientation by mean /s/ centre of gravity based on model prediction

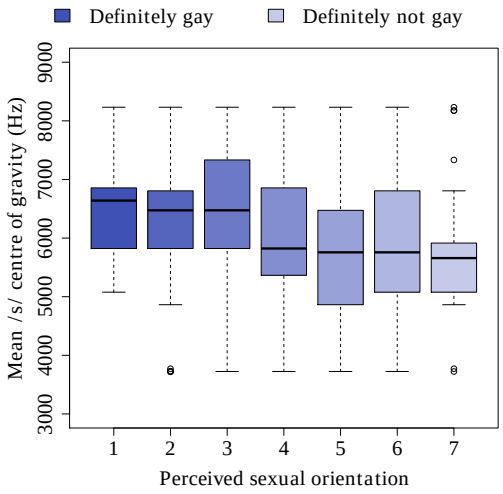

Figure 4.11: Mean /s/ centre of gravity by perceived sexual orientation

	Estimate	Std. error	t-statistic	p-value
(Intercept)	5.377	2.863e-01	18.79	<2e-16
Mean /s/ standard deviation	-3.946e-04	1.007e-04	-3.92	9.75e-05

Table 4.11: Effect of /s/ standard deviation on perceived sexual orientation

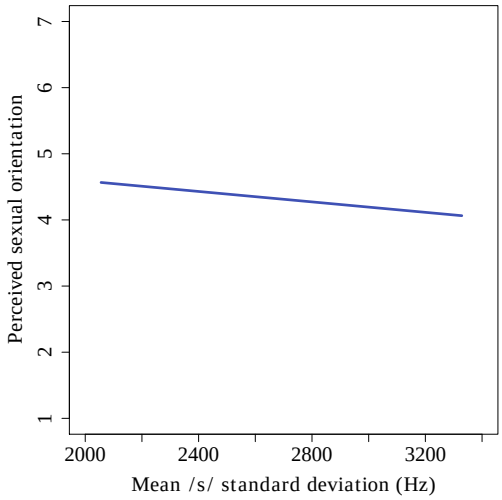

Figure 4.12: Perceived sexual orientation by mean /s/ standard deviation based on model prediction

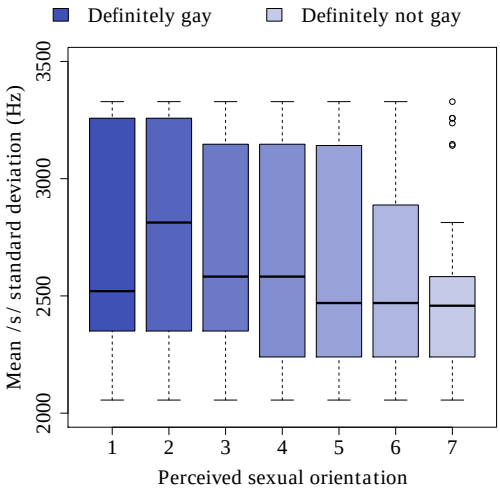

Figure 4.13: Mean /s/ standard deviation by perceived sexual orientation

/s/ spectral skew was also significant as shown in Table 4.12. Unlike its correlation with actual sexual orientation, however, its effect on perceived sexual orientation was in line with previous research (Mack and Munson 2012; Munson *et al.* 2006b): a more negatively skewed spectrum increased the likelihood of being perceived as gay, as illustrated by Figures 4.14 and 4.15.

	Estimate	Std. error	t-statistic	p-value
(Intercept)	4.15859	2.863e-01	18.79	<2e-16
Mean /s/ spectral skew	-3.946e-04	1.007e-04	-3.92	9.75e-05

Table 4.12: Effect of /s/ spectral skew on perceived sexual orientation

/s/ kurtosis also significantly correlated with perceived sexual orientation as shown in Table 4.13, with more peaked /s/ being less likely to be perceived as gay as illustrated by Figures 4.16 and 4.17.

/s/ peak frequency also had a significant effect on perceptions of sexual orientation as shown in Table 4.14. This was in line with previous findings (Mack and Munson 2012; Smyth and Rogers 2002) with a higher peak frequency correlating with increased likelihood of being perceived as gay as illustrated by Figures 4.18 and 4.19.

	Estimate	Std. error	t-statistic	p-value
(Intercept)	4.12870	0.11154	37.016	<2e-16
Mean /s/ kurtosis	0.10388	0.02683	3.872	0.000118

Table 4.13: Effect of /s/ kurtosis on perceived sexual orientation

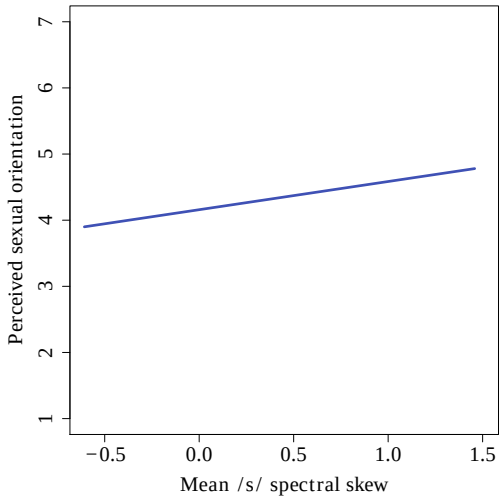

Figure 4.14: Perceived sexual orientation by mean /s/ spectral skew based on model prediction

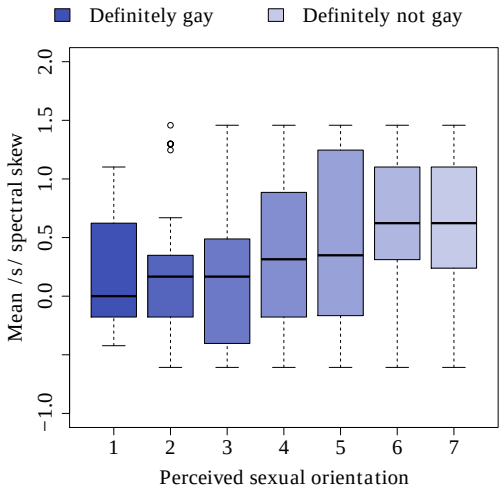

Figure 4.15: Mean /s/ spectral skew by perceived sexual orientation

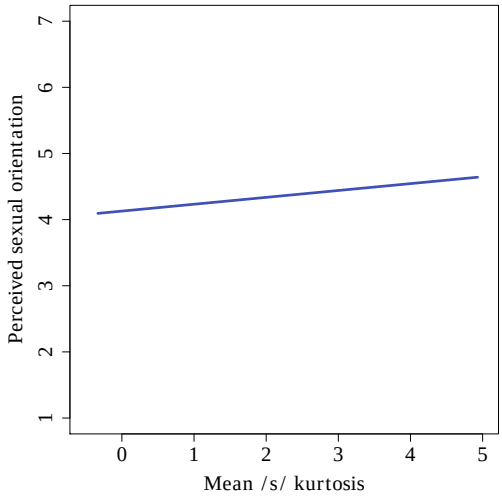

Figure 4.16: Perceived sexual orientation by mean /s/ kurtosis based on model prediction

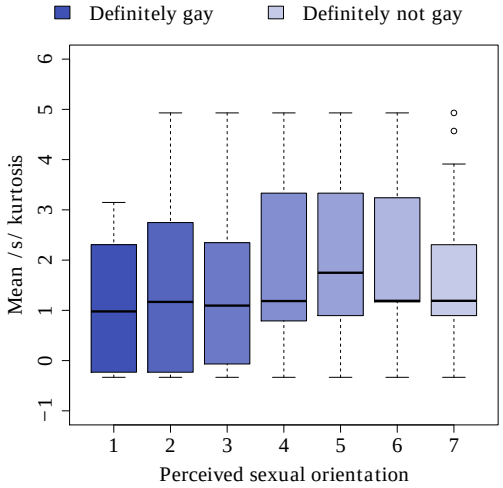

Figure 4.17: Mean /s/ kurtosis by perceived sexual orientation

	Estimate	Std. error	*t*-statistic	*p*-value
(Intercept)	6.834	3.468e-01	19.70	<2e-16
Mean /s/ peak frequency	-2.719e-04	3.602e-05	-7.55	1.41e-13

Table 4.14: Effect of /s/ peak frequency on perceived sexual orientation

The final phonetic variable to correlate with perceived sexual orientation was global pitch, as shown in Table 4.15. The higher the pitch, the more likely speakers were to be perceived as gay as illustrated by Figures 4.20 and 4.21. This is in line with Levon (2007), but goes against the acceptance of the null hypothesis by the study that preceded it (Levon 2006).

The only phonetic variables that did not correlate with perceived sexual orienta-

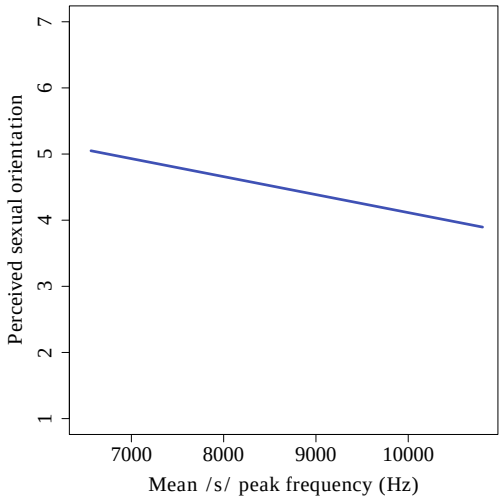

Figure 4.18: Perceived sexual orientation by mean /s/ peak frequency based on model prediction

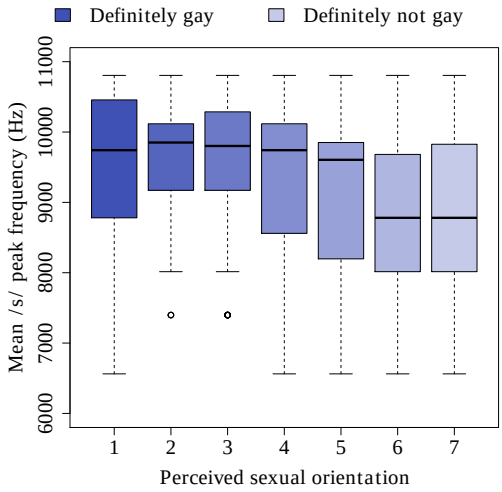

Figure 4.19: Mean /s/ peak frequency by perceived sexual orientation

	Estimate	Std. error	t-statistic	p-value
(Intercept)	6.39745	0.38176	16.758	<2e-16
Global pitch	-0.01861	0.00331	-5.622	2.76e-08

Table 4.15: Effect of global pitch on perceived sexual orientation

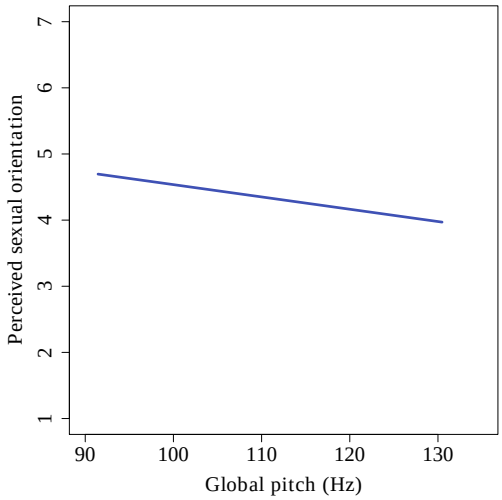

Figure 4.20: Perceived sexual orientation by global pitch based on model prediction

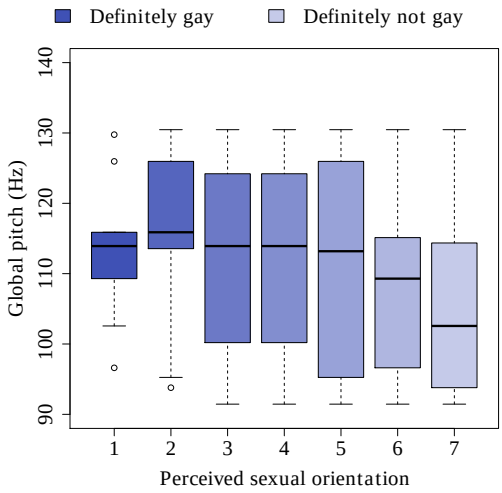

Figure 4.21: Global pitch by perceived sexual orientation

tion were /s/ intensity (t=-0.062; p=0.951) and /s/ low-cut-off frequency (t=-1.588; p=0.113). To compare the relative effects of the significant correlates, a model was run including each of them, the results of which are displayed in Table 4.16. This shows that global pitch explains the largest amount of the variation in the data (in stark contrast with Levon (2006)), followed by /s/ centre of gravity and then /s/ peak frequency.

	Estimate	Std. error	*t*-statistic	*p*-value
(Intercept)	1.017e+01	1.306	7.789	2.55e-14
Mean /s/ centre of gravity	-2.790e-04	1.254e-04	-2.226	0.0264
Mean /s/ standard deviation	-2.312e-04	2.257e-04	-1.024	0.3061
Mean /s/ spectral skew	-2.933e-01	2.944e-01	-0.996	0.3195
Mean /s/ kurtosis	8.028e-02	5.875e-02	1.366	0.1723
Mean /s/ peak frequency	-1.412e-04	7.125e-05	-1.982	0.0479
Mean global pitch	-2.055e-02	4.384e-03	-4.687	3.36e-06

Table 4.16: Effect of significant phonetic correlates on perceived sexual orientation

4.2.2 Hypothesis five

Hypothesis five predicted that perceptions of sexual orientation would correlate with actual sexual orientation, but with some overlap due to lack of complete phonetic distinctiveness between the two groups, and that accuracy would be greater for straight speakers. The model supported the first part of the hypothesis, as shown in Table 4.17, and Figure 4.22 shows clear overlap with speaker 6 (straight) identical to speakers 2 and 7 (gay), and speaker 4 (straight) sharing the same median as the gay speakers. The model also supported the final part of the hypothesis and the findings of previous studies (Carahaly 2000; Linville 1998; Smyth *et al.* 2003) other than Piccolo (2008), with straight speakers more accurately perceived as shown in Table 4.18 and illustrated in Figure 4.23. Gay speakers were actually only accurately perceived 49.48% of the time - less than the rate of chance and far below straight speakers who were accurately perceived 60.37% of the time.

	Estimate	Std. error	*t*-statistic	*p*-value
(Intercept)	4.0250	0.1081	37.248	<2e-16
Straight	0.6000	0.0850	7.059	4.18e-12

Table 4.17: Effect of actual sexual orientation on perceived sexual orientation

	Estimate	Std. error	*t*-statistic	*p*-value
(Intercept)	0.49578	0.01278	38.782	<2e-16
Straight	0.10792	0.01564	6.899	1.21e-11

Table 4.18: Effect of speaker sexual orientation on perceptual accuracy

4.2.3 Hypothesis six

Hypothesis six predicted that perceptions of sexual orientation would more accurately reflect actual sexual orientation in conversation than in the read passage environment. The model did not support this hypothesis (t=-0.644; p=0.52), predicting conversation to elicit only a 0.99% greater accuracy rate than in the read passage environment.

4.2.4 Hypothesis seven

Hypothesis seven predicted that perceptions of sexual orientation would correlate with speakers' exposure to LGBT people (more likely to be perceived as gay if more exposed to LGBT people), accounting for some of the overlap in hypothesis five. As shown in Table 4.19, speakers with medium early exposure were significantly less likely to

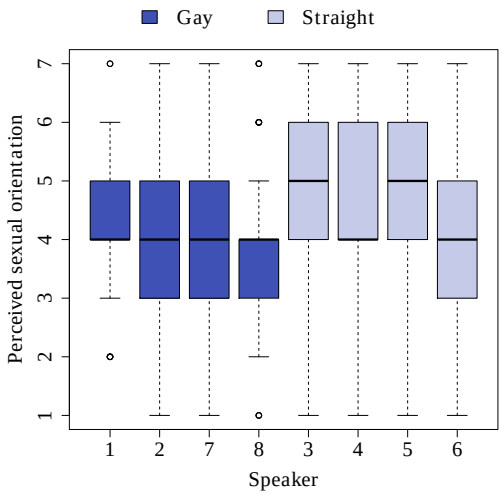

Figure 4.22: Perceived sexual orientation by speaker

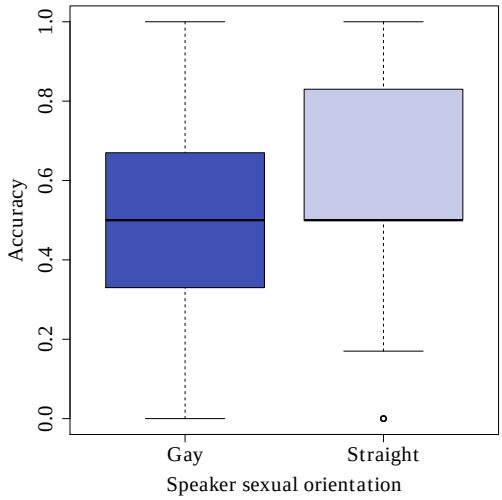

Figure 4.23: Perceptual accuracy by speaker sexual orientation

be rated as gay than those with low early exposure, whilst speakers with high early exposure were more likely to be rated as gay but the difference was non-significant. Setting the intercept to medium early exposure, we can see in Table 4.20 that the difference between this and high early exposure is significant with the latter increasing the likelihood of being rated as gay. The effect of early exposure is illustrated by Figure 4.24.

No speakers identified their current level of exposure as low, so the model only compared medium with high current exposure. The difference here was found to be significant, as shown in Table 4.21 and illustrated by Figure 4.25.

As in hypothesis three, the effect of total exposure was also analysed using the aggregate of early and current exposure - if listeners did not provide values for both early and current exposure, their data were discarded for this analysis. This effect was not significant (intercept=3; 4: t=1.852; p=0.644; 5: t=-0.314; p=0.7534; 6: t=-1.430; p=0.1533) and like early exposure the direction was inconsistent.

	Estimate	Std. error	t-statistic	p-value
(Intercept)	4.2500	0.1083	39.245	<2e-16
Medium	0.4722	0.1056	4.474	9.02e-06
High	-0.1722	0.1056	-1.632	0.103

Table 4.19: Effect of early speaker exposure on perceived sexual orientation

	Estimate	Std. error	t-statistic	p-value
(Intercept)	4.7222	0.1243	38.002	<2e-16
Low	-0.4722	0.1056	-4.474	9.02e-06
High	-0.6444	0.1219	-5.287	1.68e-07

Table 4.20: Effect of early speaker exposure on perceived sexual orientation with medium as the intercept

	Estimate	Std. error	t-statistic	p-value
(Intercept)	4.42500	0.10861	40.743	<2e-16
High	-0.20000	0.08774	-2.279	0.023

Table 4.21: Effect of current speaker exposure on perceived sexual orientation (intercept=medium)

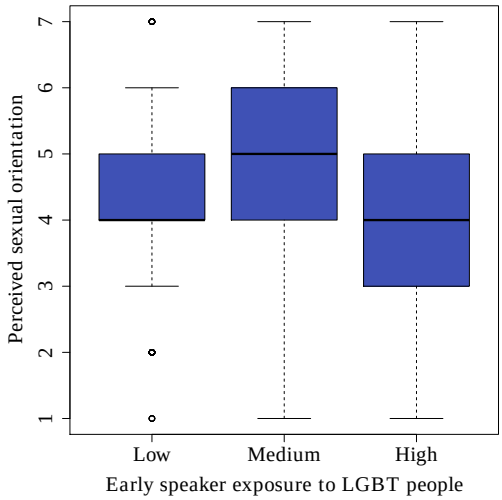

Figure 4.24: Perceived sexual orientation by early speaker exposure

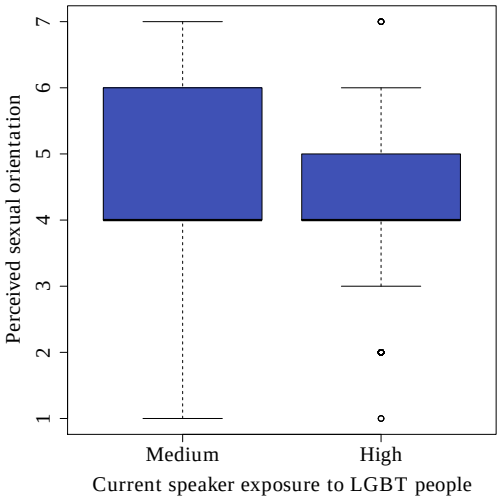

Figure 4.25: Perceived sexual orientation by current speaker exposure

4.2.5 Hypothesis eight

Hypothesis eight predicted that accuracy of perceptions of sexual orientation would be greater for listeners with higher exposure to LGBT people. There was no effect of either early (medium: t=0.730; p=0.470; high: t=1.419; p=0.163) or current listener exposure (medium: t=1.121; p=0.269; high: t=1.391; p=0.172). However, listener total listener exposure was predicted by the model to be a significant correlate with accuracy, as shown in Table 4.22, but only between exposure levels of 2 and 6 and the direction of this effect was inconsistent as shown by Figure 4.26.

	Estimate	Std. error	t-statistic	p-value
(Intercept)	0.51257	0.02201	23.293	<2e-16
3	0.02759	0.03208	0.860	0.3949
4	0.05338	0.02671	1.998	0.0525
5	0.01368	0.03967	0.345	0.7320
6	0.07656	0.03682	2.079	0.0441

Table 4.22: Effect of total listener exposure on perceptual accuracy

4.2.6 Hypothesis nine

Hypothesis nine predicted that accuracy of perceptions of sexual orientation would be greater for listeners who were LGB and/or from the United Kingdom and/or had lived in the United Kingdom and/or spoke English as their first language. The model found no effect of listener sexual orientation (t=-0.299; p=0.766), nor being from the United

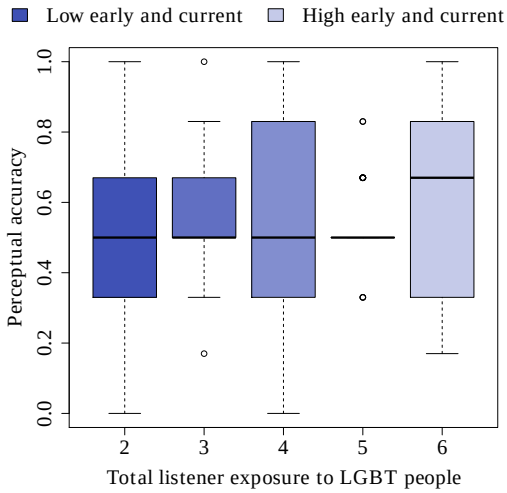

Figure 4.26: Perceptual accuracy by total listener exposure

Kingdom (t=-0.756; p=0.454), nor having lived in the United Kingdom (t=0.156; p=0.876), nor first language (t=-0.424; p=0.673).

4.2.7 Hypothesis ten

Hypothesis ten predicted that accuracy of perceptions of sexual orientation would be greater with segmental information than without, but a positive correlation between actual and perceived sexual orientation would be present in the latter. For this hypothesis, only the conversation data was used in order to control for confounding variables (as the low-pass-filtered data did not include the read passage environment). The model did predict a significant correlation between environment and accuracy as shown in Table 4.23, with low-pass filtration predicted to reduce accuracy by 5.41%. The effect is illustrated in Figure 4.27, and Figure 4.28 shows how perceptions of speakers by actual sexual orientation are affected by low-pass filtration. To test the second half of the hypothesis, the correlation between actual and perceived sexual orientation for the low-pass-filtered data was modelled and found to be non-significant (t=0.059; p=0.953).

	Estimate	Std. error	t-statistic	p-value
(Intercept)	0.55469	0.01176	47.154	<2e-16
Low-pass filtered	-0.05408	0.01664	-3.251	0.0012

Table 4.23: Effect of low-pass filtration on perceptual accuracy

4.2.8 Hypothesis eleven

Hypothesis eleven predicted that accuracy of perceptions of sexual orientation would be greater when in a forced-choice scenario where speakers must identify which of two speakers is gay than in a scalar judgment scenario with greater freedom. The model very strongly supported this hypothesis, as shown in Table 4.24. Indeed, for forced-choice questions the mean accuracy was 73.89%, much higher than the mean accuracy of 53.34% for scalar questions. The effect is illustrated in Figure 4.29.

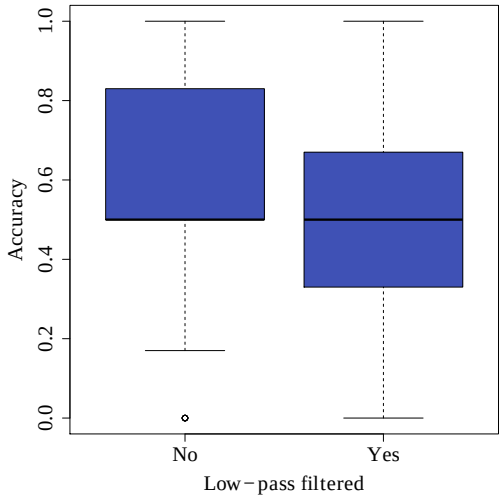

Figure 4.27: Perceptual accuracy by low-pass filtration

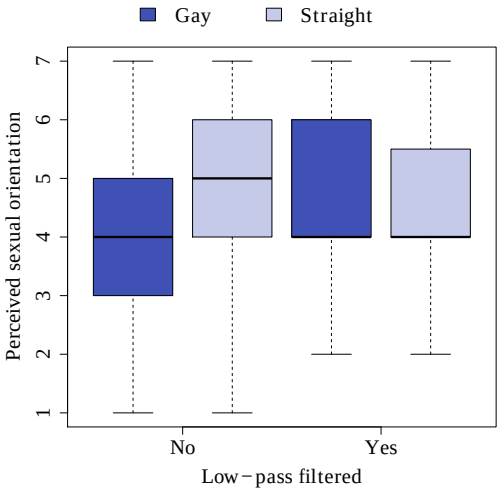

Figure 4.28: Perceived sexual orientation by actual sexual orientation and low-pass filtration

	Estimate	Std. error	t-statistic	p-value
(Intercept)	5.334e-01	9.548e-03	55.858	<2e-16
Forced choice	2.055e-01	2.104e-02	9.771	<2e-16

Table 4.24: Effect of question type on perceptual accuracy

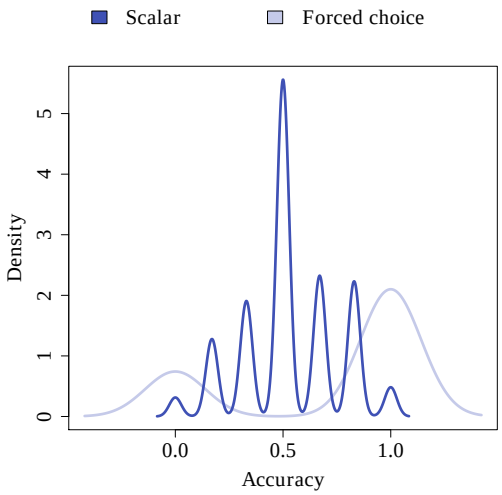

Figure 4.29: Perceptual accuracy by question type

Chapter 5

Discussion

5.1 Summary of findings

5.1.1 Phonetic variation

Both /s/ standard deviation and global pitch were found to be significant correlates with sexual orientation but with some level of overlap. The finding that pitch correlated with sexual orientation goes against previous findings (Gaudio 1994; Rendall *et al.* 2008; Smyth *et al.* 2003), all of which were based on North American English speakers. A case could therefore be made that previous findings have been affected by the speakers' cultural or linguistic backgrounds as a confounding variable. This would certainly be a possibility in the case of Gaudio (1994), where the liberal, highly LGBT-friendly environment in which the speakers were based would no doubt have led to higher levels of exposure to LGBT people and potentially accommodation and assimilation, though the findings regarding the effect of exposure in this study serve to downplay this explanation. /s/ standard deviation has not previously been observed, however it is unsurprising to find a significant correlation here given the status of the phonetic variable /s/ as a prime correlate together with previous observations of global pitch range - like standard deviation, a measure of variance - as a correlate. Overall, however, /s/ peak frequency proved to be the best correlate for sexual orientation with no overlap between gay and straight speakers and a strong level of significance. This variable has previously been found to be a good correlate by Linville (1998). Unlike Linville, /s/ duration was not found to be a significant correlate and it trended in the opposite direction: gay speakers were predicted by the model to have shorter /s/ tokens. Unlike Munson *et al.* (2006b), /s/ spectral skew was not found to be a significant correlate, but it did trend in the same direction with gay speakers predicted to produce a more negatively-skewed spectrogram. Based on these results, hypothesis one can be partially rejected and partially accepted. The majority of variables do not correlate with sexual orientation. Of those that do, two displayed some level of overlap and one did not.

Breaking it down by environment - conversation and read passage - the effect of sexual orientation on /s/ standard deviation was only significant in the passage environment, whilst for /s/ peak frequency it was only significant in conversation. For global pitch it was significant in both with greater significance in conversation but a greater effect in the read passage environment. The only phonetic variable to show significance in a specific environment that did not show significance overall was /s/ duration, which went beyond the α-level only in the passage environment. These findings do not conclusively suggest that conversation leads to greater differentiation in speech production by sexual orientation and therefore the null hypothesis must be accepted.

The finding that phonetic variation did not correlate with speaker exposure to LGBT people could suggest that an accommodation model - in which speakers adjust their speech production to accommodate to those with whom they have regular face-to-face interaction - does not satisfactorily explain phonetic variation by sexual orientation. Such a conclusion should not be drawn lightly for a couple of reasons. Firstly, the measure of exposure to LGBT people was based on the speakers' own perceptions and not verified by interviews, long-term ethnographic work as in Levon (2009, 2010) or in-depth personal knowledge of the study's subjects as in Podesva (2007, 2008, 2011a, 2011b). Each individual might perceive their level of exposure differently to the next based primarily upon their individual perception of a baseline exposure level. Secondly, even if the speakers are highly exposed to openly LGBT people, they will undoubtedly still be more exposed people who do not identify as LGBT, given that the majority of people in British society do not openly identify as LGBT (regardless of whether or not they are). If future research accounted for these limitations and found the same results, it could be posited that variation by sexual orientation is based on aspiration rather than accommodation, corroborating Levon's (2009, 2010) findings that speakers modulate their speech production as a tool for expressing their gay identity in a way that reflects where they wish to situate themselves within society.

5.1.2 Perceptual variation

Corroborating the argument that linguistic or cultural variation exists in the expression of a gay identity - based on the observation of /s/ duration correlating with sexual orientation in the opposite direction to that of previous findings (Linville 1998) - is the finding that perceived sexual orientation is also affected by /s/ duration differently to that of previous studies on North American English (Levon 2006; Levon 2007; Smyth and Rogers 2002). This study showed that the longer the /s/ duration, the less likely speakers were to be perceived as gay, the opposite of Smyth and Rogers (2002) which was based on speakers of Canadian English and also contradicting the acceptance of null hypothesis by Levon (2006, 2007) who observed speakers of American English.

Other phonetic variables that significantly correlated with perceived sexual orientation included /s/ centre of gravity, /s/ standard deviation, /s/ spectral skew, /s/ kurtosis, /s/ peak frequency and global pitch, leaving only /s/ intensity and /s/ low-cut-off frequency as non-significant predictors. This overwhelmingly supports the hypothesis that perceived sexual orientation is determined by phonetic variation.

The significant correlation between actual and perceived sexual orientation would on the surface suggest that listeners are reasonably good at picking up on phonetic cues for sexual orientation, however this is not particularly well backed up by the overall mean accuracy rate of 54.97%, only slightly greater than chance. The accuracy for rating speakers who actually identified as gay was lower than chance at 49.58%, much lower than straight speakers at 60.37% - this contrast being in line with the findings of previous research (Carahaly 2000; Linville 1998; Smyth *et al.* 2003). Listeners could be identifying only a subset of gay men as gay-sounding. This does not necessarily mean that listeners are unaware of the diversity of gay men's voices (though it could); an alternative explanation is that they are aware but when forced to make a judgement all they are able to base it on are obvious, stereotypical cues, which are only reflective of some and not all gay men. Indeed, there were a few participants who universally or almost-universally opted for the neutral response in the scalar judgements, no doubt a conscious acknowledgement of the diversity of gay men's voices. A couple of individuals even decided to withdraw their responses part-way through as they felt uncomfortable

judging people's characteristics and that this was not possible from the voice.

It is important to note, however, that the accuracy level here is largely influenced by the choice to convert the scalar definitely gay to definitely not gay judgements into equidistant decimal values. An alternative conversion in which all perceived orientation values on the not gay side were converted to 1 and all values on the gay side to 0 would have had an effect on the overall mean accuracy rate. Indeed, in the forced-choice scenario where the accuracy values were binary, the overall mean accuracy was far greater at 73.89%. This difference could in part be explained by the binary system of accuracy. It could also be evidence that when forced to make a choice between two extremes (with no neutral or non-committal options), listeners are reasonably good at perceiving sexual orientation. A third explanation of the difference is that people are better at perceiving sexual orientation in the voice when the judgement is relative to another person - if they know that one of two people is gay, then they are quite capable of perceiving relative differences in speech production and making the associations.

Returning briefly to the scalar judgements, one limitation of the experiment is that these could be interpreted in at least two ways. The intended interpretation was confidence that a speaker did or did not sound gay, with the lowest point representing complete certainty that the speaker was gay, one step up representing less certainty and so on and the inverse on the other end of the scale. Though this interpretation is what the labels on each end the scale ("definitely gay" and "definitely not gay") should provide, there is the potential for an alternative interpretation. Listeners could have interpreted the "definitely" in "definitely gay" not to represent certainty in judgement but rather to represent a perhaps more expressive judgement of the perceived level of gayness: *definitely* gay. The lowest point on the scale could to some listeners have represented speakers who embodied, as Crist (1997:53) would put it, "the queeniest, most flaming gay stereotype", and the third point might have been occupied by speakers such as those in Levon's (2010) mainstream group, who wished to regulate the expression of their gay identity in order to assimilate with or accommodate a heteronormative society. These conflicting interpretations could have created a set of results corresponding to two (or perhaps more) different scales. Future studies asking listeners for such judgements could go further in making explicit what listeners are being asked - without swelling the preamble - by splitting the response into the two questions that in essence it was asking:

1. What do you believe to be the speaker's sexual orientation?
2. How sure are you?

The first would be a forced, multiple-choice question (gay/not gay or gay/straight and possibly other) and the second would be scalar. This would add an extra level of complexity to the subsequent analysis, but would mitigate for misinterpretation of the question and therefore provide a greater guarantee that the results were sound.

Moving on, the effects of speaker and listener exposure were largely inconclusive, with significance in some areas but mostly accompanied by inconsistent directionality. This points to the likelihood that if an effect of exposure does exist, it is a small one - for listeners, only the two extremes of total exposure showed any level of significant difference. It would therefore require a considerably larger dataset in order to identify any significant effect, particularly for speaker exposure in which there were only eight different speakers for comparison.

The results of low-pass filtration indicate that segmental features are very important in the perception of sexual orientation, with perceptual accuracy for filtered data negligibly greater than chance.

There was no effect of environment suggesting style that it is not a pertinent factor, unlike the findings of Smyth *et al.* (2003). However, both environments in this study were relatively formal and focused around the elicitation of speech data, with speakers very aware of this and the researcher sat at the same table throughout. The effect may have been greater if comparing laboratory-recorded word lists to self-recorded conversation in everyday life as in Podesva (2007, 2008, 2011a, 2011b).

Also non-significant was linguistic and cultural background. However, due to the low number of participants from Malaysia and Belarus, and whose first language was Malay or Belarusian, this study could only consider a binary dimension of United Kingdom versus everyone else and first language English speakers versus everyone else, meaning people from WEIRD (Henrich *et al.* 2010) countries would feature in both groups. The same would be true of the groups for having or not having lived in the United Kingdom.

5.2 Implications and future research

To identify the implications of the study and suggest areas for future research, we will first return to the research questions:

1. How does sexual orientation affect phonetic variation in Northern England English and how does this interact with style and exposure to LGBT people?

2. How accurate are perceptions of sexual orientation based on Northern England English speech and how does this interact with phonetic variables, style, speaker and listener exposure to LGBT people, listener linguistic and cultural background, segmental features and judgemental constraints?

The study found that sexual orientation did affect phonetic variation in Northern England English, but that there was inconclusive evidence of the effect of style - some phonetic variables correlating with sexual orientation only in conversation and others only in the read passage environment - and no interaction with exposure to LGBT people. Importantly, the specific phonetic variables correlating or not correlating with sexual orientation provided novel findings. The lack of an effect on /s/ duration and /s/ spectral skew and the presence of an effect on global pitch went against North American findings (Gaudio 1994; Linville 1998; Munson *et al.* 2006b; Rendall *et al.* 2008; Smyth *et al.* 2003), whilst the finding that /s/ peak frequency did correlate supported them (Linville 1998) and the finding that /s/ standard deviation was a good correlate identifies an unexplored area for future research.

The study found that perceptions of sexual orientation are a little greater than chance, but like previous findings (Carahaly 2000; Linville 1998; Smyth *et al.* 2003) except those of Piccolo (2008), they are significantly greater for straight speakers than gay speakers. Style showed no effect. Both speaker and listener exposure played inconsistent roles in perceptual accuracy and listener linguistic and cultural background had no effect. Both the presence of segmental features and high judgemental constraints (forced-choice questions) significantly increased perceptual accuracy, with suprasegmental features alone proving inadequate cues.

The study also identified which phonetic variables correlate with perceptions of sexual orientation. It was observed that /s/ duration like North American findings (Levon 2006; Levon 2007; Smyth and Rogers 2002) was significant, but in the opposite direction. Supporting North American findings were /s/ spectral skew and /s/ peak frequency. Newly-found phonetic variables correlating with increased likelihood of being

perceived as gay include /s/ centre of gravity, /s/ standard deviation and /s/ kurtosis. The best correlate was found to be global pitch, which goes against Levon (2006) but supports Levon (2007).

The study has identified a number of variables that interact in different ways to what has been found in previous studies. This warrants further investigation to establish whether the results here are unique, or if indeed cultural and linguistic factors are important in the explanation of phonetic variation by sexual orientation and the roots and accuracy of perception. Also warranting further investigation are the effect of speaker and listener exposure and the interactions between the various significant correlates found in this study. Regarding the former, the inconsistent results here make it hard to conclusively rule out any effect, but also hard to argue for one. An effect or lack thereof would have a greater chance of becoming evident with more data. Alternatively, the ethnographic approach of Levon (2009, 2010) and Podesva (2006, 2007, 2011a, 2011b) could prove more revealing.

This study looked at the effect of listeners' cultural background on perceptions, but it did not take account of the effect of speaker linguistic or cultural background. Pharao *et al.* (2014) looked at this by observing the way linguistic variables index different meanings when used in different registers of Danish, using a matched-guise approach to ensure all other linguistic variables remained constant. Future research could use the matched-guise approach to consider whether the same linguistic variables index for the same or different meanings across languages. It may be of particular interest to compare two varieties that are not closely related, such as English versus Russian and Malay, respectively belonging to a different branch of the Indo-European language family and a different language family altogether: Austronesian (Lewis *et al.* 2015). Also worth exploring is a repeat of the perceptual experiment with more listeners from these two countries so that a more nuanced analysis can be conducted.

The study showed clear support for previous findings from North American English speakers (and listeners) that both perceived and actual sexual orientation correlate with specific phonetic variables, albeit with definite overlap indicative of the diversity of ways gay men express their identity. The field of linguistics as a whole should consider the impact of sexual orientation alongside more well-established sociodemographic variables - both for control and inquiry purposes - in taking an intersectional approach. Like the WEIRD study (Henrich *et al.* 2010) argued for on the basis of ethnocultural representation, here I argue that generalisations about all or even a specific subset of men should not be made without having controlled for or considered the impact of sexual orientation. In an ideal scenario, gay men (and their intra-orientational diversity) should be proportionally represented by sampling, though this is not always possible and determining proportionality based on an often private and no doubt underreported characteristic is no small challenge.

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