PHONETIC TRENDS IN THE SPEECH OF TRANSGENDER SPEAKERS OF ENGLISH AND GERMAN

by

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(Under the Direction of Margaret Renwick)

ABSTRACT

In this dissertation, I present trends present in the speech of transgender speakers of English and German for three features, namely fundamental frequency (F0) of vowels, vowel space, and qualities of sibilant sounds. This research is exploratory in nature and strives to expand the understanding of transgender speech as a distinct variety in both English and German. The goal of this research is to indicate what features some speakers use to form their linguistic identity regarding gender.

24 English speakers and 7 German speakers who identified as transgender were interviewed and completed three separate experimental speech tasks. Those tasks were a list of words, a short reading passage, and an open-ended interview with each task selected to elicit differing modes of speech. Participants' speech was segmented, sampled, and analyzed to determine how speakers used each phonetic feature as a potential marker of gender.

F0 is used as a consistent marker of gender for transgender men in both English and German after several months of hormonal therapy and is often in the same range as

their cisgender counterparts with respect to language. Transgender men in both languages show greater F0 ranges than their cisgender counterparts, and this may be indicative of a trans specific linguistic identity. For transgender women, F0 in both language groups show less alignment with their cisgender peers, with a lower overall F0 mean. Notably, extensive speech therapy produced a higher F0 in some women. Vowel space is variable per speaker, but transgender men show an overall space that is more contracted after hormonal therapy, though not statistically significant, and some transgender women conversely show an expanded vowel space. Sibilants show less distinct trends than the other features measured in this research, primarily that no groups in either language show a significant effect of gender on sibilant duration or center of gravity. This research indicates that for transgender people want to approach the stylistic norms of the gender they identify with, then HRT and speech therapy are both effective. HRT seems to be particularly helpful for men who want to lower their F0, while speech therapy is helpful for women who want to raise their F0.

INDEX WORDS: Phonetics, Linguistics, Transgender, Nonbinary, Fundamental frequency, Vowel space, Sibilants, English, German

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DEDICATION

This dissertation is dedicated to my family, both biological and chosen, without whom I would not be the person I am today.

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CHAPTER 1

INTRODUCTION

When hearing speech, listeners use acoustic cues to determine certain qualities about the speaker. Qualities such as dialect, age, general body size, and gender are quickly identified. Attempts to explain humans' ability to identify these qualities have led to many studies in phonetics. Regarding gender, there has been much analysis of differences and similarities between men and women, but less study of trends seen in the speech of transgender individuals has been done until recent times. This research has flourished thanks to a growing visibility of transgender people in wider society, as a consequence of the gay rights movement of the late 1960s. Though much progress has been made in social acceptance, this group is still not recognized as legitimate by many political and religious groups in the United States, with a slightly larger acceptance in Germany. This dissertation aims to respectfully examine the speech of transgender and nonbinary members of the LBGT community while fully affirming their identities.

Transgender individuals show unique phonetic trends which are similar to, but differ from, trends seen in cisgender individuals. This study examines phonetic trends seen in the speech of 24 transgender speakers of English in the United States as well as 7 transgender speakers of German in Germany. These speakers all identified as transgender, though several did not identify within the binary of men and women as is a common perception of many outside of the LBGT community. This diversity in speaker identities will help to further highlight the variety of transgender speech.

1.1 TOPIC AND FOCUS

This research focuses exclusively on the phonetic qualities of transgender speakers of German and English. This dissertation examines three phonetic features of speech, namely fundamental frequency of vowels, vowel space, and sibilant sounds. These features were analyzed based on data collected via interviews, both virtual and in person, during 2017-2020. While there is some minor comparison done between the two language groups, the primary focus is on trends seen between as well as within each gender of speakers of the same language.

1.2 VISION AND MOTIVATION FOR RESEARCH

While this type of research is fraught not only with concerns of respecting speakers' identities and a potential for othering of this highly marginalized group, my vision for this research is to illuminate the variety of ways English and German speakers use to mark their gender. Much inquiry has been done into phonetic markers of gender for both languages regarding cisgender speakers, but the inclusion of transgender speakers into this research is essential to capture the variety of speech produced by speakers of each language and gender identity.

The goal of this research is not to compare transgender speakers against cisgender speakers, but rather see what this subset of men and women use to linguistically indicate their gender to others. While some commonalities and differences to cisgender trends are mentioned, each language group is compared primarily within itself; that being with transgender speakers of other genders within their respective language.

1.3 RESEARCH QUESTIONS

Because this dissertation examines two languages, with three gender categories[1], and three phonetic features, the research questions for this dissertation are most easily presented by focusing on the phonetic features and then any relevant language specific details mentioned thereafter. First, fundamental frequency has been shown to be used by speakers in English (Pépiot 2014, Simpson 2009) and to a lesser extent in German (Simpson 2021, Mennen 2012) as a marker of gender. The first question then is how speakers in this research use F0 to mark their membership with other members of their gender identity. Secondly, vowel space has been shown by some research to align with gender (Diehl 1996, Hancock 2011) leading to the second question, that being, how speakers in this research use the overall vowel space as a marker for gender. Finally, research has shown that in English and German (Simpson 2011, Simpson 2018, Zimman 2017) men and women show differences in sibilant production related to gender. In English, this has a stronger influence on perception of masculinity and femininity than in German (Boyd et al 2021, Becker et al 2022, Simpson 2011). The third research question for this dissertation is how and whether speakers use qualities of sibilant sounds, namely center of gravity and sibilant duration, to mark their gender.

1.4 CHOICE OF SETTING AND DATA COLLECTION STRATEGY

Due to the sensitive nature of this research, much care was taken to ensure the data collection environments were as secure and sensitive to the needs and desires of each

[1] While there are definitely more than three genders, this research has grouped speakers into men, women, and "nonbinary", a decision which is explained later in the methodology chapter.

speaker. The possibility of outing an individual to others, with the potential therefore to place that individual in an unsafe environment was a risk that was not taken lightly. The risk of being outed as transgender is a genuine concern by many, as often employment, housing, and general safety in the community can hinge on who knows one's status as transgender.

Each speaker was interviewed individually in a safe location, usually a closed room in a neutral building so as not to alert any passersby that the speaker was part of the transgender community. In the US, this occurred almost exclusively in the Linguistics Lab at the University of Georgia; a location that is used by many researchers for a wide range of linguistic studies. This room is in a low traffic section of the building and the door was also able to be locked, an action which was taken with each participant.

For a latter portion of speakers, data collection was undertaken via Skype/Microsoft Teams. These interviews were conducted in a safe and private location for the speakers, a designation which was fully within the control of the participants, and the researcher was alone in their private residence with all audio directly recorded locally to their hard drive. Each interview was conducted by the researcher with headphones to further guard against accidental exposure to others, a risk that was negligible, as there were no other people present in the residence. In Germany, interviews were conducted in a variety of locales, with each participant selecting an appropriate location.

1.5 MAIN FINDINGS OF THIS DISSERTATION

The main findings of this dissertation are that the transgender speakers who were interviewed use a variety of phonetic features to mark their gender identity. For men, a lowering of F0 associated with hormone replacement therapy seems to be the strongest

marker to distinguish them from other groups in this study. Some women produce a higher F0 than the men and nonbinary speakers. In English, there is no indication that sibilant duration or center of gravity is used by speakers to mark their gender. This is a marker for cisgender speakers in English (Jongman 2000, Simpson 2015), but speakers in this study do not distinguish gender using this feature. As sibilant centers of gravity and durations do not mark for gender to the same degree in German as in English (Simpson 2015, Weirich 2015), it is not as surprising that German speakers do not show a difference in sibilant sounds.

Importantly, this research indicates that for transgender people who want to approach the stylistic norms of the gender they identify with, then HRT and speech therapy are both effective. HRT seems to be particularly helpful for trans men who want to lower their F0, while speech therapy is helpful for trans women who want to raise their F0 (especially evident for Julia in German). At the same time, it may take many doses or years' worth of therapy to approach a canonical cisgender F0 range.

1.6 CHAPTER MAP

Chapter 1 introduces the topic to be analyzed, giving details to highlight the information that will be presented throughout this dissertation. Attention is given to the most relevant aspects of the research,

Chapter 2 consists of terminology relevant for transgender research, a discussion of conceptualizations of gender globally as well as in the US and Germany, an explanation of the phonetic features and measurements to be analyzed, a detailed focus on transgender specific research, and lastly speech and voice therapies for English-speaking as well as German-speaking transgender people.

Chapter 3 provides the experimental design and methods used in data collection as well as analysis of said data. The design of the experiment is given and provides details about how participants were selected, the interview process, cautionary measures taken to ensure privacy, as well as data management. The treatment and analysis of the collected data is also provided, with an explanation of how data was segmented and measured, along with the types of analysis used for each phonetic measure.

Chapter 4 discusses the findings of the English speakers. It presents a comparison of the three groups (men, women, nonbinary) for each phonetic feature that was measured, namely fundamental frequency, vowel space, and various measurements of sibilant sounds.

Chapter 5 discusses the findings of the German speakers. As the number of speakers is smaller, each speaker is described in brief with relevant biographical information presented. A comparison is presented of the three groups (men, women, nonbinary) for each phonetic feature which was measured, those being fundamental frequency, vowel space, and sibilant sounds.

Chapter 6 provides a conclusion and summation of the trends found in both the English and German-speaking participants. A brief presentation of phonetic measurements that pattern similarly within each group is noted for all groups. Additionally, a brief discussion which compares speakers of English with speakers of German is given. A section discussing possible avenues for future study is presented followed by a chapter summary with commentary about this research as a whole.

CHAPTER 2

GENDER AND PHONETICS

2.1 INTRODUCTION

This chapter sets up the cultural framework for and details acoustic measurements used in the analysis of speech regarding gender. First, gender is addressed culturally. Relevant terminology is explained as it relates to the examination of transgender people as a distinct group. The concept of gender as it pertains to both American and German culture is discussed followed by discussion of cultural conceptualizations of gender outside the US and Germany. A section on sexual orientation is then presented as it has been shown to influence speech production and perception for certain speech sounds. Then, the measurement for the acoustic features used in this examination of transgender speech are explained, namely fundamental frequency, vowel space, and sibilants. Current knowledge about these acoustic features is then discussed and further divided by each control group: cisgender German-speaking and cisgender English-speaking men and women. After these trends are explained, several works on transgender speech specifically are examined. Finally, transgender speech therapies used in both American and German cultures are presented, as some of the participants in this research had received said therapies.

Gender Studies is a massive field, and the breadth of this discipline cannot be addressed in a work of this size. Some discussion is presented as necessitated by this research, but a full analysis of gender and the voice is not undertaken. A full treatment of

the relationship between sex and gender in linguistic expression is not possible, and this research only attempts to illuminate one small segment of the relationship between those three.

2.2 GENDER TERMINOLOGY

The term gender is used in various ways by different groups, which causes confusion for many people regarding its definition. In casual contexts, gender and sex are treated as the same (e.g., gender reveal parties, many types of official forms and applications, and unfortunately legislative bodies at various levels). In gender studies, it is important to distinguish gender from sex as they are not true synonyms. While these two terms may overlap in some regards, the distinction between the two is essential for an adequate analysis of gender as it relates to speech. Firstly, gender is a term used to describe people grouped together based on shared social characteristics, values, and roles. A simple yet trite example is the outmoded ideal 1950s American homemaker. This conceptualization of femininity is easily imagined and has largely informed femininity in modern American culture (Wilde 2005, Stalp 2015). While often treated the same as sex in mainstream culture, gender must be separated from sex in several important ways.

Gender is often conflated with sex, and because these terms are used similarly, many do not bother to make a distinction between the two. While in many contexts, there is not a great need for this distinction (e.g., placing an order at a coffee shop), in terms of research into speech, this distinction can be vital. Sex is a medical term and is based on physical characteristics of the body (Deaux 1985). Someone's sex is very often assigned shortly after birth at the latest but is often identified before delivery thanks to ultrasound technology and some genetic testing (Colmant 2013). For the most part, sex is treated as

a binary option (male or female), but there are many cases where a strict medical definition of sex cannot account for the variation seen in human bodies (Hester 2004). Sex has long been described as either male or female, and only recently has the term "intersex" been adopted in some realms (Hester 2004, Malatino 2019). Any irregularities in external/internal sexual organs or chromosomes which may differ from the traditional understanding of sex as binary can be grouped into the intersex category. Because of this, determining sex by visual inspection of external genitals, the most common method used by doctors shortly after birth (O'Keefe 2016), allows for some degree of misidentification (Turban 2022). Using chromosomal evidence for sex determination is also a complex issue, as the long-taught and simplified explanation of sex being based solely on two chromosomes (X and Y) is often not the case. As shown by Nielson 1991, chromosomal abnormalities are present in 1:1000 live births in the US. Intersex is the term used to describe those people who vary in some way, physiologically or genetically, from the binary conceptualization mentioned prior. Intersex is an expansive term that encompasses people as diverse as partial chromosomal variation (Blizzard 2002) which may have no notable effect on that person (Furman 2020) as well as including those with physiological differences, such as testes in place of ovaries, vice versa, or sexual organs that diverge notably from the norm. Therefore, it is better to imagine the classification of intersex as a wide spectrum, rather than a clearly demarcated category. Although an arguably small proportion, the existence of such variation shows that sex cannot be purely binary.

In summary, gender and sex are similar and related but not synonymous terms. Sex refers to physical characteristics of a body and is assigned by a medical professional

at birth. Gender refers to social expectations and roles placed on a person within a culture.

Using accurate and precise terminology regarding gender is important to the analysis of gendered speech. Firstly, the term cisgender is used to describe an individual whose gender identity aligns with the sex they were assigned at birth. For a vast majority of people, gender and sex align, possibly as high as 99.3% (Herman 2017) though the prevalence is higher for youth (Salas-Humara 2019, Rosenthal 2016). Cisgender is a term that was recently coined as early as 1997 in an online Usenet group (Oxford English Dictionary, n.d.) to describe those who are not transgender. Transgender is a term that is used to describe an individual whose gender does not align with the sex they were assigned at birth. Both cisgender and transgender refer to someone's gender identity. Gender identity is a term used to describe the social roles and characteristics that best align with the roles and characteristics that a person displays. For example, someone who goes by the name Lewis, maintains facial hair, and uses masculine pronouns would likely say that his gender identity is man. Someone who uses the name Lindsey, regularly wears makeup, and uses female pronouns would likely say that her gender is woman. Importantly, gender identity is not reliant on physical or chromosomal characteristics, but rather cultural alignment with conceptions of gender.

Earlier terminology for people who now might identify as transgender is often perceived as pejorative or has a more specific meaning than when it was in more widespread use. Transsexual and hermaphrodite are terms that are used today, though have a more specific meaning depending on the context/environment in which it is used. In fact, some of the participants interviewed in this study identified as transsexual, rather

than transgender. The term transgender being relatively new, was not preferred by these speakers as they had always used the term transsexual to identify themselves. A similar pattern was noted by older speakers of German, though with the corresponding terms *Travestie* and *Transgender*. In fact, for both groups of speakers, younger speakers had a resistance to the older terminology.

In order to respect a transgender person's gender identity, when it is necessary to refer to their birth sex, the terms assigned female at birth (AFAB) and assigned male at birth (AMAB) are currently the most widely accepted terminology (Lyninger 2019, MacKinnon 2012). Most transgender people do not use these terms as part of their identity unless it has some bearing on the situation, e.g., medical care that may require such information.

Gender identity is an internal psychological concept for each individual. As is common with many LBGT people, the concept of coming out is also very relevant to the transgender experience. For transgender people, coming out is the process of changing your social relationships to reflect your gender identity. This usually involves telling family, friends, and employers. Sometimes, it may also involve official changes to government documents, such as amendments to birth certificates, drivers' licenses, etc. Coming out requires no medical intervention or treatment and is often referred to as social transitioning. This then contrasts with medical transition, which many transgender people do not undertake for a variety of reasons from financial burden to philosophical conceptions of gender (Koch 2020). This is the introduction to gender as being binary. Also discuss the Western concept of gender as men and women. Historical roles and changes thereto in modern times.

The concept of gender as having only two options (men and women) does not jibe for many people. Some individuals find that they have characteristics of both genders. Framing gender as a spectrum rather than binary categories allows for gender identities outside man and woman and is explained in following sections regarding each culture/country.

So far in this chapter, gender has been discussed through the lenses of the United States and Germany. The two cultures are very similar in their understanding and conceptualizations of gender. While there has been a larger acceptance of transgender, and to a smaller degree nonbinary people, in Europe and North America and some former European colonies (i.e., "the West"), other parts of the world often greatly differ in their organization of gender relative to culture.

2.3 WORLD CONCEPTIONS OF GENDER

In the cultures of North America that survived through European colonization, there are many examples of gender systems other than binary. Blackfoot, Cree, Crow, Lakota, Navajo, Ojibwe, and Zuni cultures all have the concept of a two-spirit or someone who is not solely man or woman and may be a mixture of the two or an entirely separate identity that is neither man nor woman. These cultures are not monolithic and have individual distinctions within each culture. For example, the Blackfoot culture of the northern Great Plains region had a third gender that may be somewhat similar to the concept of nonbinary in mainstream US culture. The Diné (Navajo) culture of the American Southwest traditionally recognized five genders as distinct from one another, though ideas about gender in this culture have changed dramatically after pressures from Western culture and Christianity from the late 1800s to the 1930s (Thomas 1997).

In South America, the Zapotec culture in southern Mexico has a third gender that is neither man nor woman called *muxe* (Stephen, 2022). In many parts of Asia, gender groups are organized in various ways. In Asia, there are multiple cultures with a third gender. In Polynesian cultures, the Fa'afafine (Samoan) are a third gender that has a long historical line of evidence (Vasey 2009). In the Philippines, a number of local sex/gender identities are commonly referred to as a third sex (Brewer 1999). In Thailand the concept of a ladyboy as a gender identity is one that has reached outside of the bounds of the nation itself. (Käng 2016, Totman 2011)

In India, possibly the most well-known third gender is the Hijra. The Hijra received legal recognition as a third gender in India in 2014 (Hossain 2017) The Hijra have a history as a third gender and separate caste (social class group) in the subcontinent since antiquity. In Africa, there are several cultures that have genders other than man and woman. Several cultures in Kenya, for example, have gender systems that are larger than the binary (Epprecht 2022). It is clear the dual system of gender, that being man and woman, may be common in many world cultures, relevant for this study the US and Germany, though it is definitely not the only system that exists.

2.4 GENDER IN THE UNITED STATES

Gender roles in the united state are traditionally understood to be man and women, though in recent years more gender identities have arisen and been recognized in society. The transgender umbrella is rather large, including identities such as agender, non-binary, fluid, transfemme, demi, etc. (Hagai 2022) There is a diversity of genders as well as reactionary ideas about it, such as the long-heard claim that there are "only two genders: man and woman" or people attacking the concept of a gender other than man or

woman and therefore claiming to identify as an “attack-helicopter”, a facetious claim often employed online by anti-trans commenters as well as incels (Blake 2020).

In the legal realm, The US Supreme Court decision in 2020 upheld the individual’s employment protection regardless of transgender identity. Current legislation in many state and local (school board) governing bodies restricts both medical transition (surgery, hormonal, and psychological assistance) as well as denial of existence/banning of such terminology in public spaces. Similarly, there have been recent restrictions on drag performance, which many of these governing bodies conflate with transgender identity.

2.5 GENDER IN GERMANY

Gender roles in Germany are traditionally understood to be *männlich* and *weiblich* (male and female, literally “man-ly” and “wife-ly”) though in recent years more gender identities have arisen and been recognized in society. The transgender community uses a variety of terms regarding identification. Many choose to simply identify as *männlich* or *weiblich* once reaching a certain point in their transition. Others maintain their identity as transgender and may use the terms *Transgender*, or *Travestie*, with younger members of the community using *Transgender* or *trans** like people do in the US. Younger Germans might also identify as *nichtbinär*, NB (pronounced /ɛnbi/), or *Nonbinary*.

2.6 SEXUAL ORIENTATION AND TRANSGENDER IDENTITY

This section discusses sexual orientation and the relevant features as it relates to this research. Firstly, a description of basic terminology regarding sexual orientation is given. Then cultural factors that may affect speech are discussed. Lastly, the intersection of sexuality and gender, specifically transgender identity, is discussed.

2.6.1 BROAD EXPLANATION

While not the same as gender, sexual orientation is closely tied to gender performance. Sexual orientation can be conceptualized as a spectrum in a similar way to gender. A simple three-way distinction of heterosexual, homosexual, and bisexual is how many Americans and Germans view sexual orientation. Because this has been normalized in culture in recent years, only a short explanation will be given for the relevant terminology. If someone is heterosexual, they are sexually, and usually romantically, attracted to members of the opposite gender. If someone is homosexual, they are conversely attracted to someone of the same gender. And finally, if someone is attracted to someone of any gender, they often identify as bisexual. It is important when discussing these terms to note that this attraction is to someone of a specific gender not someone of a specific sex. This distinction matters because a heterosexual cisgender man attracted to a heterosexual transgender woman still falls under the umbrella of heterosexuality.

According to several sources, (Sell 1995, Chiang 2009, Frisch 2021), the majority of humanity is heterosexual ranged anywhere from 2 to 10%. In a 2022 Gallup poll, the percentage of US adults who identify as non-heterosexual has increased from 3.5% in 2012 to 7.1% in 2021. As heterosexuality and cisgender individuals account for most humans, research done on language can be assumed to accurately represent heterosexual and cisgender speech. Despite this, much research has been done in the past 60 years or so to examine the speech of non-heterosexual and transgender people. As opinions toward those of different gender identities and sexual orientations have changed dramatically in this time, changes in research, both in quality and quantity, have occurred, leading to more research of gender. Due to sexist/patriarchal nature of

academia and culture at large, more research on homosexual speech has been conducted with regard to men. This topic will be mentioned where relevant in subsequent sections.

In the US, this pairing of a cisgender man ad transgender woman is a socially stigmatized relationship (Bradford et al 2013, Poteat et al 2013) and a struggle for many trans women and their cisgender male partners. As a disproportionately large percentage of domestic violence occurs between cisgender men and transgender women in relationship when compared with cisgender men and women (Ard & Makadon 2011, Seelman 2015), a greater understanding and acceptance of this definition as a heterosexual relationship is essential in reducing violence done to transgender women. Transgender women are victims of domestic and sexual violence at alarming rates. Various studies have shown staggering rates of sexual violence: 50% according to Stolzer 2009, 59% per Clemments-Nolle et al 2006, and 52% per Garafolo et al 2006. This violence from sexual partners, is due to the stigma associated with having a transgender partner who may be incorrectly perceived by some as being of the same gender as the cisgender partner.

2.7 RELEVANT PHONETIC MEASURES

This section presents the phonetic features relevant for this study. How these features are quantified is explained in this section which is divided by features. The trends seen in cisgender people for both English and German speakers are then presented in following sections.

There are several measures that are used when teasing apart gendered performance in speech. While lexical selection and pragmatics may differ drastically, differences in phonetic qualities are often used by speakers of any language to quickly

align themselves with a gender identity. Any number of phonetic features may be used to denote gender for speakers of a language, but those that often indicate/are identified with gender in English and German are discussed in this section. While not a fully comprehensive list of cues used by listeners to discern gender, the features discussed are fundamental frequency, vowel space, and sibilants. Other features like speech rate or the use of hedging are not addressed at this time, despite these potentially being useful when speakers form their linguistic gender identity.

2.7.1 FUNDAMENTAL FREQUENCY

Fundamental frequency (F0) is a measure of a voiced sound that is closely related to pitch by listeners (Simpson 2009, Johnson 2004). As this is a quality of speech that most people can make clear judgments on (Gelfer 2005), it is a very useful one when trying to identify a voice as belonging to a speaker of a specific gender. Fundamental frequency is measured in Hertz (Hz), which is a measure of regular oscillations in the sine wave of the speech signal. In the table below, average frequency ranges for English monophthongs are given for both men and women (assumedly cisgender) from a variety of sources:

Table 2.1: F0 Average of Cisgender Men and Women

	per Pépiot (2014)	Per Simpson (2009)	Per Baken (2000)
Women	210 Hz	200-220 Hz	212 Hz
Men	119 Hz	100-120 Hz	120 Hz

The above table shows that women generally have a higher F0 than men. The averages for each study presented above show that women produce speech with an F0 nearly twice that of men. This aligns with what many non-linguists intuitively understand about voices of men and women: women have higher pitched voices than men on average.

Ohala's frequency code (1983, 1984) suggests that lower frequency sounds are associated with larger body size, dominance, and then takes these associations and extrapolates this idea to include men's physical and social dominance over women. ... Greatly influenced by physical structures, or not at all according to others.

There are many ways to quantify this difference in F0 between women and men. Vowel space is easily manipulatable and can be quantified in a variety of ways. These include a plotting of all vowels for a selected amount of speech samples, a vowel space area measured as a quadrilateral, or distance of a vowel mean from a midpoint. Men and women also vary in the phonetic qualities of their speech by other measures as well.

2.7.2 VOWEL SPACE

This section examines quantifying vowel space as it relates to gender. First, the phonemic inventories and vowel spaces of English and German are presented. This is vital in that the available vowel space is limited by anatomy, which should be similar for speakers of the same gender regardless of language. Because the two languages have different phonemic inventories, this will affect how variable vowels can be in their production. Vowel space is quantified by measuring the first and second formant frequencies of a speech signal.

Vowels formants can be measured and used to organize those vowels into a two-dimensional diagram roughly correlating to the height and backness of the tongue in the mouth. The first (F1) and second (F2) formants are used to place vowels in relation to one another. Women and men show variation in F1 and F2 when the two groups are compared. Although the two vowel spaces overlap, men generally have a more constrained vowel space and women generally have a more spread vowel space. Per Diehl et al (1996) this difference in the vowel spaces of men and women is due to higher F0 generally seen in women. Diehl found that at F0 measures beyond 150Hz vowel labeling accuracy dramatically decreased. He claims that the vowel spaces of women show greater dispersion as a compensatory effect for this difference in the speech signal, namely that there is a reduced identifiability for vowels in women due to a sparser sampling of harmonic envelopes. Transwomen mentioned in this study are addressed studies done on the transgender voice. While F0 is useful in gender determination by listeners, which can also affect other formant frequencies as just mentioned, excluding F0, a change to the vowel space can also affect a listener's perception of gender. Avery 1996 found that men whose speech was deemed "less masculine" in a perception task

showed a more fronted /æ/ and /i/, though not as fronted as those vowels for female speakers. This judgment of a voice being perceived as less masculine (by assumedly cisgender heterosexual men) only highlights that fact that the spread of the vowel space is a measure that listeners use to determine the gender of speakers.

While there is a definite relationship of body size to the variation seen in the speech of men and women, some of these measures are not simply explained by physiology. Busby 1995 showed that in the speech of preadolescent boys and girls, while there was no notable difference in the F0 for both groups, there was a difference in the first three fundamentals. This difference was strongest for F1 (height) of low vowels /æ/, /a/, and /ʌ/, with girls consistently having a higher value (and hence more spread) than boys, despite these values changing with regard to age. F2 (backness) showed differences between the genders for each vowel. This shows that gender and gender roles influence speech before the physiological changes of puberty and can be somewhat controlled by speakers.

2.7.3 SIBILANT FRICATIVES

Women and men also vary in their sibilants. This research goes back considerably further than studies on gay sibilants. In early studies of gendered speech, Schwarz (1968) and Ingemann (1968) both found that listeners could identify the gender of a speaker merely from an isolated [s]. Schwarz (1968) also found similar trends in gay sibilants regarding higher peak frequency. Women also show higher spectral means (centers of gravity) for /s/ and /ʃ/ than males. Overall, it seems that women have higher frequency voiceless sibilant fricatives in general compared with men. On a perceptual level, Avery 1996 shows that listeners rate men as more masculine regarding sibilants in two ways.

Firstly, a higher spectral mean for /s/ was identified as sounding less masculine, and secondly a and a wider distance between /s/ and /ʃ/ was noted as sounding less masculine. Whether or not less masculine speech shares actual measurable commonalities with the speech of women, it is important to note the cultural implication of speech sounding more feminine especially in the context of transwomen.

When comparing the sibilants to one another, Jongman et al. 2000 shows that the overall the fricatives /s/ and /z/ have a higher spectral mean (around 6100 Hz) while the fricatives /ʃ/ and /ʒ/ have a lower spectral mean (around 4200 Hz). The participants in Jongman et al. consisted of ten men and ten women, which were then averaged together. Because Jongman's data included both men and women in the mean, it would be reasonable to compare his measures to the transgender sibilant data collected for this experiment in following sections. As transgender women and men often desire to pass as their identified gender, we might expect transwomen to have a higher value than presented in Jongman for the four sibilants and transmen to have a lower value which would patten with cisgender women and men respectively. Variation based on sexual orientation in English is present.

2.8. PHONETICS OF ENGLISH CISGENDER SPEECH

This section deals with the sibilants and select fricatives of English. The phonological inventories are relevant to the examination of vowels as the ranges and values depend on each other to some degree. When examining the center of gravity as it correlates to place of articulation, fewer sounds within a range of places of articulation would allow for wider variation of production of a phoneme. Because English and German have a different distribution of fricatives, these are discussed in this section.

The phonological system of English has been thoroughly described (Jongman 2000, Giegerich 1993, Plotkin 1972), and exhibits 9 phonemic fricatives. These are shown in the subset of the IPA chart below with sibilant sounds highlighted in red:

Table 2.2: English Fricative Inventory

	Labiodental	Dental	Alveolar	Postalveolar	Glottal
Fricative	f v	θ ð	s z	ʃ ʒ	h

These phonemic fricatives are described by four spectral moments. These moments indicate different measurements of the fricative. The first four spectral moments are spectral mean (sometimes called center of gravity), variance, skewness, and kurtosis. Spectral mean is "the mean frequency of the noise distribution for the target fricative. This measure increases when the place of constriction for the fricative approaches the front of the vocal tract such that /s/ has higher spectral mean than /ʃ/." (Glaspey 2009). Variance is how "wide" the fricative is in terms of frequency. A higher value here would indicate a sound with more variation. Skewness indicates how imbalanced the frequencies are relative to the spectral mean. For example, a negative skewness score would indicate that the measure is below the spectral mean; a positive skewness value would indicate that the measure is above the spectral mean. The final spectral moment is called kurtosis for fricatives in English, Jongman (2000) provides the following values.

Table 2.3: Mean Spectral Moments in English (per Jongman 2000)

Place of Articulation	Spectral Mean (Hz)	Variance (MHz)	Skewness	Kurtosis
/f, v/	5108	6.37	0.077	2.11
/θ,ð/	5137	6.19	-0.083	1.27
/s,z/	6133	2.92	-0.229	2.36
/ʃ,ʒ/	4229	3.38	0.693	0.42

These values are further corroborated with similar values by Maniwa 2009 and Fox 2005.

2.8.1 FUNDAMENTAL FREQUENCY IN WOMEN

As mentioned earlier, women show an overall higher fundamental frequency than men do. This is due in part to physiology (Simpson 2021) but also due to cultural norms (Graddol 1983, Skuk 2014). For American English-speaking women, many researchers have found similar values regarding F0 range and averages.

2.8.4 FUNDAMENTAL FREQUENCY IN MEN

Many studies have examined fundamental frequency of male speakers of English. Studies included in this section will be provided forthwith. In English, men have lower and overall, less variable F0. This is of course excepting things like falsetto or

prepubescent males. The following section details how sexual orientation interacts with gender relevant to the measures examined in this research. This section applies only to the English speakers.

2.9 PHONETICS OF GERMAN CISGENDER SPEECH

2.9.1 FUNDAMENTAL FREQUENCY

In German, women are less variable and lower than American women though still produce an F0 higher than German-speaking men (Mennen 2012), and men show ranges that are very similar to cisgender English-speaking men. As men often sit on the lower range of F0 in many languages, this is expected and well represented in the literature (Simpson 2021, Skuk 2014, Mennen 2012, Mixdorff 1994).

2.9.2 FRICATIVE INVENTORY

The phonological system of German has been thoroughly described (Wiese 2000, Hickey 2000) and is generally accepted as having 8 phonemic fricatives. These are shown in the subset of the IPA chart below with sibilant sounds highlighted in red:

Table 2.4: German Fricative Inventory (per Wiese 2000)

	Labiodental	Alveolar	Postalveolar	Palatal	Glottal
Fricative	f v	s z	ʃ ʒ	ç	h

The phoneme /ç/ is complex and within German dialects shows a wide variety of productions (Robinson 2001, Jannedy 2010). For simplicity's sake, this explanation will use Standard German, as many of the participants in this study lived in Hannover, and the Hanoverian dialect is often described as "closest to" or "the basis for" standard German (Acker 2019). In Standard German this phoneme is described as having two allophones one being palatal /ç/ and the other being velar /x/, both conditioned by the backness of the following vowel. These phones may interact with the range of values one has (when compared to English postalveolar fricative) in that the German allophonic realizations decrease the frequency "space" that one can use to produce distinct and differentiable sounds.

2.10 TRANSGENDER SPEECH STUDIES

2.10.1 ZIMMAN (2010)

In a 2010 pilot study, Zimman 2010 examined the voices of three female-to-male transsexual (Zimman's term) men's voices. This study focuses on the perception of trans voices as gay or straight as it relates to various acoustic features. Zimman contrasts the perception of these trans men's voices with those of gay-sounding and straight-sounding men's voices. Zimman examines voiceless sibilants (mean duration, mean center of gravity, mean frequency at peak amplitude), F0 of vowels (mean and range across 11 stressed vowels), mean F1 and F2 of 11 stressed vowels, and the F1 and F2 of /æ/ and /ɛ/. For the voiceless sibilants /s/, Zimman found that trans speakers' /s/ showed a significantly higher center of gravity than either the gay-sounding ($p < 0.0012$) or and

straight-sounding men ($p < 0.0043$). Zimman also found that for /ʃ/ trans speakers showed a significantly higher mean center of gravity from gay-sounding men ($p < 0.0234$), but not from straight-sounding men, and straight and gay sounding men did not show significant differences. Other measures for /s/ (mean duration and mean frequency at peak amplitude) and any measure for /ʃ/ showed no significant difference from gay-sounding or straight-sounding men.

Looking at F0 in vowels, Zimman found that there were no significant differences between the three groups and there was greater variation within groups than between groups. Zimman also looked at the front vowels /æ/ and /ɛ/ specifically and found no significance. Zimman also found that for the overall mean F1 and F2 of vowels, there was no significant difference between any of the groups. for the vowels /æ/ and /ɛ/.

2.10.2 HANCOCK (2011)

In a 2011 article, Hancock 2011 examines the vowel spaces of transgender women speaking American English. Hancock found that the participants selected for that study showed overall vowel spaces that exhibited ranges directly between cisgender men and cisgender women. This led Hancock to conclude that speakers had some degree of conscious control over the spread of their vowel space.

A diagram below shows a vowel plot for vowel spaces of cisgender men, cisgender women, and transmen:

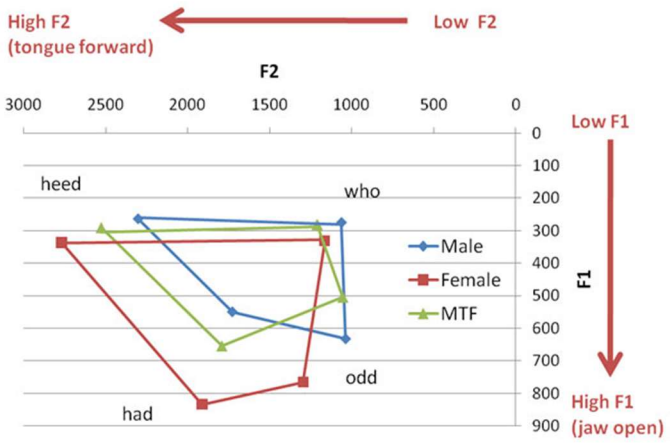

Figure 2.1: Vowel Spaces of Men and Women (per Hancock 2011)

It is useful to note that these two charts show some overlap of vowel spaces especially in the high back vowels of women and men. Notably the greatest observable difference seen between the three groups is in the low vowels /ae/ and /a/ and the high front vowel /i/. This is not surprising as the vowel /u/ shows the lowest measures for both F1 and F2 measurements.

2.10.3 ZIMMAN (2012)

Zimman 2012 is a dissertation that expands upon the 2010 pilot study. This dissertation focuses on transgender men and how testosterone and masculinity affect the voice. It followed the changes in voice among 15 trans men during the first 1-2 years receiving hormone replacement therapy. Zimman focused on F0, and acoustic characteristics of /s/, finding that F0 lowers during this period of testosterone therapy and that the acoustic values of /s/ is used to shape masculinity, alongside F0.

2.11 TRANSGENDER SPEECH THERAPIES

2.11.1 THERAPIES FOR TRANSGENDER MEN

While not all transgender men choose to use HRT, those that do experience physiological changes in several ways. Most importantly with regard to speech, transmen who receive HRT usually experience a thickening of the vocal folds. This is very similar to, though not exactly the same as, the changes a male might experience during puberty. In fact, most of the transmen interviewed for this research casually referred to it as "second puberty". An important difference between the natural puberty experienced by those assigned male at birth and those who transition but were assigned female at birth, is vocal tract length. In general, males have a larger stature and therefore longer vocal tract than females (Simpson 2001, Smith 2005). Despite this, once beginning testosterone, the voices of transmen generally lower to a range associated with cismen (Glaser 2016, Dabbs 1999). Due to this change, speech therapy is not common for transmen. Importantly, none of the transmen who participated in this research had received any speech therapy to alter their voice and instead relied on the lower pitch and social norms they associated with men's speech to project their voice as masculine.

While none of the speakers in this research have received any voice training or therapy, surgical options for voice lowering do exist. One of the participants in this research indicated that he was not satisfied with the changes to his voice that they experienced. This led this person to seek surgery to alter their voice. This surgery (type-III thyroplasty) is an uncommon one, though intended for cisgender men with mutational dysphonia, a disorder in which the male voice remains high in overall F0 and may cause discomfort when speaking in lower ranges. This surgery shortens the distance between

the cartilage that the vocal folds are attached to, which allows for the vocal folds to be slacker, giving the speaker a lower F0 overall. This surgical option is relatively new as a treatment for transgender men and has been performed with relative success (Bezerra 2021, Bultynck 2022).

2.11.2 THERAPIES FOR TRANSGENDER WOMEN

In Germany, there are several speech therapy types that are available for transwomen wishing to alter their voice to be perceived as more feminine. Seldom do men undertake voice therapy, as aforementioned, due to the effect of testosterone on the vocal tract. A very common type is called the LaKru method (Kruse 2016) and in fact was mentioned by two of the participants and later confirmed by a speech therapist (*Logopäde*) who works primarily with transwomen. The LaKru method uses several training exercises to feminize the voice. The goal of creating a consistent and feminine voice for the speakers, regardless of situation is achieved primarily through rote practice and muscle memory. Speakers regularly record themselves speaking at different times in the day, using the recorded speech in therapy session and analyze their speech alongside their speech therapist.

2.12 CONCLUSION

In sum, gender and the voice are related both physiologically but the influence of gender on the voice exerts a pressure on fundamental frequency and vowel space at a greater level than can be accounted for by physiology alone. Women show a higher fundamental frequency and a more spread vowel space than men. English-speaking women show fricative measurements that are notably higher than their male counterparts, while no such difference can be seen between German- speaking men and women.

CHAPTER 3

DESIGN AND METHODOLOGY

3.1 INTRODUCTION

This chapter details the design and methodology for this dissertation. Because English and German have different phonological systems, those will be briefly discussed as it relates to study design. Then the equipment used for data collection is described. Speaker selection and procedures of the interviews are then given with differences between in-person and virtual interviews explained. The following section addresses the experimental tasks: a word list, a short passage, and discussion. These tasks varied with each language and therefore each task is separately described. After these sections, the demographics and other details about the individual speakers are provided for both English and German participants. The final sections explain how the data were processed and transcribed and then how the transcriptions were aligned to the audio of each task to allow for later statistical analysis.

3.2 PHONOLOGICAL INVENTORIES

A brief discussion of the distinct phonological systems for English and German is presented in the following subsections. As both languages not only have differing phonological inventories, which may affect qualities of vowels and consonants, but also exist in different socio-cultural contexts, these factors must be discussed. The phonological systems are given in detail later in this section, but a brief discussion of the socio-cultural contexts is important and is presented thereafter.

3.2.1 ENGLISH

English has a vowel inventory ranging anywhere from 14 to 25 sounds (Ladefoged 2014, Roach 2014, Labov 2006, Thomas 2001, Wells 1982, Kumath 1977) depending on dialect. As all speakers in this study were from the US, though from a variety of dialect regions, American English will be used as the baseline for this analysis. In most varieties of English at least 8 monophthongs exist. An example of the phonological vowel system of American English can be seen below:

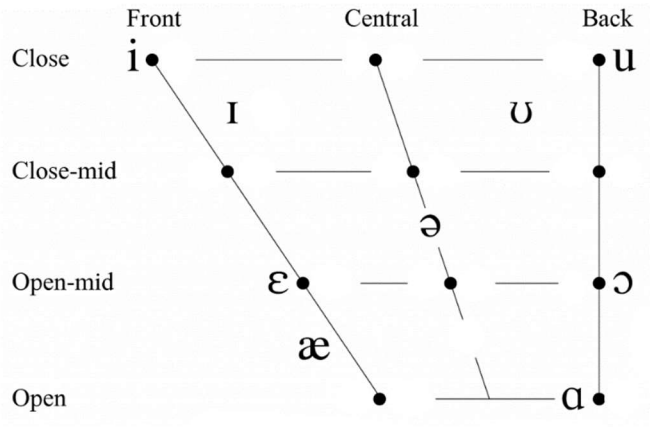

Figure 3.1: Phonological Vowel System of American English (per Ladefoged 2014)

American English dialects vary in their number of vowels, but all have only two high tense vowels, namely /i/ and /u/. As for low vowels, all dialects also have /æ/ and at least one low back vowel /ɔ/ or /ɑ/. These vowels exist at the maximal periphery of the vowel space. The above table lists /e/ and /o/ as phonemes, and very often in American English, these sounds surface as the diphthongs /eɪ/ and /oʊ/. The symbols “e” and “o” are used

for simplicity with the knowledge that this is a phonological rather than phonetic representation. This study relies on several measurements for vowel systems as described in Audibert 2015, the first of which involves these peripheral vowels. These methods for vowel space measurement are detailed later in §3.6.

Not listed in the chart above are the diphthongs of English. These vowels were sampled during each data collection portion of this study, though not directly used for analysis of the vowel space. Rather, these are used, in addition to the monophthongs, to calculate different measures of vowels in general, such as F0 and duration.

Sibilant fricatives were noted in Chapter 2 to exhibit differences based on gender as well as sexual orientation. American English has 9 fricatives, four of which are sibilants. The sibilant fricatives in English consist of /s/, /z/, /ʃ/, and /ʒ/. There are four fricatives further forward in the vocal tract, namely /f/, /v/, /θ/, and /ð/, and one further back in the vocal tract, namely /h/. A table of the English fricatives can be seen below:

Table 3.1: English Fricatives (per Maniwa 2009)

	labial	dental	alveolar	post-alveolar	glottal
voiceless	/f/	/θ/	/s/	/ʃ/	/h/
voiced	/v/	/ð/	/z/	/ʒ/	

The above table shows the fricatives of English with the sibilant fricatives in gray boxes. The fricative [s] has been shown to be a marker of identity for certain LGBT groups

(Zimman 2017, Zimman 2013, Mack 2012, Babel 2010, Munson 2006) and for the purposes of this study, all sibilants were examined to see if this pattern extended to this whole group of sounds. English also has two affricate phonemes that contain a sibilant sound, namely /tʃ/ and /dʒ/, but these were not included in this analysis. Because affricate sounds are made up of a stop and a sibilant, the duration and frequency qualities of the sibilant portion may show trends that differ from sibilant sounds proper. The possibility that this difference may obscure trends in the data warrants their exclusion from analysis.

3.2.2 GERMAN

Standard German also has a relatively large vowel inventory of vowels and more than English. Depending on the dialect, German has between 12 and 24 phonemic vowels (Duden 2000, Wiese 1996, Muthmann 1996, Kohler 1995, Benware 1986). Although dialects of German exist and are robust in their variety, this study will treat the recorded speech as being Standard German (*Hochdeutsch* 'high German') as defined by the Duden, the preeminent dictionary of German. This standard form of the language is used in determining the assumed phonemic inventory, as this is the variety of the language used in official contexts as well as the form taught in schools. Because of its status as the official form of German, most speakers are fluent in this form. A table of the German vowel inventory can be seen below:

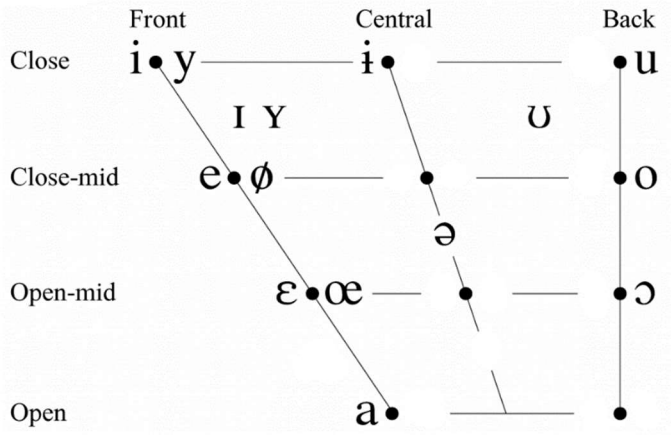

Figure 3.2: Phonological Vowel System of Standard German (per Wiese 1996)

Compared with English, it can be noted that German has a larger number of vowels due to the existence of a set of round vowels in the front portion of the vowel space. Similar to the English vowel system, boundaries of the German vowel inventory can be set using the most peripheral vowels. In the case of high vowels, the two tense vowels at the edge of the vowel space, namely /i/ and /u/, can be used as the upper periphery, and the low vowel must be used for the lower periphery. This simple polygon only has three points (since German lacks a low front vowel present in English) and may not be the most useful in determining the vowel space as this peripheral style measurement was for English. Instead, using the five-point vowel space presented by Audibert 2015 may be more appropriate for German. Treating the five vowels (/i/, /e/, /a/, /o/, and /u/) as the most peripheral aligns with Audibert's VSA method, providing a pentagon bounded by tense vowels except for the low vowel /a/, which does not have a tense form in German. This and the other methods used to quantify vowel space are later explained in a later section.

Sibilant fricatives were noted in Chapter 2 as not exhibiting differences based on gender or sexual orientation in German (Weirich 2015). Although this claim has been made in the literature, analyzing measurements of these sounds will either confirm or refute this. There is some anecdotal evidence from speakers that a difference may exist in this sound for LGBT speakers. Standard German has eight phonemic fricatives, four of which are sibilants. The sibilant fricatives in German consist of /s/, /z/, /ʃ/, and /ʒ/. There are two fricatives that are more front, namely /f/ and /v/, and three that are further back /ç/, /x/, and /h/. The fricative system of German can be seen in the table below with the sibilant fricatives in gray boxes:

Table 3.2: German Fricatives (Wiese 1996)

	labial	alveolar	post-alveolar	dorsal	glottal
voiceless	/f/	/s/	/ʃ/	/x/ ~ /ç/	/h/
voiced	/v/	/z/	/ʒ/*		

This table shows that German possesses the same sibilants as English, though the other fricative inventory is different. It is important to note that the phone [ʒ] is of uncertain phonemic status in German. Some scholars claim that this sound isn't phonemic, as this sound only occurs in loanwords and is in free variation with [dʒ] (Benware 1986). Others claim that [ʒ] is phonemic, as it is present in many words of French origin which are now widely accepted by speakers (Muthmann 1996). For the purposes of this research, this

sound was elicited based on the orthographic guidelines presented in the pronunciation guides given in Benware and Muthmann as well as the pronunciation given in Duden. The production of the speakers varied, and that is noted in a subsequent chapter.

The phonemic status of the affricates in German is not wholly agreed upon either. Most phonologists accept the affricates /pf/ and /ts/, but for others [tʃ], [dʒ] are less agreed upon (Wiese 1996, Griffin 1981), again due to the nature of the production of the loan sound as either [ʒ] or [dʒ]. The [tʃ] affricate exists only in historic clusters words, toponyms/words of non-Germanic origin, expressive words (Griffin 1982). Examples of these types can be seen in the table below:

Table 3.3: German Phone [tʃ] (per Griffin 1982)

a. *Deutsch* [dɔʏtʃ] 'German'	c. *Matcha* [matʃa] 'matcha tea'	e. *glitschig* [glɪtʃɪç] 'slippery'
b. *Zschopau* [tʃo:paʊ] 'Zschopau' (city)	d. *Kutsche* [kʊtʃə] 'carriage'	

The above table shows examples of the three categories of where the affricate [tʃ] exist. The first, *Deutsch*, was a result of reduction from a Middle High German *diutisch* where the [i]/[ɪ] in the second syllable is reduced to zero, causing this cluster to appear and

eventually be recognized as a single sound. Of course, toponyms may show this cluster as in *Zschopau*, a city not far from the Czech-German border. Borrowings are another source of this affricate as in *Matcha* from Japanese *matcha* (romanization of 抹茶) "matcha" (literally "to rub" and "tea") and *Kutsche* from the Hungarian *cosci* "cart, carriage" were accepted with this sound cluster due to its existence as an allowable string based on historical clusters seen in the *Deutsch* example earlier. Finally, the expressive words show this affricate as they are either onomatopoetic or expressive in some other imitative way. Because this cluster is rare already, it is important to also use this information to compare with the voiced version of this cluster [dʒ].

The phones [ʒ] and [dʒ] only appear in loanwords into German, as mentioned earlier. It is disputed by some linguists as to whether these should be treated as separate phonemes or not (Wiese 2000). As with English, the German phonological system has affricate sounds that include sibilants, if the affricates are indeed given phonemic status as one or two. These affricate sounds are not addressed in German for the same reason as they were not addressed in English, that being that sibilants portions of affricates may show different phonetic qualities than sibilants that exist as phonemes on their own. The second reason for exclusion is that the relationship of the voiced fricative and affricates, namely [ʒ], [dʒ], and [tʃ], is neither easily nor clearly phonemically distinguished in German.

3.2.3 SOCIOCULTURAL LANDSCAPE

In order to orient this research to the real world with regard to participant demographics, the sociocultural landscape for each nation must be briefly discussed. How transgender individuals in the US and Germany navigate the world is similar in

many ways, but there are also some marked differences in the two cultures. These are discussed below, as it affects how participants interact with their respective cultures on legal, social, and personal levels.

3.2.4 UNITED STATES

There have been many strides forward in society's treatment of transgender people, both in legal and social spheres. As with many minority groups, these advances have been hard-won and piecemeal. There are still many steps toward equality remaining, but a brief discussion of the current state of affairs, both legal and social, is important when discussing how data was collected.

Transgender legal rights can be traced back to several cases and events going back as far as the late 1960s. Cases regarding name and sex change on birth certificates were first brought before courts in New York State (Anonymous v. Wiener 1966, Anonymous 1968) and with the plaintiffs being denied a legal change of sex on their birth certificates and Anonymous 1968 being granted a name change. In the summer of 1969, the Stonewall Riots began in New York city which is often taken as a starting point for LBGT rights in the US. This riot was led by Marsha P. Johnson and Sylvia Rivera, both of whom identified at the time as drag queens and transvestites. The term transgender was not in common usage at the time and the term transvestite did not hold the same negative connotation in the LBGT community as it does today. In 1975, Minneapolis was the first city to adopt an employment non-discrimination policy that included trans people (Minneapolis 1975). Various cases have been decided upon by cities, states, and federal districts, with rulings both in favor and against transgender plaintiffs. The first discrimination case regarding gender identity and employment was

brought before the Supreme Court of the United States in October 2019 and a decision was released in June 2020 protecting the rights of transgender individuals from being fired based on their status as transgender (Mallory 2020)

Social acceptance of transgender individuals has changed greatly in the past 50 years. As noted previously, the term "transgender" was not in common use when the modern gay rights movement began. The first observation of the Transgender Day of Remembrance occurred in 1999. More recently in 2009, transgender activists promoted International Transgender Day of Visibility with the goal of celebration rather than mourning. Within the past 10 years, transgender visibility has increased exponentially with the presence of transgender people on the covers of magazines. Transgender firsts on magazine covers are notably television star Laverne Cox on the cover of Times in 2014 and television personality and former Olympic gold medal-winning athlete Caitlyn Jenner on the cover of Vanity Fair in 2015. Though visibility doesn't equate to legal and social change directly, their visibility has done much for the transgender community. Along with transgender individuals on the cover of national magazines, a larger cultural acceptance of transgender and gender non-conforming individuals can be seen in the recent success of shows like RuPaul's Drag Race, which often features transgender performers and directly exposes viewers to the realities of being trans on a personal level. Although social acceptance is difficult to judge, these examples of visibility show changes in the social and cultural landscape in the US.

3.2.5 GERMANY

In a similar way to the United States, Germany has also made great strides in the treatment of transgender people legally and socially. Despite a brief period of acceptance

and proliferation of gay culture in the 1920s to 1930s, much of the cultural treatment of LGBT individuals was negative before and after this period. In recent decades, Germany has been more progressive with its treatment of LGBT people than the US, but especially so concerning transgender people in the legal system.

The legal history of LGBT people in Germany is a massive topic on its own, so only brief highlights are mentioned here. Due to the ruling powers of German-speaking lands being essentially the Catholic church, there is a long history of legal discrimination. Notably during the formation of the modern German state in 1871, the *Strafgesetzbuch*, "penal code", included a prohibition on homosexual behaviors in Paragraph 175 (§ 175 *Strafgesetzbuch*). Though the political systems of Germany were in flux throughout the 19th and early 20th centuries, legal codes were often maintained and altered to fit the systems in which they were applied. During the brief period after the First World War, LGBT life in Germany flourished until it was outlawed by the Nazi Party in 1933 (Whisnant 2016). After World War II, Germany was divided between the Allied Powers and settled into East and West Germany. In East Germany, Paragraph 175 was not enforced after 1957 and was stricken entirely by the Supreme Court of East Germany in 1988, because East Germany was a self-described socialist state that viewed homosexual interactions as of little negative impact on society (Lemke 1991). In West Germany, organized Christian churches had a much stronger influence and Paragraph 175 was enforced to some degree through reunification, with a notable relaxation of enforcement in the late 60s. Although the application of Paragraph 175 was diminished within West Germany, after reunification in 1990, this legal code was finally removed in 1994 as the legal codes of the two former states were reconciled.

Regarding transgender rights specifically, West Germany has had legal protections for transgender/transexual individuals since 1980, with the adoption of *Gesetz über die Änderung der Vornamen und die Feststellung der Geschlechtszugehörigkeit in besonderen Fällen*, in English the "law regarding change of first name and determination of gender affiliation in special cases". With the adoption of this law, transgender Germans have had the right to change their name and in many states their gender listed on their birth certificates. This legal enshrinement has allowed for a more rapid advance in medical assistance and social acceptance of transgender Germans in the past 40 years. This law was kept during reunification and then applied to Germans formerly a part of East Germany. In 2006, the German Parliament passed the *Allgemeines Gleichbehandlungsgesetz*, in English the "general act on equal treatment", which includes protections for transgender persons regarding services provided and forbids denial of services based on gender identity in addition to other characteristics like race, religion, etc. In 2018, the federal court ruled that citizens would be allowed to select *divers* "diverse" as a third gender option. This option had previously been allowed for parents of children with atypical sexual organs. This legal recognition has led to transition related therapies and surgeries being more easily accessible than in the US.

In speaking with participants, overall, they seemed to have a different take on their identities than transgender participants in the US. Transgender Germans viewed their community as a steppingstone for transition, after which they would continue their lives outside of the LGBT community. One potential participant noted at a pre-pride community event, "I don't really participate in trans things anymore. I'm a woman and I don't need the support system and I've medically transitioned. I live my life as a woman,

and everyone recognizes me as such. There's not really a constant trans community like there is in the US.[2]" She declined to participate in the study as she felt she wasn't really part of the community anymore. Other participants mentioned that they felt concerned about safety early in their transition, especially in unsafe situations (i.e., at a bar or walking home late at night) but after they became comfortable with their gender presentation, were largely ignored with regard to their gender in public spheres. Overall, participants expressed a lack of overt prejudice from their local communities which may be indicative of a larger acceptance or at least tolerance of transgender people in Germany.

3.2.3 EFFECT ON DATA COLLECTION

In the US, networks of transgender people were easier to access, especially with those who had been living as their identified gender for long periods of time. Though some participants expressed wariness initially, most participants ended the interview with interest as to the findings and connected the researcher with others in the community. Expectedly, many participants were self-conscious regarding their voices, and several said they would participate as long as only the researcher would hear their voice. Some participants felt that their participation was a vital part of visibility as trans and would be vital for wider acceptance of trans people in the US.

In Germany, transgender people were very wary to participate. There are several factors that were at play to cause this wariness. One of the earliest participants, a 38-year-

[2] Translated by the researcher from German into English.

old trans woman, noted that some may be reluctant to participate because of cultural memory of persecution under Naziism and the associated experimentation on those in concentration camps at that time. Another factor was the aforementioned lack of continuous community of transgender people. Because there was the concept of transition and community being only necessary in the initial stages, this causes networks in Germany to be weaker than in the US. Lastly, German-speaking participants may have been harder to find due to the researcher being American and a non-native German speaker. This status as an outgroup member for several qualities might account for the smaller number of participants in Germany than in the US.

3.3 EQUIPMENT

The equipment used for data collection varied based on the method of interview. For interviews done in person, a Marantz PMD661 MK-II solid state recorder was used with an Audio-Technica AT899 condenser lavalier microphone. The participants clipped the microphone on their lapel. In Athens, the speakers were recorded in the Linguistics Lab in Gilbert Hall at the University of Georgia. The consent form and biographical survey were completed using a pen and paper. In Germany, speakers were recorded in a variety of locations: participants' homes, classrooms, a public park, etc. All locations selected were relatively quiet, though some were louder than others. As participants' comfort regarding safety was of utmost concern, the researcher deferred to the participants' preference for location. The consent form and biographical survey were completed in the same manner as in-person interviews in Athens. All consent forms were stored securely by the researcher and the biographical data was entered into a password protected excel spreadsheet.

For interviews done virtually, the researcher's personal computer was used. The audio output from the interviews was recorded directly using Audacity[3] (Mazzoni 2000), and the audio saved as .wav files. Participants used in-ear or over-ear headphones with an attached microphone for virtual interviews. One participant used the built-in microphone on their laptop. Participants received the documents (consent form, biographical survey, and an interview guide) through email and submitted the completed biographical survey to the researcher as a Word document.

3.4 SPEAKER SELECTION

All participants in this study met two requirements; each was 18 years old or older and a native English or German speaker. English speakers were selected using a variety of methods. For the English portion, the first method involved the researcher connecting with local members of the transgender community in Athens, Georgia. The researcher initially reached out to transgender people who were acquaintances. These participants were asked to share the study with others who identify as transgender in an attempt at a snowball sampling method. The LGBT Resource Center at the University of Georgia was also contacted, flyers distributed throughout their offices, and a call for participants was sent out to that office's listserv. Initially participants were not offered any incentive for participation (only two participants), and then a $10 compensation was offered to incentivize participation. Payment was distributed in cash. This was not largely

[3] Audacity® software (v. 2.0.5) is copyright © 1999-2019 Audacity Team. The name Audacity® is a registered trademark of Dominic Mazzoni.

successful as many transgender people frequently use the internet[4] rather than physical spaces to find a safe and welcoming community.

Due to an insufficient number of participants, data collection was expanded to virtual interviews. The call for participants was posted/promoted by contacts on Facebook, Twitter, and Instagram. This greatly increased participation, with speakers from across the United States expressing interest in participating. As with the physical interviews, participants received a $10 payment, this time through various virtual means (Amazon, Venmo, Cash App, PayPal).

For in-person interviews, German speakers were found during the summers of 2017 and 2018. The first method used for finding participants was contacting local LGBT organizations (namely CSD Hannover and andersRaum e.V.) and visiting the LGBT student group (der Queer-Keller) at the Leibniz Universität Hannover. Flyers were also placed at LBGT gathering places and businesses. The second method, like the English participants, was snowball sampled via word-of-mouth. On the advice of native members of the community, participants were offered a small compensation for their time, usually a piece of fruit, chocolate, or bread. The German speakers were lacking in number as well, therefore data collection for German speakers was also expanded to virtual interviews. Participants were offered a €10 compensation for participation which was sent virtually, either as an Amazon gift card or via PayPal.

One of the German speakers who participated in this study was currently receiving speech therapy as part of her transition treatment plan. This participant

[4] Nearly all participants, both in English and German interviews mentioned that the internet was essential in their transition.

welcomed the researcher to observe a therapy session (after consent from the medical professional), thus providing invaluable insight into the physiological manipulations to the vocal tract as advised by her speech pathologist. According to this speech pathologist, this method, LaKru[5], is becoming a favored standard for this type of therapy in Germany, as mentioned in Chapter 2.

Because the target group for this research is a very small subset of the population, no one was denied the opportunity to participate. Some speakers had just begun transition and others considered their transition to be complete many years prior. This gives a great amount of variability to the data but is an accurate representation of the diversity within this community. Many participants did not fit into the binary gender system of either the United States or Germany. This data was included as well to capture the diversity of speakers who identify as something other than cisgender, rather than using a strict definition of "transgender".

3.5 PROCEDURES

3.5.1 IN-PERSON INTERVIEWS

Interviews in Athens, GA were all conducted at the University of Georgia in the Linguistics Lab. This lab contains a sound attenuated room and interviews were conducted there to provide the clearest recording quality possible. Participants were welcomed by the researcher and then seated at a table with the research equipment. Participants read the consent form and gave either written or oral consent. Due to the sensitive nature of identification as a member of a gender minority, oral consent allowed

[5] This method is a registered trademark to Thomas Lascheit und Stephanie A. Kruse.

for further identity protection. After consent was given, the participants completed the biographical survey. The participants were then fitted with the microphone (usually on the collar or lapel) and then the recording process started. After the interview was complete, the recording was stopped, and the microphone was removed. Participants were then provided compensation, thanked, then escorted out of the lab.

Interviews in Germany were more variable in their procedure. Participants were met in a variety of locations, though care was taken to find relatively quiet locations with limited background noise (busy streets, busy pedestrian areas, loud cafés). Participants always completed the consent form, biographical survey, then were fitted with the equipment. For two participants, these interviews happened one after another in the same location, and the participants were present during the interview of the other. After the recording was completed, participants were compensated, thanked, and then the researcher and participant departed.

3.5.2. VIRTUAL INTERVIEWS

Interviews conducted using Skype or Google Hangouts were scheduled via email. The participants received the consent form, biographical survey, and the interview guide as .doc attachments in the response to their initial email. Participants were asked to read the consent form then complete and return the biographical survey before the interview commenced. The researcher called the participant at the scheduled time and more often than not, participants preferred to include video in the call. Those who did not use a video feed expressed that they were more comfortable with the anonymity of just their voice being observed. During the initial greeting, participants often would explain or verbally complete the biographical survey. After consent was verbally given and the biographical

survey completed, the recording began using Audacity. The tasks were completed then recording was stopped. The participants were then sent their preferred form of compensation and bid farewell.

3.6 TASKS

Participants completed three tasks from which samples were taken. In an attempt to have both easily comparable speech and naturalistic speech, these tasks varied in their level of naturalness. The tasks are described in the following sections. The interview guide that participants were able to read is available as supplementary material (see Appendix I and Appendix J).

3.6.1 WORD LIST

The first task was a list of words that each speaker read. The speaker was instructed to speak at a comfortable pace while going through the list. To control for the phonological environment, each word was elicited in a carrier phrase. For English speakers, the phrase was "please repeat [WORD] to me". This phrase was selected so that each target word was surrounded by voiceless stops, in both cases here /t/, because this voiceless stop would be easily identifiable as silence in the waveform and spectrogram. In the case of the word *repeat* that final /t/ may have a release burst. If this is the case, the aspiration is as easy to identify as the silence is. For German speakers, the phrase "*Sag das Wort* [WORD] *zweimal*" was used. Like the English phrase, both sounds surrounding the target word are voiceless stops[6] of the same place. According to Wiese (1996: 270) aspiration in German is never phonemic, its status as a regular phonological rule is

[6] The letter "z" in German corresponds with the sound /ts/

debated, and therefore it is optional in word final position. In determining the word boundary for the German *Wort*, potential aspiration/release is easily identifiable in a similar way to English. For most speakers there was an apparent release for the word final [t] in each instance. For both carrier phrases, in addition to the directly surrounding sound, an attempt to control the prosodic/syllabic structure was made. Both carrier phrases contain three syllables before and two after the target word. As the prosody between the two languages differs, controlling for syllables may help in cross linguistic comparison.

The words were selected to capture the variety of sibilant and fricative sounds in each language. For English, all phonemic fricatives and affricates (except for /ʒ/ and /dʒ/) were captured in word initial position. Both /ʒ/ and /dʒ/ were elicited in word medial position. Monophthongs and diphthongs were collected in stressed position, except for /i/, /u/, and /ə/. These monophthongs were elicited in unstressed position. The vowels /i/, /u/, and /ə/ are well represented in the other tasks. For German, all the fricatives were captured in the word list, though due to the phonology of German, not all sounds were possible in each position. For word initial position, /x/ and /s/ were not collected. These sounds, according to Wiese 1996 and Benware 1986, are not possible in word initial position. In word medial position, all consonants except for /v/ and /h/ were collected. As neither of these were target sounds for this study, their lack of representation in the word list is compensated for by their presence in the reading passage and discussion tasks. In word final position, the fricatives /s/, /ç/, and /x/ were collected. Due to a Final Devoicing rule in German (Wiese 1996, Brockhaus 1992), voiced segments are devoiced when at the end of the word, eliminating the possibility of /z/ or /ʒ/ in these positions.

Monophthongs were collected in stressed and unstressed positions except for /y/, /ø/, and /u/. These sounds are represented in the other tasks. The diphthongs /ɔɪ/ and /aʊ/ were collected in stressed position. Overall, the target sibilants were accounted for in this task, with at least one instance for each sound.

3.6.2 SHORT PASSAGE

The second task was a short reading passage. Participants were instructed to read at a comfortable pace and to not be concerned with speech errors. Participants were told that if they stumbled, they were free to continue or start the sentence again, depending on what felt most comfortable to the speaker. For English interviews, the Rainbow Passage[7] (Fairbanks 1960) was used. This passage was selected due to its widespread use in dialectal research as well as its employment by Zimman 2012. The passage itself is 330 words long and contains all the phonemes of English except for /ʒ/. For German interviews, a short story Der Skorpion[8] (Reinig 1974) was selected. This short story is 408 words long and contains all phonemes except for /ʒ/ ~ /dʒ/ of Standard German. Although both passages lack certain sounds ([ʒ], [dʒ]), these sounds are represented in the word lists and are also rare within each language, and in the case of German, disputed.

3.6.3 INTERVIEW

The final task was a set of open-ended discussion questions aimed at eliciting the most naturalistic speech. This was placed as the final task, in order for the participant to

[7] Due to the association of the rainbow as a symbol in the LGBT community, the Rainbow Passage seemed more fitting than the Northwind and the Sun passage.

[8] Though not extremely well-known, Christa Reinig was an out lesbian who was vocal about LGBT rights as well as a feminist activist in both former East Germany and West Germany after her expulsion. In the spirit of her activism and based on themes in the short story, this passage was selected.

be in the most comfortable and relaxed state, both with the researcher and the process itself. Participants were told that the questions in this section were guidelines for discussion rather than questions to be answered directly. Participants were generally very forthcoming and loquacious, but a few answered the questions in a very brief manner.

3.6.4 POTENTIAL COMPLICATIONS AND EFFECTS

It is important to acknowledge how the researcher and his identity may have influenced the speech of the participants. Linguistic accommodation is a matching of or distancing from language/speech style/dialect/register that is common when speakers of different communities interact (Giles and Powesland 1975). Disadvantaged communities may accommodate more dominant speech communities to access that social power/acceptance (Muir 2016). As noted previously, the transgender community is a disadvantaged group, socially, legally, and economically.

While the researcher is not a member of the transgender community, his identity as a gay man places him in a larger social group, that being the LGBT community. This commonality may have different impacts on the speech produced. It is possible that the participants feel comfortable in this environment, where their identity is known and not judged negatively, and therefore speak casually, placing less emphasis on "passing" since the researcher is perceived as being part of their ingroup to a degree. Another possibility is that speakers focus on their speech in an attempt to best emulate cisgender speech of their respective genders. This would likely be most present in the word list and short passage, but diminish during the discussion portion, due not only to the nature of the tasks, but also fatigue. Although speakers were not explicitly instructed to speak in a specific manner with regard to gender, speakers were at least somewhat conscious of

their speech since that is the focus of the experiment. With regard to speech style, several speakers commented on or asked about the different speech styles they might employ. One participant, who is a transgender woman, asked if she should use her "girl voice" or her "normal speaking voice." Another commented, after the word list, that she had been using her "higher pitched, public voice" but that she hadn't practiced it in a while and that the reading passage would be lower and sound more like her everyday speech. The transmen and those outside the gender binary hardly mentioned their speech style regarding pitch.

In addition to possible interaction between the speakers' and researcher's respective identities, the question of whether it is ethical for someone outside of this community to research transgender speech. Much of the debate has been within the field of anthropology. This issue has been approached in various ways depending on the discipline and the social position of the researcher. The concept of a "native ethnographer" has been proposed primarily through the lens of colonialism. According to Jankie 2004, which deals with the use of a prestige language over native language in sociological interviews, it is important to address the role of the researcher and their identities as it may affect participant response. Jankie notes that employing minority status that aligns with the participants may help elicit more natural and honest responses, while the researcher's status as a scientist allows for the research to be grounded in authority for the participants and accepted by the academic community at large. Some argue (Zinn 1979) that participants from minority groups should be the ones to conduct and publish research on their communities, so that they can control the narrative surrounding their own communities. Some (Crean 2018, Maykovich 1977) stress that the

role of the minority researcher can be both an insider and an outsider, so those roles must be addressed when analyzing data. This was addressed in Egharevba 2010, which further argues that members of differing minority groups sit in a unique position as they can find commonality in their experience of otherness despite experiences not matching exactly. Others still (Sue 1993, Villenas 1996) argue that intent and recognition of one's identity (privileged or disadvantaged regarding race, ethnicity, age, gender, orientation, etc.) is important when working with a minority community as subconscious bias can have a real-world effect on the community due to the impact of the research conducted. The position of the researcher is that this line of inquiry is ethically sound because the intent for this research is not only affirming and fair to the community, but also aims to simply identify features that transgender speakers use. Support for this ethicalness can be taken in the comments from several participants that they were excited about the findings of the research and their candidness on several very personal details about their experiences. This research does not intend to prescribe features that transgender speakers should use in order to pass or even suggest that transgender speakers should strive to pass at all. The researcher recognizes his status as both an insider to some degree (membership in the larger LBGT community) and an outsider (non-trans and power related to his role as researcher) and that those details may have some effect on the responses of the participants.

3.7 SPEAKER DATA

This section outlines the data about the speakers in this study. The self-reported biographical information is given along with different presentations of these data. The subsections are divided into the English data and German data.

3.7.1 ENGLISH DATA

Initially, speakers were selected locally (Athens, GA) and then snowball sampled, so a majority of the earliest speakers reside in northern Georgia. As data collection continued, speakers from various regions were interviewed increasing the dialectal variation in the data. All speakers were born and currently reside in the continental US. A map of speaker hometowns is given below:

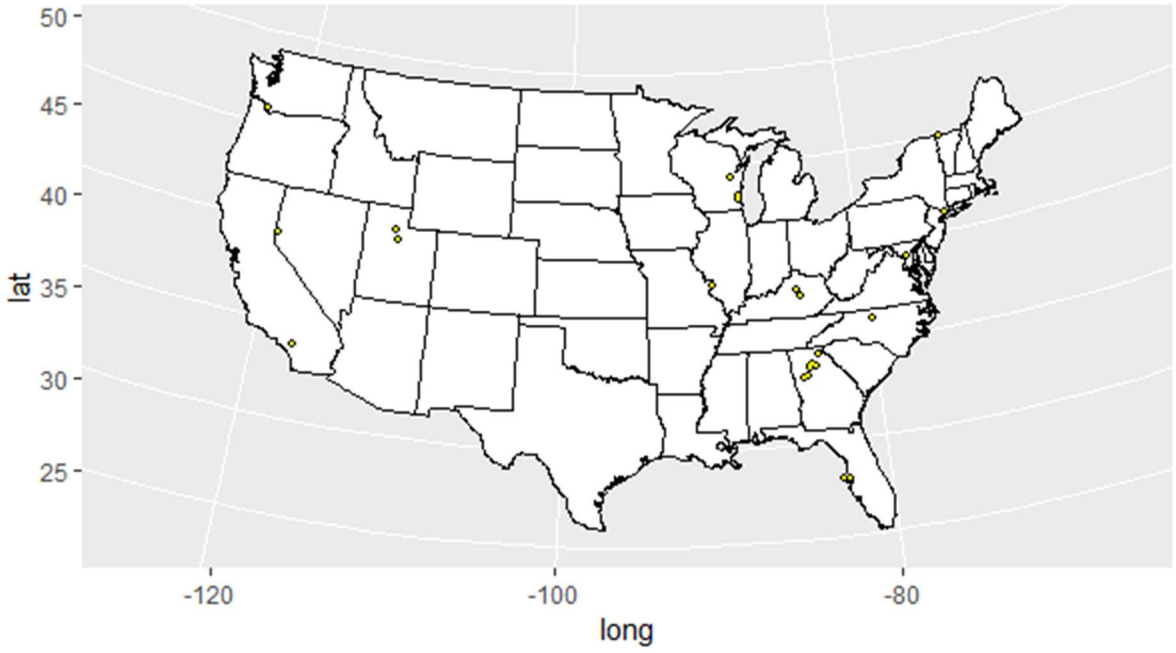

Figure 3.3: Transgender English Speakers' Hometown

The above map shows that most speakers grew up in the eastern half of the United States. In terms of dialect, we can group these speakers into four categories (re Labov 2008):

West, South, Midland, and North. This variety is expected to be most pronounced in the differences in vowel space and is addressed in the results and analysis chapter.

The current home for speakers is also an important factor in how they may be constructing their vowel space. Although some speakers currently live in the same dialect region, many have moved outside of these regions and may alter their phonological system in order to better linguistically assimilate. The completeness of assimilation to current city dialect may depend on the length of time lived in the current city, age of arrival, or a multitude of other factors. A map of the speakers' current city is given below:

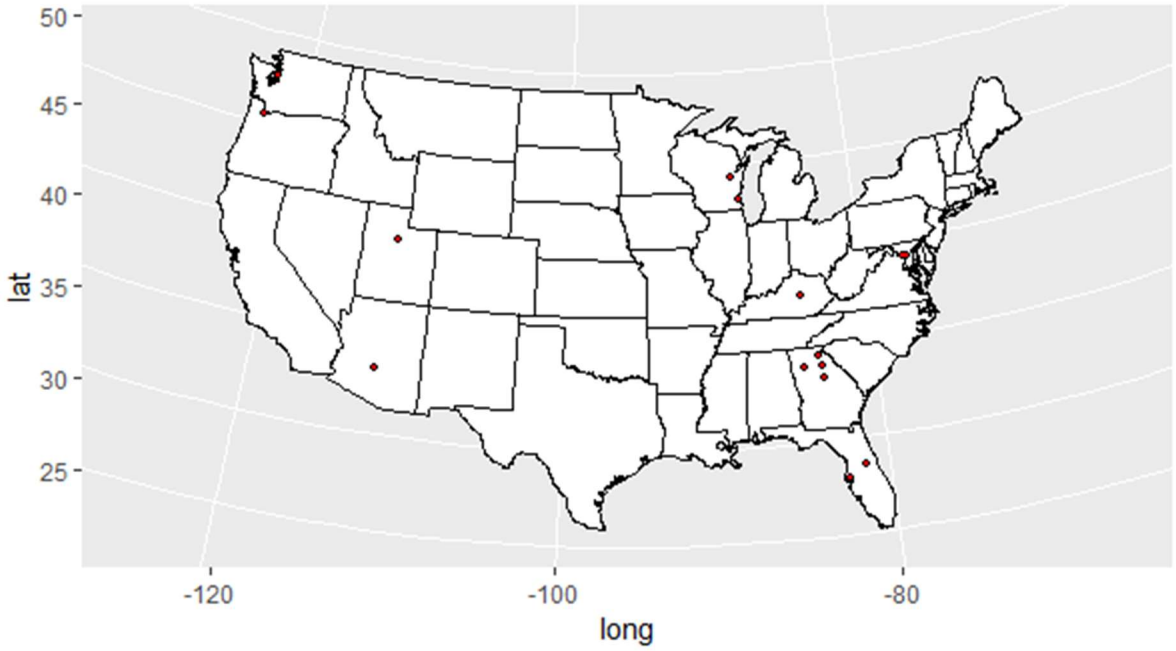

Figure 3.4: Transgender English Speakers' Current City

The above map shows that similarly to the hometown map, most speakers reside in the eastern half of the United States with only four being in the western region. The current residence of speakers may have some effect on the vowel systems of the speakers as they may accommodate to their local speech communities or attempt to distance themselves from those communities depending on their personal identity.

It is also important to place speakers in a generational and socioeconomic class. This was done using the level of education as an identifier. As mentioned previously, many transgender persons in the US are economically disadvantaged to a large degree, as gender affirmation surgeries are often not covered by insurance and employment and housing discrimination is legal in many regions (Grant 2011, Bradford 2013, Kattari 2016). Although this is often the case, speakers in this study all had some college (excluding one speaker) and several were working toward or had post-graduate degrees. About half of the speakers had received hormone replacement therapy, which is often cost-prohibitive even with insurance, which also helps in identifying speakers as members of the middle/upper middle class. Speaker ages ranged from 18-39 with the mean age being 27. The table below shows the speakers' demographic information which can be used as an estimation of socioeconomic status. Level of education and ability to afford hormone replacement therapy are both used as indicators of a higher socioeconomic rank.

Table 3.5: English Speakers Biographical Information

Speaker	Hometown	Current Residence	Education	Age	HRT
1E	Austell, GA	Marietta, GA	some college	26	0*
2E	Winder, GA	Athens, GA	bachelors	33	96
3E	Clearwater, FL	Athens, GA	bachelors	35	84
4E	St. Louis, MO	Athens, GA	some college	18	0
5E	Suwannee, GA	Athens, GA	some college	21	0
6E	New Carrollton, MD	Athens, GA	other	35	110
7E	Norcross, GA	Athens, GA	some college	20	18
8E	Peachtree City, GA	Athens, GA	some college	32	120
9E	Battle Ground, WA	Appleton, WI	high school	20	0
10E	Appleton, WI	Appleton, WI	some college	19	30
11E	Provo, UT	Provo, UT	some college	31	0
12E	Greensboro, NC	Athens, GA	bachelors	25	0
13E	Reno, NV	Athens, GA	bachelors	32	0
14E	Richmond, KY	Richmond, KY	doctorate	29	81
15E	Swanton, VT	Orlando, FL	some college	37	170
16E	Lexington, KY	Tempe, AZ	masters	26	96
17E	Salt Lake City, UT	Portland, OR	technical degree	24	6
18E	Duluth, GA	Seattle, WA	bachelors	24	13
19E	Mamaroneck, NY	Rockville, MD	doctorate	29	9
20E	Riverside, CA	College Park, MD	bachelors	25	0
21E	Cedarburg, WI	Milwaukee, WI	bachelors	25	0
22E	Tampa, FL	Tampa, FL	masters	26	1
23E	Demorest, GA	Cornelia, GA	bachelors	39	10
24E	Milwaukee, WI	Milwaukee, WI	some college	22	11

As shown in the table above, all speakers except 9E had some college/higher education experience. It is also important to note the number of months that participants had received hormone replacement therapy. This number is 0 for some due to their identity as non-binary or agender, while for two (transgender women) they had received HRT previously, only to cease treatments as the benefits from this therapy were deemed unnecessary after a certain point in their transition. Regarding ethnicity, most speakers were white, though 2 participants self-identified as Latinx and one as Black. Ethnicity is noted in the data so that potential interactions between race and dialect can be examined.

3.7.2 GERMAN DATA

German speakers were first recruited in Hannover, Germany and then snowball sampled. Due to this, many speakers reside in Lower Saxony (*Niedersachsen*). Participants were recruited through a variety of methods. Firstly, the researcher contacted LGBT groups, one at Leibniz Universität Hannover (der Queer Keller) and the other a community organization (AndersRaum e.V.). Initial contacts in these groups suggested local LGBT businesses/locales and flyers were posted in these locations. Finally, during Hannover's CSD (equivalent to pride events in the English-speaking countries), the researcher distributed flyers to booths that catered specifically to trans issues as well as passersby at the festival. As data collection continued, speakers from various regions were interviewed, potentially increasing the dialectal variation in the data. Despite this, speakers were all born and currently reside in western Germany. Speakers can be grouped into two large dialect regions that can roughly be described as Middle and Low German (Kürscher 2018, Salmons 2018, Russ 1990, Noble 1983, Waterman 1966). Various isoglosses are used to determine the boundaries of Middle and Low German (Benrath

line, Speyer line, Uerdingen line), and those are provided on the map below. Because of the nature of this experiment (speaking with a non-native speaker in a more formal context), it is likely that most speakers used a form of German that more closely matched the Standard German (*Hochdeutsch*) taught in school rather than their regional dialects. A map of speaker residences is given below:

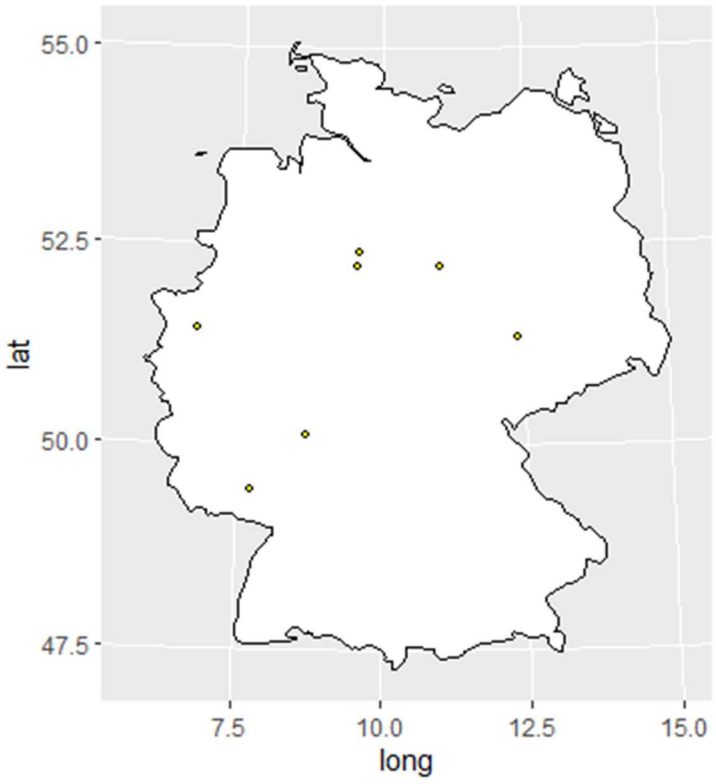

Figure 3.5: Transgender German Speakers' Hometown

As shown above all speakers were within the isogloss ranges for Low and Middle German and were somewhat centrally located within the country.

Just as with American speakers, Germans may approximate the speech of their new speech communities for various reasons explained in previous sections. This necessitates a map of their current residences. A map of the current residence of each speaker is given below:

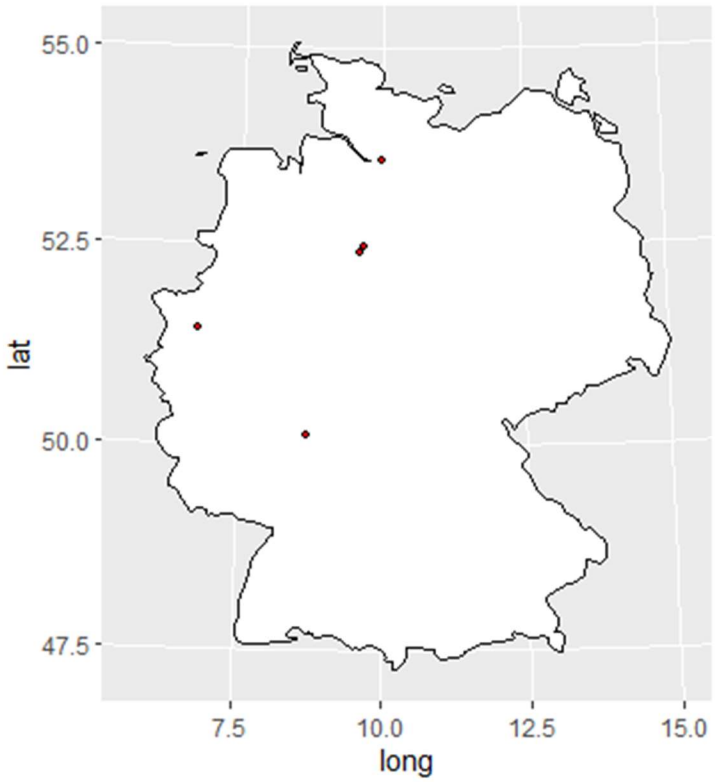

Figure 3.6: Transgender German Speakers Current City

This map shows speakers clustering in the western half of Germany and that all speakers still fit within the Middle and Low German dialect regions. There is a clustering around

Hannover, Germany as participants were initially recruited in that city and its immediate surroundings.

In order to place speakers in a generational and socioeconomic class level of education was used as an identifier. As mentioned in the sociocultural landscape section, when compared with transgender persons in the US, transgender individuals in Germany are less economically disadvantaged than their American equivalents due to the aforementioned cultural differences. In addition, speakers in this study all had some college (excluding one speaker) and several were working toward or had earned post-graduate degrees. About half of the speakers had received hormone replacement therapy, which is considerably less cost prohibitive than in the US, but still helps in identifying speakers as members of the upper middle class due to the number of institutional hoops one must go through to receive this therapy. Speaker ages ranged from 18-54 with the mean age being 31. Each speaker was assigned a pseudonym which aligns with their gender identity, and the pseudonym “Sascha” was selected for the nonbinary participant, as it does not denote a specific gender in German but can be used as a nickname for people of either a masculine or feminine gender. The table below shows the speakers' age and an estimation of socioeconomic status, based on education and ability to afford hormone replacement therapy:

Table 3.6: German Speakers Biographical Information

Speaker	Hometown	Current Residence	Education	Age	HRT
Lukas	Leipzig, SN	Hannover, NI	some college	20	1
Sabine	Helmstedt, NI	Hannover, NI	bachelors	38	156
Anna	Kaiserslautern, RP	Hannover, NI	bachelors	32	0
Tobias	Springe, NI	Hannover, NI	pre-college	18	0
Julia	Seelze, NI	Hannover, NI	bachelors	56	0
~~Hamish~~	~~Glasgow, GB~~[9]	~~Hannover, NI~~	~~bachelors~~	~~28~~	~~103~~
Sascha	Duisburg, NW	Duisburg, NW	Realschule[10]	18	0
Stefan	Frankfurt, HE	Frankfurt, HE	masters	29	49
Andreas	Frankfurt, HE	Hamburg, HH	some college	37	48

As shown in the table above, all but Sascha have some college or will attend during the coming semester. Tobias and Sascha were both set to begin HRT in the coming months and of the remaining participants who were not receiving HRT, Julia didn't view it as an important part of her transition at her stage of life and Anna had recently begin her transition socially and was unsure if she would pursue medical transition of any sort. All participants were of European/German heritage (all being white) and all except for the excluded participant Hamish were born in and grew up in Germany.

[9] Hamish is excluded as he only revealed his non-native German status asfter the interview.
[10] In the German educational system, *Realschule* is a secondary school aimed at students not intending on university study. Often, though not always, this educational level corresponds with a lower economic status than college preparatory secondary schools.

3.8 AUDIO PROCESSING AND TRANSCRIPTION

For in-person interviews, audio was saved as a .wav file. These files were then transferred to a secure external hard drive for later analysis. Although some virtual interviews were conducted using Google Hangouts and others using Skype, the recordings varied in quality primarily due to the speaker's local environment. All of the interviews analyzed were of reasonable quality as speakers generally were in their bedrooms or offices. Virtual interviews were recorded using Audacity and the built-in WASAPI audio host, which allows for direct recording of the audio output that would normally be sent through a system mixer then to external speakers/headphones. The recorded audio was then exported as a .wav file for analysis. A benefit of recording virtual interviews using this method is that the only audio being recorded is what also comes from the speakers. This exclusion of the researcher's speech makes preparing the audio for analysis very simple. For these audio files, silence was removed by the researcher. For the word list, the carrier phrase was removed in each instance. During the interviews, one participant had a recurring cough (Anna) and another sneezed twice (Stephan). These non-speech sounds were both removed by the researcher to make analysis easier.

Because in-person interviews contained speech from both the interviewer and the participant, the audio had to be processed so that the only speech signal was from the participant. This was done manually by the researcher using Audacity and the interviewer's voice was simply cropped out. This cropping did not affect the word list[11]

[11] Three speakers asked questions halfway through the word list and the interviewer responded. These instances were removed along with the participants' questions.

or the reading passage and was almost exclusively used during the discussion portion of the interviews. Because participants were recounting their life experiences as trans or sharing their story of transition, large portions of the discussions were essentially monologues by the participants.

The audio of each speaker (after the aforementioned removals) was then divided into individual files that corresponded to each task. This allows for easier transcription and alignment. These files were all named using the participant number, language, and task type. For the word list there was no need to transcribe anything as the simple list was the same for every speaker with respect to language. For the short passage, the transcript was manually edited from the passage given in the interview guide, as some speakers misspoke or repeated phrases. For the discussion task in English, the audio was automatically transcribed using DARLA (Reddy & Stanford 2015). This returned a plaintext file for each audio file, which was then manually checked for accuracy. After these processes, each audio file is paired with a corresponding plaintext file containing the transcription. The German interview was transcribed using WebMAUS with ASR (Schiel 1999, Kisler 2017), which returned an aligned transcript of the speech.

3.9 SEGMENTATION AND ALIGNMENT

After a transcription, the audio files and plaintext transcripts were also force aligned. The alignment process itself involves examining a sound file and determining boundaries of vowels and consonants (within each word and between words) as it relates to the transcription of the speech in the sound file. The boundaries of each sound are marked, with each segment assigned with a symbol representing that sound. For example,

the phrase “wet cat” would be divided into six segments, those being w-ɛ-t-k-æ-t[12]. The segments are then lined up with the sound file so that each symbol aligns with its corresponding audio segment. Doing this for each sound file allows for measurements to be taken for any vowel or consonant. Manually completing this process is not only tedious but would also take far too long for the quantity of data collected. To aid in this task, the data were force aligned, which is an automated process. For English data, this alignment was done using DARLA (Reddy & Stanford 2015), the Montreal Forced Aligner (McAuliffe et al. 2017), FAVE-Extract (Rosenfelder et al. 2014), and the Vowels R package (Kendall & Thomas 2010). This process produces a textgrid with the transcript (in this case a string of sound segments rather than English text) aligned to the sound file so that the sound segments match to the acoustic points in the file when they occur. Because this process is automated and not perfect, the alignments were then hand-checked in Praat (Boersma 2013) to ensure accuracy and then corrected if not. For German data, this alignment was done using WebMAUS (Schiel 1999, Kisler 2017). WebMAUS works in a very similar manner to DARLA but allows for languages other than English. WebMAUS was developed at the Ludwig-Maximilian-Universität München in Munich. WebMAUS accesses the Bavarian Archive for Speech Signals, a repository of spoken German with meta-data and annotations that can be used for linguistic-phonetic evaluation. This allows for very precise forced alignment. These force-aligned data were hand checked to ensure accuracy.

[12] IPA was used in this example for simplicity’s sake. DARLA does not return IPA transcriptions, but rather a modified Arpabet transcription. WebMAUS also uses a modified Arpabet transcription. Both IPA transcription and Arpabet transcription use a one-to-one sound to symbol correspondence.

In addition to segmentation and alignment, DARLA automatically provides some measures of the sounds within the file, such as vowel plots, unnormalized formant values, and normalized formant values. Because DARLA can return measurements and for already aligned speech, the hand-checked text grids were reanalyzed, which generated a spreadsheet containing these results. These basic measurements are useful in later analysis. Some of these measurements were duplicated using the script mentioned previously.

3.10 MEASUREMENTS COLLECTED

Several measurements were taken for different aspects of the speech recorded. For vowels, the fundamental frequency (F0), the first four formants (F1, F2, and F3), and duration were collected. Sibilants are measured for duration, center of gravity, skew, and kurtosis. These measurements are explained in detail in this section and were the same for both languages with only the vowels varying due to language specific inventory.

Because F1, F2, and are necessary to determine the vowel space and for each speaker, each vowel was sampled at five points (20%, 35%, 50%, 65% and 80%) for F1 and F2. These measures were provided through DARLA as part of the automated process mentioned previously. This provides 10 data points for each vowel: F1 and F2 at five points during the vowel. These allow for analysis of overall vowel space on average (either at the midpoint of the vowel or an average of all vowel measurements) or the movement of F1 and F2 across time. This is useful in the case of diphthongs or diphthongized monophthongs. As seen in some of the literature, F3 can be indicative of gender/sexual qualities (Zimman 2010, 2012), and F3 was provided by DARLA as a single measurement at the midpoint. F3 is useful to some degree, but not as useful in

terms of visualization of the vowel space in a conventional manner. Because DARLA does not return any measurement for F0 or for sibilant sounds, a Praat script was written and run to extract the F0 for all voiced segments, duration for all sounds, as well as center of gravity, skewness, and kurtosis for sibilant segments. Since MAUS does not provide the same output as DARLA, a script was written to extract the same measurements from the German data.

As noted in Chapter 2, F0 is often how transgender individuals are coached to feminize/masculinize their voices and that F0 is a feature of speech that we easily identify as being associated with some identity of the speaker, be it gender, race, or sexual orientation (Pépiot 2014, Podesva 2011, Simpson 2009, Podesva 2007, Munson 2007, Baken 2000, Avery 1996). F0 is also relatively simple to manipulate to a degree. The script mentioned above samples pitch at five points (20%, 35%, 50%, 65% and 80%) for each voiced segment. This will allow for overall pitch (range and mean) as well as an analysis for F0 of specific vowels. Because voiced segments include consonants and vowels, both were sampled though vowels were the primary focus of this measurement. These data were measured and entered into a spreadsheet for each instance of any voiced segment.

This script also extracts measurements for sibilant consonants: duration and center of gravity, skew, and kurtosis. Duration measures were taken from the length of time for each sibilant segment per the aligned data. Center of gravity measurements were taken for each fricative. These data were then automatically written into a spreadsheet for each instance of a sibilant sound detected in the transcript.

All these data were compiled in one spreadsheet which was then matched to the speakers' demographic information. This allows for detailed statistics to be run on the data as each instance of a measurement of a sound is associated with all details of each speaker.

This study relies on several measurements of vowel systems as described in Audibert 2015. Firstly, a measurement called vowel space uses the peripheral vowels to estimate overall vowel space. Audibert presents this as a pentagram with five vowels (i, e, a, o, u) and then calculates the area within this pentagram to yield a single value. While this method may work well for languages with five vowel systems, this is not as easily applied to English. Despite this, the four peripheral vowels mentioned earlier (i.e., /i/, /æ/, /a/, /u/) were used in one measure of the vowel space. In further calculating vowel space, Audibert 2015 also provides different methods to calculate vowel space. Because there are more than 4 or 5 vowels in the English vowel space, the VSA method may lack accuracy that other methods can provide, though it provides a rough yet useful description of a vowel system that could then be applied to and compared with other languages. The remaining vowels at the edge of the vowel space are not used to calculate VSA thus not considering the potential for some vowels be distributed outside the quadrilateral (a fronted /u/ in English may result in /ʊ/ being the furthest back vowel). Another method uses the distances of each vowel from the center point of the vowel space to determine how distances of each vowel from the vowel space center. This will allow for each vowel to be compared with regard to distance from the center of the vowel space and allows for comparison between speakers as it can be scaled with most peripheral vowels having the longest distance from the center point.

Each voiced segment is measured at for F0, F1, and F2 at five points in time (20%, 35%, 50%, 65% and 80%) and various interpretations of these measures can be formed (a traditional depiction of vowel space, VSA, distance from center) using these points. All sibilants are measured for duration, center of gravity, skewness, and kurtosis.

3.11 CONCLUSION

This chapter explains the methods used for this experiment. Firstly, an explanation of the phonological inventories of English and German, noting the specific vowel system as well as the fricative system of each language and phonological processes that might complicate data collection. The cultural landscape of each speaker group was explained, noting how differences between each culture may affect participant selection and response rate. The equipment and speaker selection methods were briefly discussed followed by detailed procedures for each interview type (in-person and virtually). The tasks (word list, short passage, and discussion) were explained followed by how the researcher's various identities and privileges may have affected participant responses. Data about each language group were then presented with comments on any issues that arose during the collection process. A section on manipulating the data was presented which includes processing the sound files, transcription, segmentation, and alignment. Lastly, the measurements collected from the sound files were explained as to how they will be used in subsequent chapters for analysis.

CHAPTER 4

RESULTS - ENGLISH

4.1 INTRODUCTION

This chapter details the findings from the data collected from recorded interviews with transgender individuals (as detailed in Chapter 3), focusing exclusively on the data collected from the English interviews. The chapter is organized into three major sections based on the measurements collected: fundamental frequency, vowel space, and sibilants. Within each section, an overview of these measurements is presented for all speakers, then examined with respect to specific gender categories: transwomen, transmen, and nonbinary. To determine if a task exhibits some noticeable effect on the data, the section is further subdivided to reveal that effect. Finally, a summation of identifiable trends is presented.

Although discussed in detail in the Methodology chapter, a brief review of the participants is necessary in order to best understand the outcomes shown by the data. The English speakers consist of 13 transmen, 4 transwomen, and 7 nonbinary individuals. Because there are so many participants, a detailed description of each participant will not be given, but this biographical information is provided in the Appendix.

4.2 FUNDAMENTAL FREQUENCY

As discussed in previous chapters, fundamental frequency (F0) is a measurement of the lowest clustering of frequencies in voiced sounds that roughly correlates to pitch.

F0 is a salient feature of speech, is easily perceptible to those without linguistic training and is also easily manipulated.

Fundamental frequency has been shown to correlate with gender identity in multiple studies of English speakers over many years. Coleman 1956 and Smith 1973 both show that English-speaking men generally have narrower F0 ranges and lower means than English-speaking women. Per the aforementioned studies, men's F0 range from 100 to 120 Hz and women's range from 200 to 250 Hz. Looking just at mean values, men show a lower mean at about 110 Hz and women show a higher mean at about 225 Hz. This size difference is language specific (Mennen 2012) and therefore indicates that it is not purely physiological differences that are at play, but rather sociological ones as well.

Trans men, trans women, and nonbinary people may use F0 to indicate membership to one of the binary gender categories, man or woman, or rather may use F0 to mark their own linguistic gender identity, such as transman, transwoman, or nonbinary separate from cisgender men and women. One possible tactic might be that transgender speakers seek to align the F0 (pitch) of their voice to cisgender norms. If this is the case, the following trends are expected in the data: trans men will approach the lowest mean F0, trans women will have a higher mean F0, and nonbinary speakers' mean F0 may lie at an intermediate level.

4.2.1 OVERALL

This section discusses the overall findings for fundamental frequency measurements taken from the data. Men, women, and nonbinary categories are all plotted together for the sake of comparison. Figure 4.1 (below) shows the overall range

(whiskers), mean (dark line), and interquartile range (shaded box) for each speaker in all tasks. This figure is organized with F0 on the x axis, and speaker given on the y-axis, sorted by gender then by participant. Lastly, each gender is sorted with regard to length of time on hormone replacement therapy, with months given in parentheses.

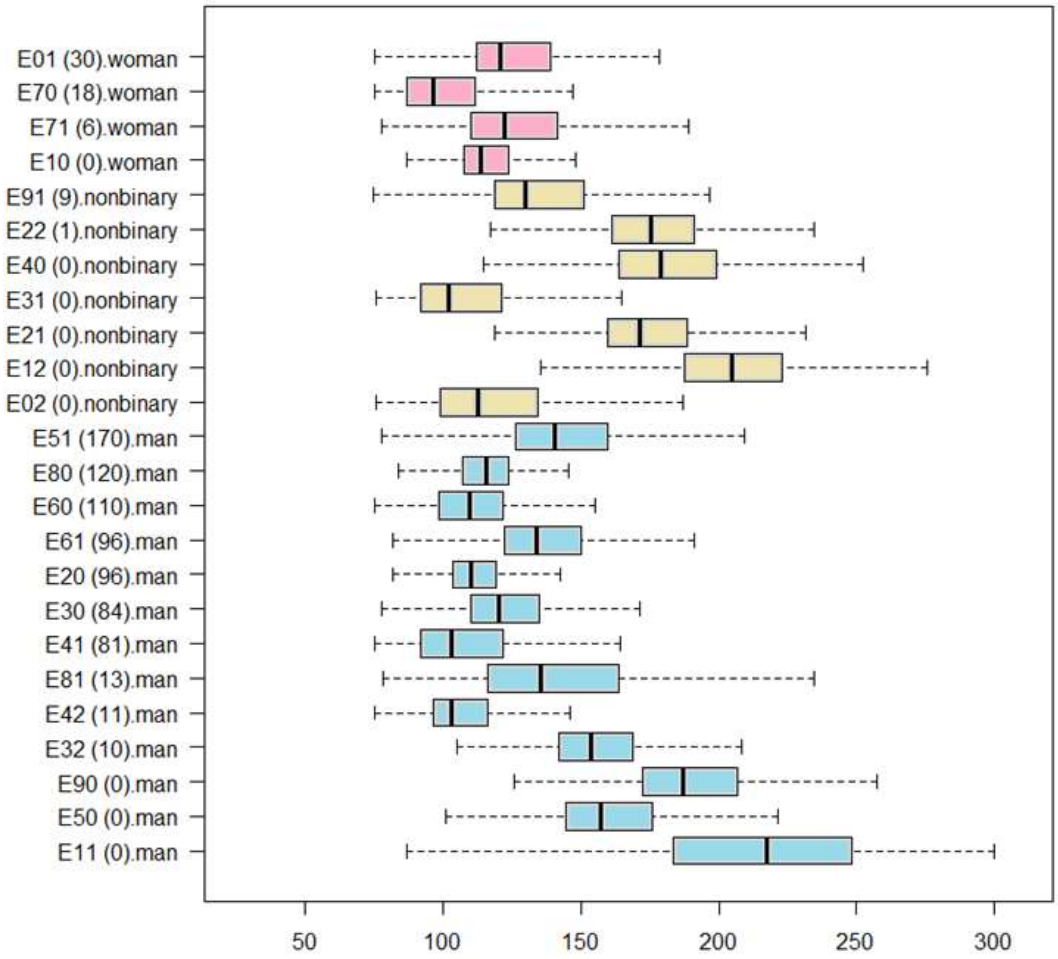

Figure 4.1: F0 of all English Speakers

Figure 4.1 shows several trends in the F0 production by these speakers. As mentioned in Chapter 2: Gender and Phonetics, when someone assigned female at birth receives testosterone as part of hormone replacement therapy (HRT), there are physiological changes to the vocal tract as well as corresponding changes to the production of speech, notably a lower F0. When examining the data for the men shown in Figure 4.1, as the number of months after beginning transition increases, there is a lowering of F0 in terms of mean, interquartile range, and low range. This follows closely with data presented in Chapter 2. The disparity in months since beginning therapy makes this even more notable as there are 4 men who have had no HRT, but all others have had more than 10 months. This difference shows a clear break between the interquartile ranges and means between the no HRT speakers and the rest, with participant E18 (13 months on HRT) showing a wider overall range that then overlaps with many of the no HRT speakers.

The F0 for the women in Figure 4.1 show a low overall range and mean, which aligns with previous research indicating that HRT shows no real notable change to the vocal track in transwomen. As such, there is no notable difference between the women who have received no HRT and those who have received said therapy for years.

Speakers completed three separate and sequential tasks, and each task shows different trends for F0 based on the type of task. For the first task, speakers read a list of twenty words twice in a carrier phrase and each word had been selected with the goal of eliciting most of the English vowels, most consonants, and all sibilant sounds in English. This type of task should elicit careful speech (Ladefoged 2014, Warner 2011, Ellis 1999). This list as well as the other tasks can be found in Appendix I.

To contrast with Task 1, participants also read a short passage to elicit careful running speech. Each participant read the Rainbow Passage (Fairbanks, 1960) as it is a commonly used passage and should then allow for easy comparison with other research. Participants were instructed to pause or repeat as needed and that accuracy was not the ultimate goal. The measurements for the overall F0 range of vowels in Task 2 (Short Passage) are presented in the figure below and are sorted by gender.

Finally, for Task 3 (Interview) participants were asked a series of semi-biographical questions and were told they could answer as briefly or lengthily as desired. Task 3 presented the most naturalistic speech of the three tasks, but was not balanced per participant, as some participants gave terse responses totaling 3 minutes, while one participant spoke for an hour and a half (only the first 30 minutes were analyzed). Most participants spoke for between 20 and 30 minutes.

4.2.2 TRANSWOMEN

This subsection provides an analysis of the data for women overall and is further subdivided by task. This is useful to show intergroup variation based on task. The figure below shows the overall F0 ranges and mean for each participant.

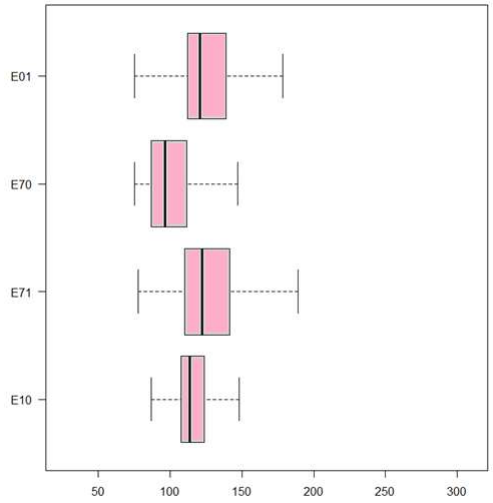

Figure 4.2: F0 of English-Speaking Women

This figure shows the overall F0 for English-speaking women in this study and is therefore a subset of the overall F0 data shown in Figure 4.1. Figure 4.2 shows that these women have mean F0 values as low as 96Hz for E20 and as high as 123 Hz for speaker E21. The range for F0 is large for Speakers E01 and E21, ranging from below 80 Hz to as high as 180 Hz.

As each participant completed three tasks, subsetting the data into these tasks can help show differences in different modes of speech for the participants. The first task to be discussed is the word list. This consisted of a list of 20 words, with the intent of collecting careful speech and including most consonants and vowels of English. For this task, only the vowels in the target words were sampled.

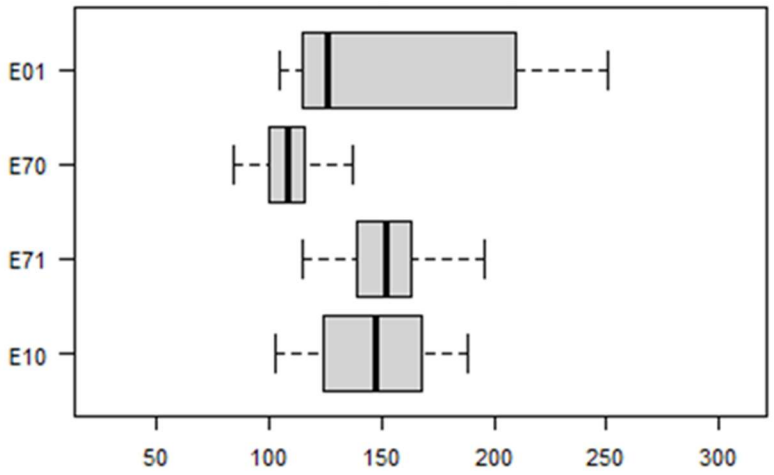

Figure 4.3: F0 of English-Speaking Women (List)

This figure shows an interesting divergence from the overall data shown in Figure 4.2, most notably all speakers show a higher mean F0 value for their speech. While the difference for speaker E20 was not large with only a difference of about 10 Hz, both E21 and E10 show a mean nearing or just past 150 Hz, with the difference being just over 30hz. Another apparent difference is the interquartile range for speaker E01, with a large range when compared with their overall measurements (Figure 4.1).

The second task consisted of speakers reading a passage in order to produce flowing speech that was more naturalistic, but still careful. The Rainbow Passage was selected due to its frequent use in other research and somewhat cheekily, due to the content being about the rainbow, a widely known symbol for the LGBT community. A figure showing the F0 measurements for only the interview task for the women is given below.

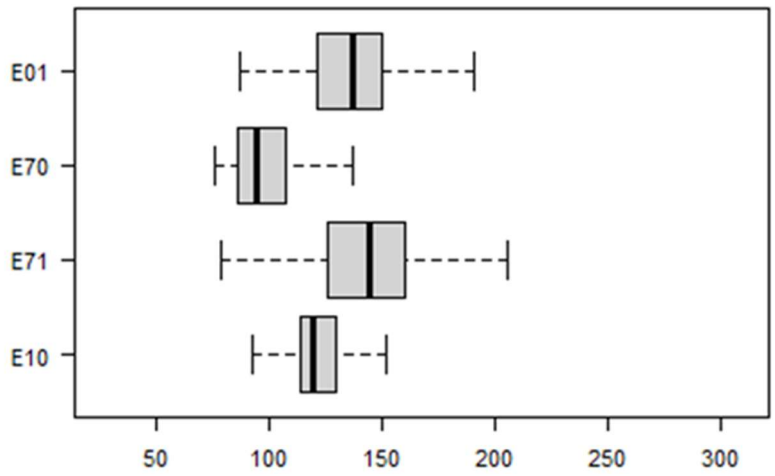

Figure 4.4: F0 of English-Speaking Women (Passage)

The above figure shows the F0 measurements of all vowels for women reading the passage (Task 2). Notable in this figure is speaker E71, who has a much higher mean than her overall mean (cf. Figure 4.2). Most speakers have a lower F0 than the word list (Task 1), which is is likely due to the performative nature of reading a list (most careful) and reading a story aloud (careful, but less so).

The final task that participants completed was a set of open-ended questions, henceforth "the interview", designed to elicit the most natural speech possible. The questions begin with surface level questions (age, hometown, level of education, etc.) then progress to more personal topics related to transition and life as a transperson. This task elicited the most naturalistic speech, and therefore may be more representative of what speakers do during their day-to-day speech. A figure showing the Interview task for the women is given below:

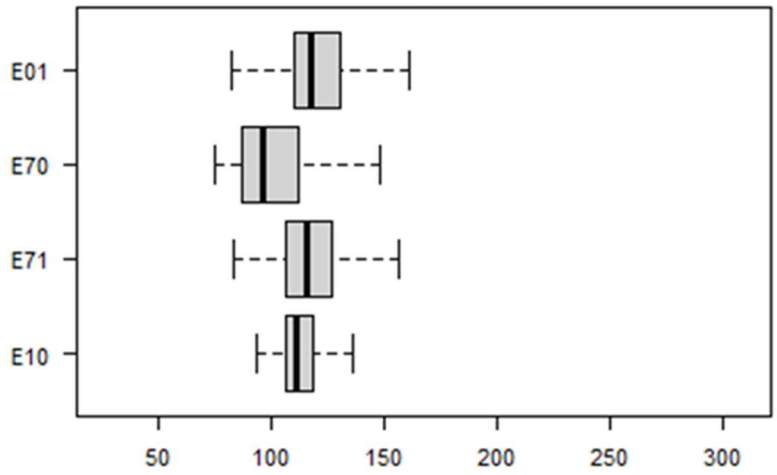

Figure 4.5: F0 of English-Speaking Women (Interview)

This figure shows the data from the interview portion of this study. The F0 represented by this data should be closest to naturalistic data, as it was casual conversation instead of a task where the focus could be interpreted as speech itself. Most participants spoke at a higher speed, were overall more casual, and seemed more relaxed during this task compared to other tasks. Notably, all speakers also exhibited a lower F0 in the interview task than in either of the previous tasks. At least two interesting explanations arise for this observation of F0 lowering. One possibility is that, by this point in the recording session, speakers were experiencing some degree of vocal fatigue. Effort would be required to maintain F0 levels in a typical (female) cisgender range, and speakers may have been unable to keep sufficient muscle tension for the entire duration of the session. Alternatively, the lowering of F0 may have been due to speakers' increased relaxation and degree of comfort with the interviewer or interview setting as the session continued. In this case, speakers may have reduced the stringency of F0 self-monitoring over time.

4.2.3 TRANS MEN

This subsection provides an analysis of the data for men overall and is further subdivided by task. This is useful to show intergroup variation based on task. The figure below shows the overall F0 ranges and mean for each participant.

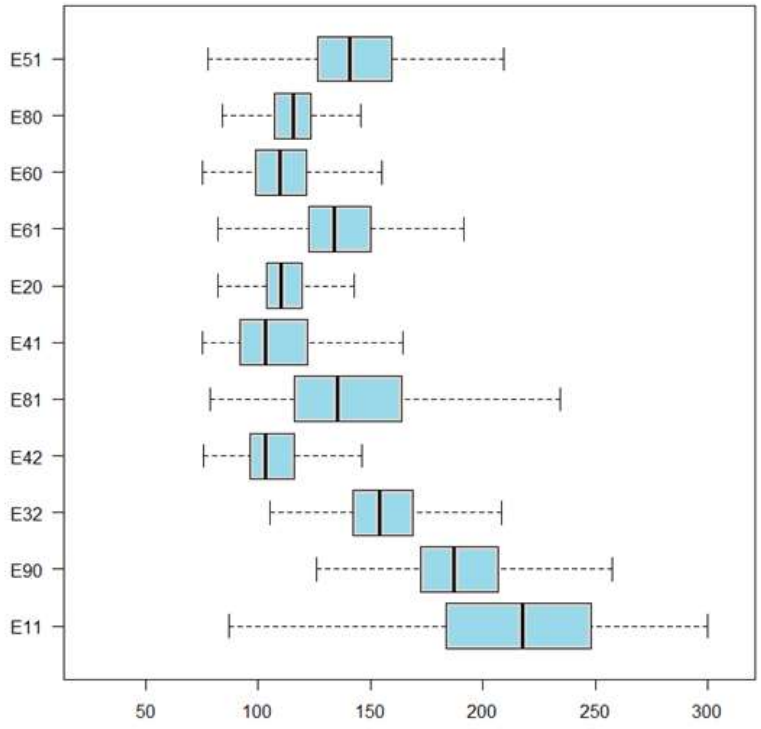

Figure 4.6: F0 of English-Speaking Men

This figure shows the overall F0 for English-speaking men in this study and is therefore a subset of the overall F0 data shown in Figure 4.1. Figure 4.6 shows that these men have mean F0 values as low as 100Hz for E41 and as high as 220 Hz for speaker E11. The men are sorted by time on HRT, with longest time receiving HRT is at the top and least time receiving HRT is on the bottom. This shows the expected trend of longer time HRT

lowering F0. This claim is reinforced by the statistical analysis mentioned in section 4.2.1 which showed that HRT did in fact have a significant effect on F0.

As each participant completed three tasks, subsetting the data into these tasks can help show differences in different modes of speech for the participants. The first task to be discussed is the word list. This consisted of a list of 20 words, with the intent of collecting careful speech and including most consonants and vowels of English. For this task, only the vowels in the target words were sampled.

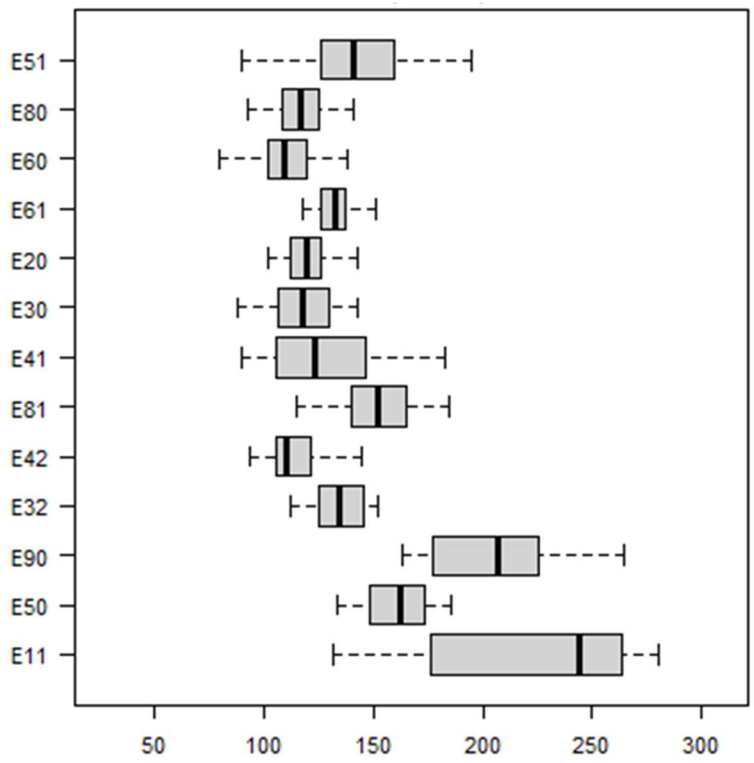

Figure 4.7: F0 of English-Speaking Men (List)

This figure shows an interesting divergence from the overall data shown in Figure 4.6, most notably many speakers show a higher mean F0 value for their speech, especially

those who have received HRT for a longer time. Another apparent difference is a raising in F0 of the speakers who had received HRT the shortest amount of time, with speaker E90 jumping to about 210 Hz from about 285 Hz.

The second task (passage) is separated from the overall data to show flowing speech that was more naturalistic, but still careful. A figure showing the F0 measurements for only the interview task for the women is given below:

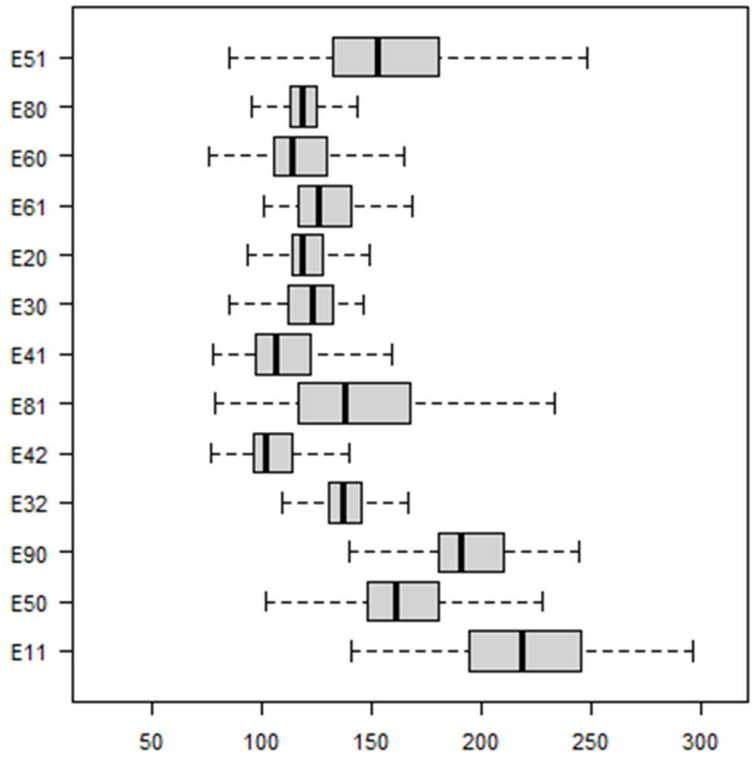

Figure 4.8: F0 for English-Speaking Men (Passage)

The above figure shows the F0 measurements of all vowels for trans men reading the passage (Task 2). Notable in this figure is speaker E71, who has a much higher mean than

the overall mean (cf. Figure 4.2). The speakers with the least amount of time on HRT have a lower F0 than the word list (Task 1), which is likely due to the performative nature of reading a list (most careful) and reading a story aloud (careful, but less so). Notably, the speakers with the most time on HRT, excluding speaker 71, all show means and ranges that are very close and cluster around 120 Hz.

The final task that participants completed the interview, designed to elicit the most natural speech possible, which should be more representative of what speakers do during their day-to-day speech. Figure 4.9 shows Task 3 (interview) for the men below:

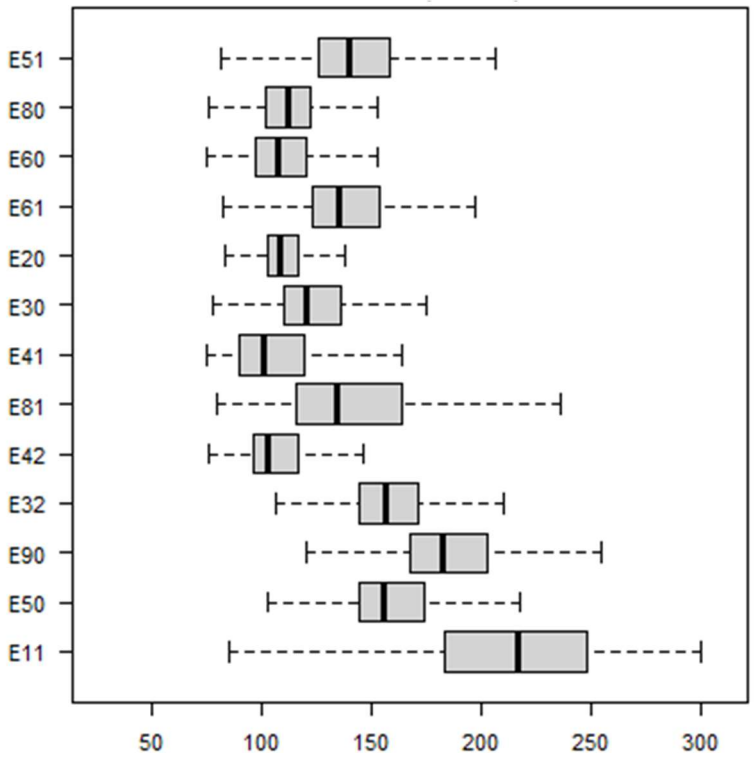

Figure 4.9: F0 of English-Speaking Trans Men (Interview)

This figure shows the data from the interview portion of this study. The F0 represented was sampled casual conversation instead of a task where the focus could be interpreted as speech itself. Many speakers have a lower F0 than the word list (Task 1), which is likely due to the performative nature of reading a list (most careful) and reading a story aloud (careful, but less so). Notably, the speakers with the most time on HRT are much more variable than either of the previous tasks. This was likely due to some speakers being more expressive during the interview, as speaking about a personal topic in which they were emotionally invested required more variation to express their feelings.

4.2.4 NONBINARY

The final group consists of speakers who indicated that they identify neither as men nor women. While speakers used a variety of terms, as previously discussed, "nonbinary" is used here as an overarching term to best capture this group with somewhat disparate identities. This subsection provides an analysis of the data for nonbinary speakers overall and is further subdivided by task. This is useful to show intergroup variation based on task. The figure below shows the overall F0 ranges and mean for each participant.

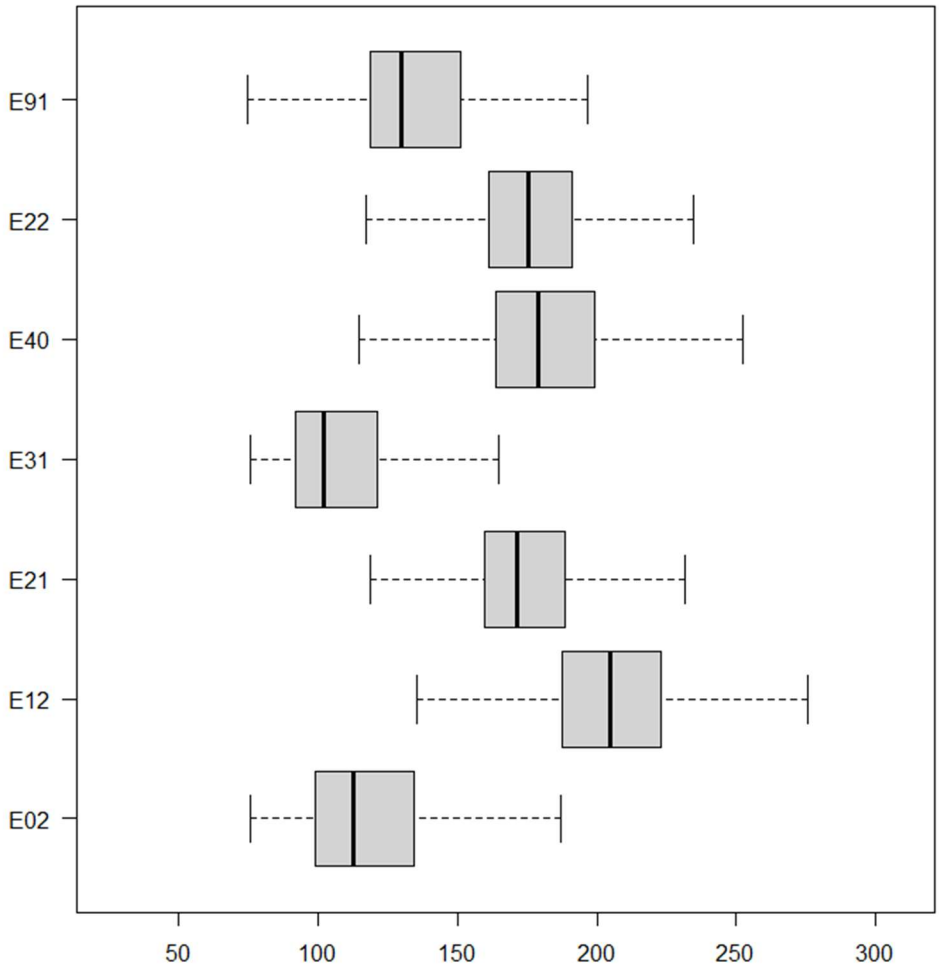

Figure 4.10: F0 for Nonbinary English Speakers

This figure shows the overall F0 for nonbinary English speakers in this study and is therefore a subset of the overall F0 data shown in Figure 4.1. Figure 4.10 shows that these speakers have mean F0 values that are highly variable. The speakers are sorted by time on HRT, with longest time receiving HRT is at the top and least time receiving HRT is at the bottom. As speakers in this group used either testosterone or estrogen, there is not a balanced effect on F0, so there are not many trends seen within this overall data.

Subsetting the data into the three tasks can help show differences in different modes of speech for the participants. The first task to be discussed is the word list. For this task, only the vowels in the target words were sampled. The following figure shows the F0 measurements for nonbinary speakers of English:

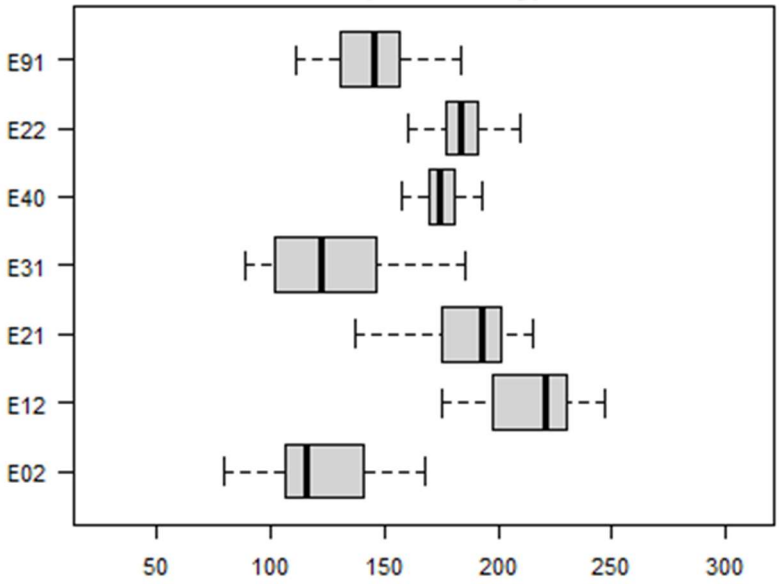

Figure 4.11: F0 for Nonbinary English Speakers (List)

Much like the overall data, these speakers show no real trends relative to time on HRT. All speakers have a higher F0 than their overall F0 measurements (Speaker E02 has a very small increase). This is likely due to the task type and speakers intending to speak clearly and precisely.

The second task (passage) is separated from the overall data to show flowing speech that was more naturalistic, but still careful. A figure showing the F0 measurements for only the interview task for the nonbinary speakers is given below:

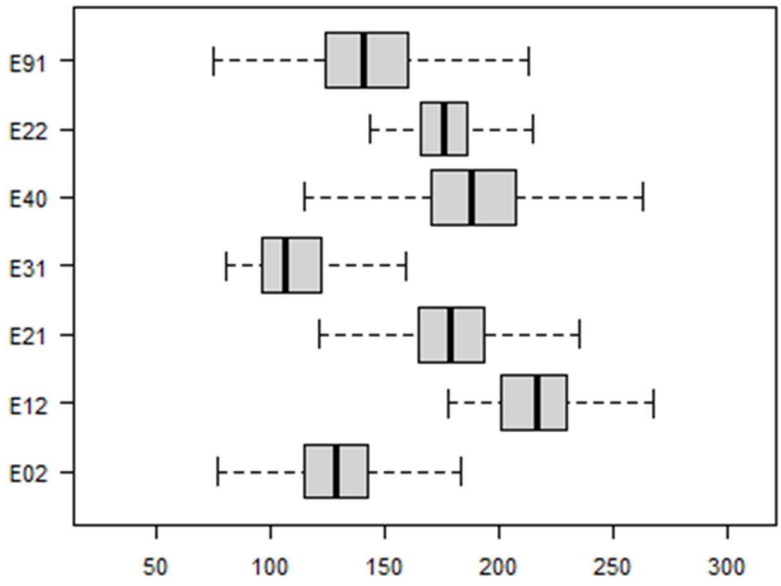

Figure 4.12: F0 for Nonbinary English Speakers (Passage)

The above figure shows the F0 measurements of the vowels for nonbinary speakers reading the passage (Task 2). Many speakers show a lowering of F0 similar to the trans men and women in this study, but some show a higher F0, such as speaker E02 and E40.

The final task that participants completed the interview, designed to elicit the most natural speech possible, which should be more representative of what speakers do during their day-to-day speech. A figure showing Task 3 (interview) for the nonbinary speakers is given below:

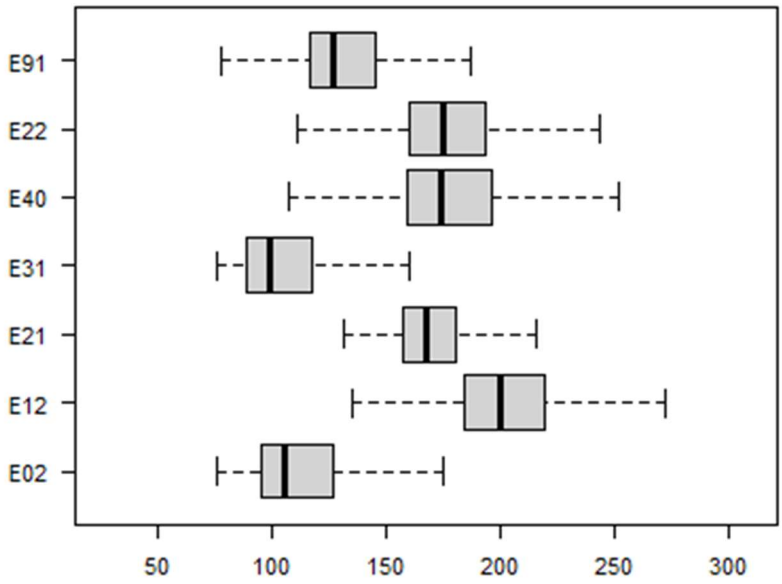

Figure 4.13: F0 for Nonbinary English Speakers (Interview)

This figure shows the data from the interview portion of this study. The F0 represented was sampled casual conversation instead of a task where the focus could be interpreted as speech itself. All speakers have a lower F0 than the reading passage (Task 2), and some have a lower F0 than in the word list (Task 1). Again, these differences are likely due to the performative nature of reading (most careful) and reading a story aloud (careful, but less so).

4.2.5 EFFECT OF HRT ON F0

This section discusses the findings of HRT on F0. The data and analysis of F0 confirms the previous research, which shows that HRT does in fact lower the F0 for transgender men, but it has no such effect on women (Irwig 2017, Ziegler 2018). To test

this, I used a linear mixed model using Gaussian error structure and identity link function. Random effects were “participant ID” and “word”, and fixed effects were “task” and “gender”. For testing F0, I also used a second model, which included an interaction effect between “gender” and “hrt” where “hrt” is time spent on HRT in months, but excluded nonbinary participants, as HRT has different effects on the voice depending on which sex was assigned at birth and which hormones (testosterone or estrogen) speakers received. Response variables tested were “F0”. Where a significant effect was identified, I undertook post-hoc testing with the “emmeans” package to identify effect sizes and test pairwise comparisons. For F0 of all speakers, I found a significant effect of “Task” ($\chi_{22,8} = 51.7$, $p < 0.001$) and no significant effect of “Gender” ($\chi_{22,8} = 4.1$, $p = 0.126$). Due to the differing effect of HRT on men and women due to hormone received, excluding the nonbinary speakers yielded different results. For F0 of men and women (nonbinary excluded), I found a significant effect of “Task” ($\chi_{22,9} = 21.9$, $p < 0.001$) and a significant effect of “Gender” ($\chi_{21,9} = 4.2$, $p = 0.041$) and a significant interaction effect of “Gender” and “HRT” ($\chi_{22,9} = 6.2$, $p = 0.046$). This shows that HRT does in fact lower the F0 for men and is significant, but for women, no corresponding change was evident. This aligns with previous research into HRT and F0 as noted in a previously.

Since the nonbinary speakers were excluded, it is important to note that several speakers in the nonbinary category produce not only a relatively high mean F0 when compared with both the men and women, they also produce a wider overall range for F0. This indicates that speakers categorized in this group produce speech that might be perceived as not strictly masculine, but also not strictly feminine. For some who wish to indicate their non-binary identity through their speech, a wide range for F0 seems to be

how these speakers highlight that social difference. There were speakers in this category who were assigned male at birth and others assigned female at birth, so this seems to be a social decision rather than one based on physiology.

4.3 VOWEL SPACE

Vowel space can be quantified in several ways, as discussed in Chapter 3. To simplify the vowel space for the same measurements, the vowel space in this section is treated as having five vowels, namely /i/, /e/, /a/, /o/, and /u/. This section is organized by participant groups first, then subdivided into the type of analysis of the data: all data points vowel plot, vowel space area, and distance from centroid.

4.3.1 OVERALL

First, the data for all English speakers will be presented firstly grouped by gender, then sorted by length of time on HRT. The first row (n = 4) is the women with an increase of time receiving HRT each subsequent plot. The next three rows (n = 13) are the men with an increase of time receiving HRT with each subsequent plot. The final two rows (n = 7) are the nonbinary speakers. This is also sorted with each subsequent plot representing time receiving HRT, but this group is variable (some received testosterone, and some received estrogen), so this organization is arbitrary and done merely for simplicity and to match the other two groups. This can be seen in the figure below:

Figure 4.14: Vowel Space of English Speakers

This shows the vowel spaces for all speakers of English. The vowels are color coded with the front vowel /i/ red, /ae/ being green, /u/ being orange, and /a/ being orange. This shows the variability of the data, meaning some speakers have notably more vowel instances represented than others. This is due to the length of time taken for Task 3, the biographical interview. While this shows the vowels and how they exist within the vowel space, this can be quantified and analyzed using different representations of the same data, namely VSA and distance from centroid, which are discussed in subsequent sections.

4.3.2 VOWEL SPACE AREA

Vowel space may also be represented as a quadrilateral with each corner of the quadrilateral representing the mean of all instances of the respective vowel, termed here as vowel space area (VSA). VSA was used by Audibert et al. (2015) as one of many ways to gauge vowel space. Vowel space was calculated using the formula from Audibert et al. (2015): given F1 & F2 mean values of /i,e,a,o,u/, pVSA=0.5*ABS(F1i (F2e -F2u)+F1u (F2i -F2e)+F1e (F2u - F2i))+ABS(F1u (F2e -F2o)+F1o (F2u -F2e)+F1e (F2o - F2u))+ABS(F1a (F2e -F2o)+F1o (F2a -F2e)+F1e (F2o -F2a)). This formula was modified to include only for vowels /i/, /ae/, /u/, /a/. Instead of yielding a pentagon, this produced a quadrilateral in English that is bounded on the four sides by /i/ in the upper left corner, /u/ in the upper right corner, /ae/ in the lower left corner, and /a/ in the lower right corner. A figure showing these representations for the English speakers can be seen below:

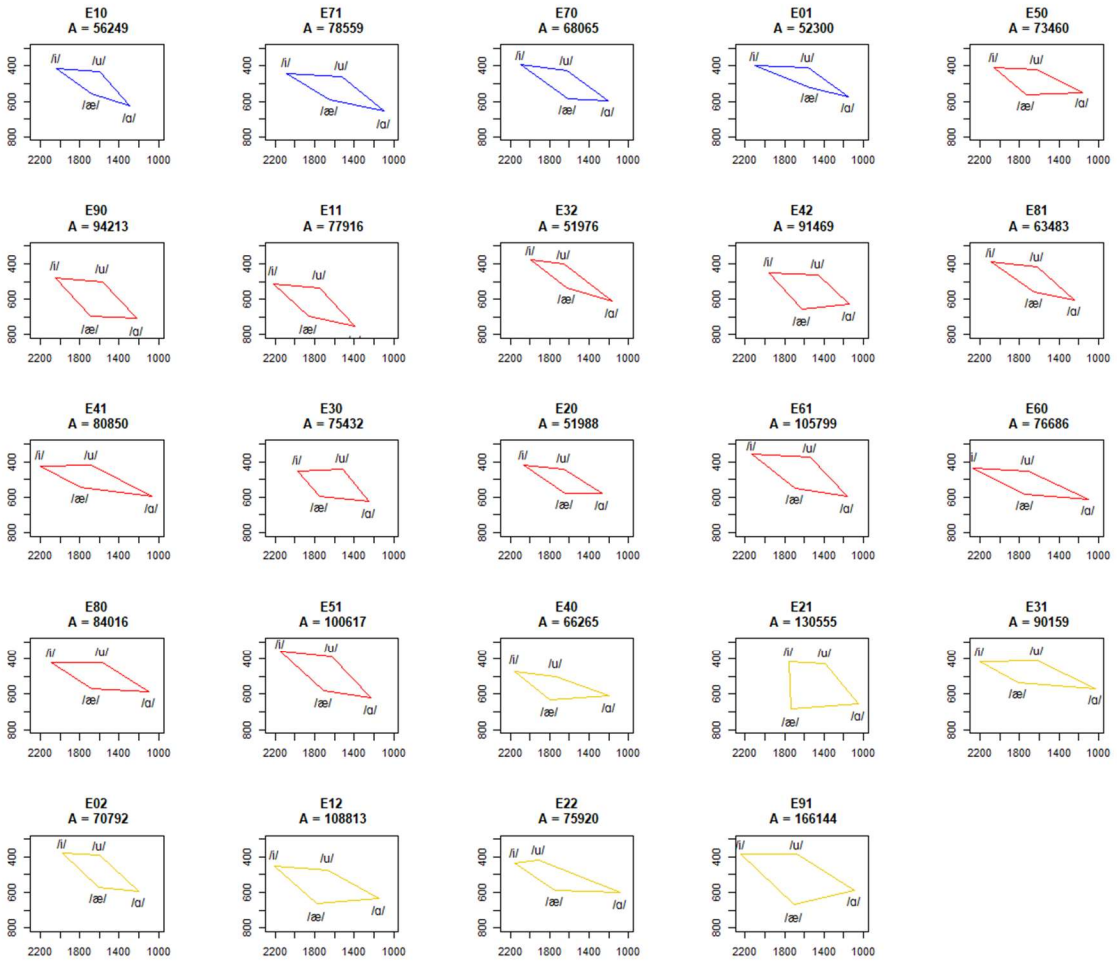

Figure 4.15: VSA of English Speakers

The above figure shows the vowel quadrilaterals for each English speaker. The lines of the quadrilaterals are colored according to gender. Trans men are indicated by blue, women by the red, and nonbinary people represented with yellow lines. These representations show that for many of the men, the vowel space is more contracted than the women in this sample. To determine if gender had an effect on vowel space, I used an analysis of variance with the predictor of "gender" and the corresponding response

variable (VSA, Distance to Centroid from /i/, Centroid Range of F1, etc.) paired with Tukey's Honest Significant Difference test for pairwise comparisons. P-values in text are adjusted p-values. For men, the mean vowel space area was 79070 Hz^2 (± 6580), women have a mean VSA of 63793 Hz^2 (± 11862), and nonbinary speakers have a VSA of 101236 Hz^2 (± 8976). For VSA, there is no significant difference between nonbinary speakers and men ($p = 0.139$), no significant difference between women and men ($p=0.509$), but there is a significant difference between women and nonbinary speakers ($p=0.050$). This indicates that women and nonbinary speakers show vowel spaces that differ from women, but not from men.

To determine if gender had an effect on the F1 or F2 ranges of the vowell space, I used an analysis of variance with the predictor of "gender" and the corresponding response variable (F1 range / F2 range) paired with Tukey's Honest Significant Difference test for pairwise comparisons. Distances and standard deviations are presented in Table XX below. The Tukey's HSD test returned no significant differences: $p > 0.05$ in all cases.

TABLE 4.1: English F1 and F2 Range

Mean formant value (SD)	Man	Nonbinary	Woman
F1	510 (13)	524 (18)	491 (24)
F2	1761 (21)	1772 (29)	1729 (38)

4.3.3 DISTANCE FROM CENTROID

The vowel space can also be represented by measuring the distance of these mean points for each vowel from the centroid (center) of the vowel space. This measure is called distance to centroid and was used by Audibert et al. (2015) as another way to measure vowel space. This method gives a center point for each speaker's vowel space and provides insight into how far each vowel is from the center of the vowel space. A visualization of this for each speaker is given below:

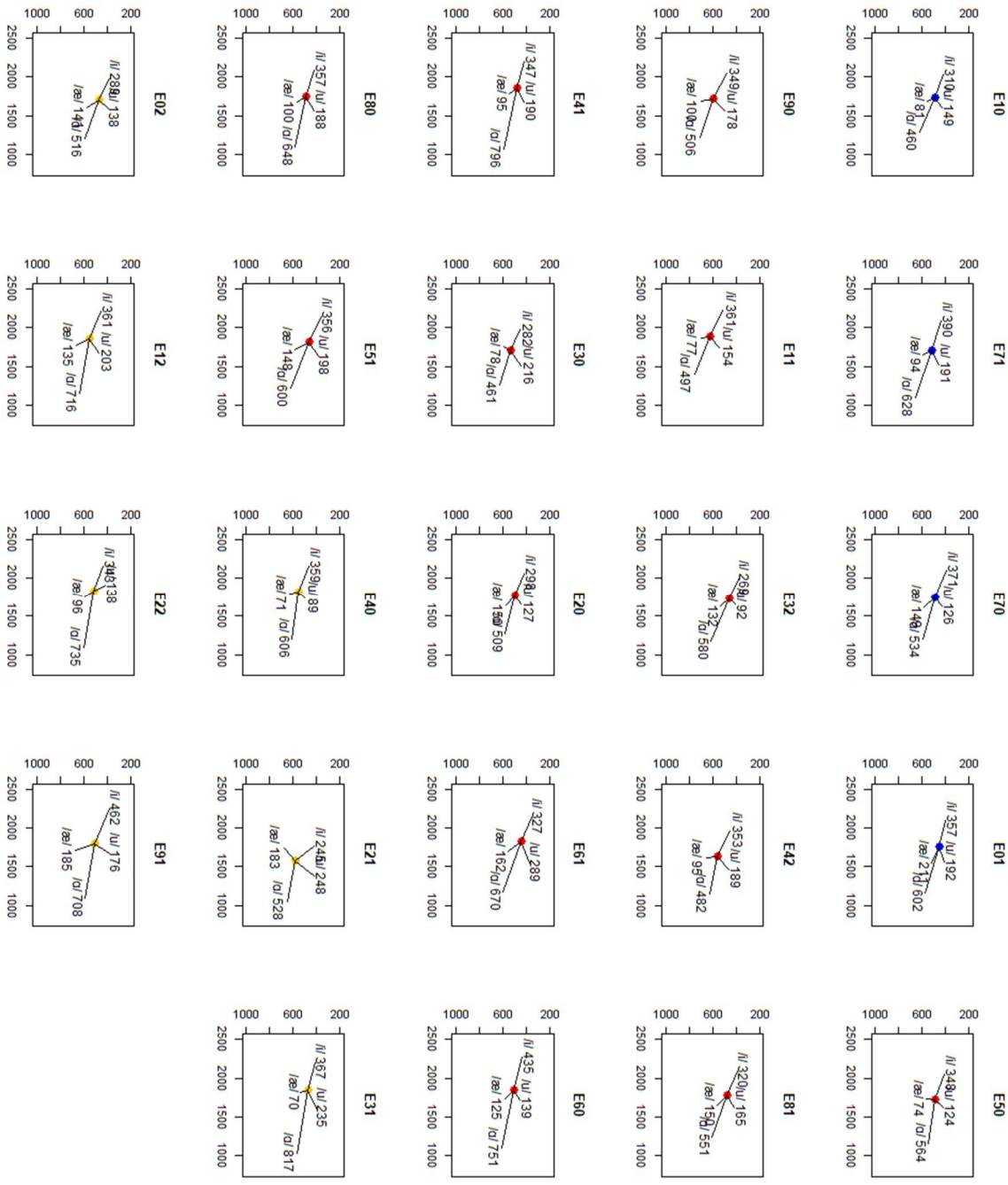

Figure 4.16: Distance from Centroid of English Speakers

The figure above shows men being marked with a red point for the centroid, women with a blue point, and nonbinary speakers with yellow. To determine if gender had an effect on the distance of any vowel from the centroid of the vowel space, I used an analysis of variance with the predictor of "gender" and the corresponding response variable (e.g., Distance to Centroid from /i/) paired with Tukey's Honest Significant Difference test for pairwise comparisons. Distances and standard deviations are presented in Table XX below. The Tukey's HSD test returned no significant differences: $p > 0.05$ in all cases.

TABLE 4.2: English Distance to Centroid

Mean distance to centroid (SD)	Man	Nonbinary	Woman
/i/	339 (14)	346 (19)	357 (25)
/o/	173 (14)	175 (19)	165 (25)
/e/	586 (29)	661 (39)	556 (52)
/u/	114 (12)	126 (16)	134 (21)

4.4 SIBILANTS

This section discusses the sibilant sounds collected in this experiment. English has four sibilant phonemes [s] [z] [ʃ] [ʒ], and two phonemic affricates [dʒ], and [tʃ]. As mentioned previously, although the affricates share features of the sibilant sounds, they are not analyzed in this study. Sibilants can be measured via several values. The measurements used in this dissertation are center of gravity (CoG) and sibilant duration. Center of gravity is a measurable feature that aids in the identification and differentiation of fricative sounds (Chodroff, 2020). Center of gravity is a measure of the magnitude-

weighted average of the frequencies present in the spectrum for the fricative (Forrest 1988). The centers of gravity for the sibilant sounds of all English speakers for all tasks are shown below:

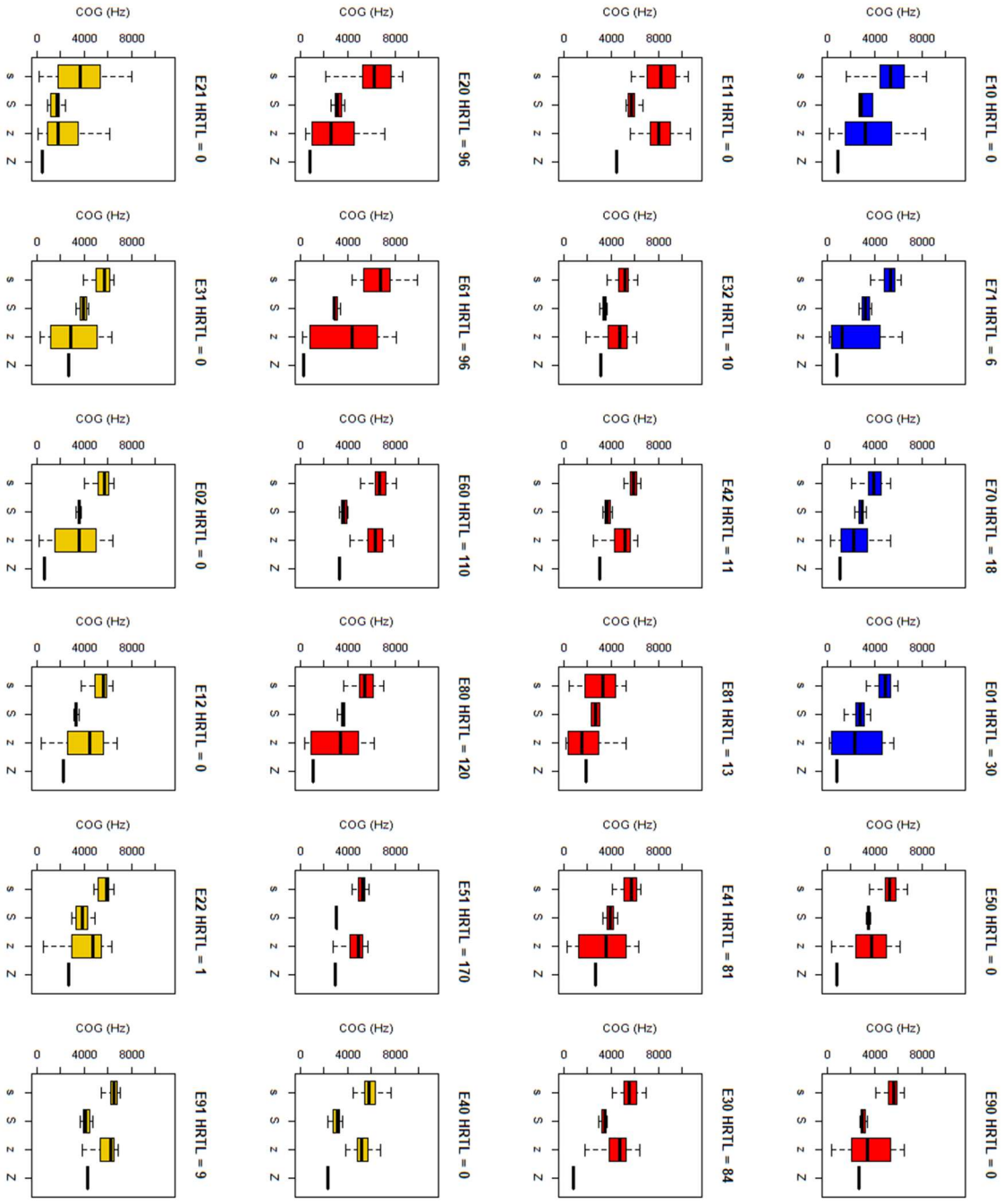

Figure 4.17: Center of Gravity of English Speakers

The above figure shows the center of gravity for each sibilant sound. Perhaps most notably, many of the speakers only show three sibilant sounds, with /ʒ/ missing. This was the case for these speakers primarily because there is such a small sample of this sound, which was noted as being a less common sound in English in a previous chapter. Unlike the vowel data, there is no significant effect of gender on these sounds. This was evaluated using an analysis of variance with the predictor of "gender" and the corresponding response variable (center of gravity) paired with Tukey's Honest Significant Difference test for pairwise comparisons. P-values in text are adjusted p-values. For the center of gravity for /S/, I found no significant effect of "Task" ($\chi_{22,8}$ = 1.9, p = 0.385) and also and no significant effect of "Gender" ($\chi_{22,8}$ = 2.6, p = 0.278). For the gender of gravity of /z/ I found a significant effect of "Task" ($\chi_{22,8}$ = 23.2, p < 0.001) and no significant effect of "Gender" ($\chi_{22,8}$ = 4.6, p = 0.101). Lastly for the center of gravity for /Z/, I found no significant effect of "Task" ($\chi_{22,8}$ = 2.9, p = 0.236) and no significant effect of "Gender" ($\chi_{22,8}$ = 2.2, p = 0.335).

Sibilants can also be measured for duration, which has been shown by some (Simpson 1998, Smyth 2022) to indicate differences in gender with women showing a longer duration for sibilants. The data can be further subset into the individual tasks undertaken by participants. The measures of duration were not normalized or scaled for this analysis. A figure showing the duration for sibilants for all tasks can be seen in the figure below:

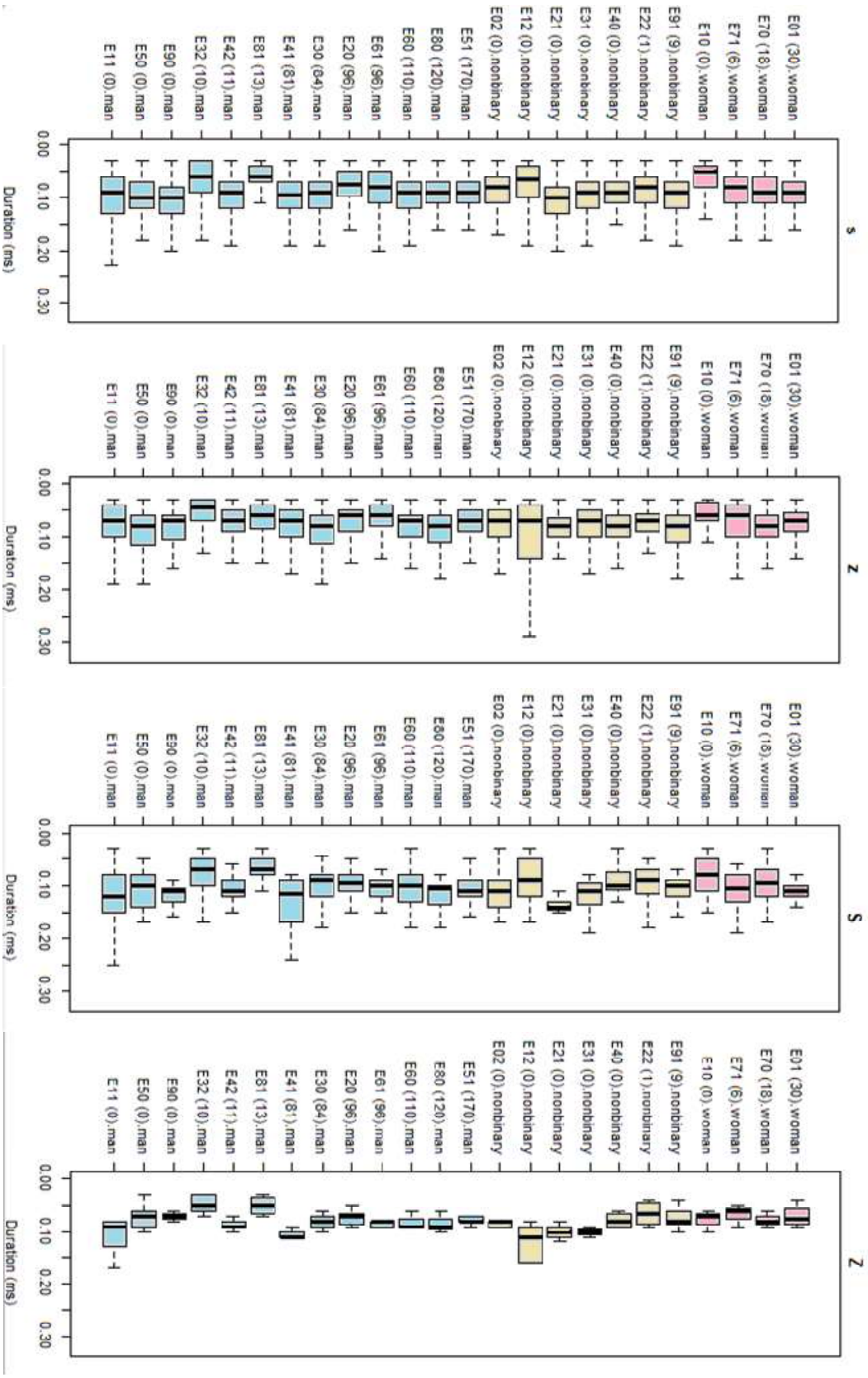

Figure 4.18: Sibilant Duration of English Speakers

As shown in Figure 4.17, there are hardly any visible trends for any of the groups for most of the sounds. This is corroborated by the lack of any significance for these sounds relative to gender. The only qualitative difference may be in the /ʒ/ sound (listed as EZ here) which is much more variable than the other sounds. Notably, the nonbinary group, specifically speakers E31, E21, and E12, show longer mean duration and only speaker E41 (a trans man) has a similar mean. Again, while this can be seen in the figure, it did not reach statistical significance. This was evaluated using an analysis of variance with the predictor of "gender" and the corresponding response variable (center of gravity) paired with Tukey's Honest Significant Difference test for pairwise comparisons. P-values in text are adjusted p-values. For the duration of /s/, I found a significant effect of "Task" ($\chi_{22,8} = 11.7$, $p = 0.003$) and no significant effect of "Gender" ($\chi_{22,8} = 1.6$, $p = 0.454$). For the duration of /ʃ/, I found a significant effect of "Task" ($\chi_{22,8} = 18.6$, $p < 0.001$) and no significant effect of "Gender" ($\chi_{22,8} = 1.12$, $p = 0.563$). For the duration of /z/, I found a significant effect of "Task" ($\chi_{22,8} = 47.3$, p less than 0.001), and no significant effect of "Gender" ($\chi_{22,8} = 3.5$, $p = 0.174$). Lastly, for the duration of /ʒ/, I found no significant effect of "Task" ($\chi_{22,8} = 0.3$, $p = 0.869$) and no significant effect of "Gender" ($\chi_{22,8} = 2.5$, $p = 0.294$).

4.5 SUMMARY OF FINDINGS

This section summarizes all the findings for this chapter. Firstly, regarding F0, men and women are not statistically different, but the effect of HRT on gender is significant for men. This means, that HRT affects men, that being it lowers their F0, but that HRT does not similarly (lowering F0) or conversely (raising F0) affect women.

Nonbinary speakers show essentially no real trends as a group, due to the variety as well as the differing effects of HRT on people assigned male (no change in F0) at birth from assigned female at birth (lowering of F0).

Examining vowel space, two measurements were used VSA and vowel distance from centroid. It was shown that gender has a significant effect on gender for VSA in each case (men, women, nonbinary), with men having the smallest VSA, women having a VSA larger than men, and nonbinary speakers having the largest overall VSA. Regarding distance from centroid, every vowel (/i/ /u/ /a/ /æ/) showed a significant effect of gender, meaning that the distance from the center of the vowel space to each vowel was distinct for each group and vowel. Lastly, the centroids themselves were significantly different based on gender. Mean centroids for men, women, and nonbinary speakers each showed a significant difference for the F1 centroid and F2 centroid. This indicates that the center of the vowel space is different and significant for each group.

For sibilant sounds, there was no significant effect of gender on duration, despite its being expected based on the literature, or of gender on center of gravity. The source of this null result is not clear. One possibility is that the speaker sample is not large enough to detect significant trends. Another possibility is that sibilant quality is simply not used as a marker of gender by trans speakers. A speculative motivation for this is the strong stereotypical association between sibilant quality and gay (men's) speech (Munson 2006, Kachel et al 2018) which this speech community might seek to avoid.

4.6 CONCLUSION

This chapter examined data for vowels and sibilants for English speakers who identify as transgender, and trends were identified for fundamental frequency and vowel

space, and sibilants. For men, gender had a significant effect on F0 and time on HRT, but no such significance was found with women. Gender for all speakers had a no significant effect on VSA or distance from centroid, with centroids. The English data collected for this dissertation showed no significant effect of gender on any of the measures for sibilant sounds.

CHAPTER 5

RESULTS - GERMAN

5.1 INTRODUCTION

This chapter details the findings from the data collected via recorded interviews as detailed in Chapter 3. This chapter is focused exclusively on the data collected from the German interviews. The chapter is organized into three major sections based on the measurements collected: fundamental frequency (F0), vowel space, sibilants. Within each section, an overview of these measurements is presented for all speakers, then examined with respect to specific genders (women, men, and nonbinary[13]). If a task exhibits some measurable effect on the data, the section is further subdivided to reveal that effect. Finally, a summation of identifiable trends is presented.

Although discussed in detail in the Design and Methodology chapter, a brief review of the participants is necessary to best understand the outcomes shown by the data. Although the sample size is quite small with only 8 speakers, some insight into how transgender individuals form their linguistic identities can be gained. Speakers were interviewed both in-person (6) as well as virtually (2). The in-person interviews were conducted primarily in Hannover at various locations in the city, ranging from quiet spaces (classrooms, a living room, a room at the LGBT center) to more ambient public

[13] The naming of this group is not ideal, as the sole member of this category did not use "Nonbinary" as their gender identity, but rather "*beides*". The terms Nonbinary, NB, and enby are used by some speakers in German LGBT communities, but this speaker did not choose to use any of these terms. For the sake of clarity and comparison with English, the term nonbinary was chosen as an English translation, since the gender identity "both" is not commonly used in the English-speaking world.

spaces (a public park, neighborhood square). Only one in-person interview was not conducted in Hannover and was instead conducted in Düsseldorf in a small neighborhood square.

The virtual interviews were undertaken using Skype and then recorded directly from the call as a .wav file using Audacity. Each virtual interview was done in the participant's home to best ensure the privacy and safety of the participants.

Despite the small sample size, there was a fair balance between the genders, with 4 transmen, 3 transwomen, and 1 non-binary (participant responded with *beides*[14] "both"). With a relatively even number of men and women and a small sample size, statistical analysis is not particularly powerful and weaker results were found when tests comparable with the English speaker data were run on the German data. Therefore, the following discussion of patterns in the German speaker data will be primarily qualitative in nature with the statistical findings mentioned for the sake of noting how strong the patterns appear.

5.1.1 PARTICIPANT OVERVIEW

This section provides a short biography of each German-speaking participant. Due to the small sample size and imbalance in some sociological factors, a clear picture of each participant will help illustrate the differences shown in the data. Each participant has been assigned a German pseudonym that corresponds with their gender. Participants are presented by gender: men, women, and the singular nonbinary participant. The

[14] beides can mean "both" or "either". When asked for clarification on their response, the participant indicated that they felt aspects of both masculine and feminine gender roles/characteristics.

pseudonym Sascha was selected for the nonbinary person, as it can be either a masculine or feminine name in German.

Lukas: 20-year-old man who had received hormone therapy (testosterone injection) for 1 month and had socially transitioned 3 months prior. Lukas was studying toward a bachelor's at a university in Hannover. He was from Leipzig, Saxony in eastern central Germany and spoke (Ober)Sächsisch[15], Upper Saxon. Before his interview began, he indicated that he would speak Hochdeutsch (Standard German) throughout the interview.

Tobias: 18-year-old man who had received no hormone therapy but had begun the process with his healthcare provider. Tobias had completed his secondary education and was enrolled to begin his bachelor studies at a university in Hannover in the coming fall. Tobias was from Springe, Niedersachsen, a city about 25 km south of Hannover. He indicated that his speech was very close to Hochdeutsch, but he would focus on producing "proper" speech. The dialect spoken in Hannover and the surrounding region is commonly referred to "*das beste Hochdeutsch*" the best Standard German[16] (Ehrlich & Conrad, 2021; Ikenaga 2020) despite not always aligning with prescriptive forms of the language. Therefore, the regional dialect of speakers from or near to Hannover is expected to have little effect on vowel space if Hochdeutsch (as presented in the Duden, the current official prescriptive dictionary) is taken as the basis for pronunciation.

[15] Hochdeutsch is a standardized version of German based heavily on the grammatical and lexical forms used in the Upper Saxon dialect. Its creation/selection as a standardized form is due to its use by Martin Luther's translation of the Bible in 1522 and by further grammarians.
[16] Outside the literature on dialect, three participants noted how "useful" and "representative" of "German" their interviews would be due to their speaking of a non-regionally marked Hochdeutsch.

Stefan: 29-year-old man who had received hormone therapy (testosterone) for 49 months and had socially transitioned 6 months before he began taking testosterone. Stefan had completed a bachelor's and was currently studying toward a master's degree. Stefan was from and currently resided in Frankfurt, Hessen. Stefan was very proficient in several languages and assured the researcher that he would speak Hochdeutsch for the entirety of the interview unless otherwise noted.

Andreas: 37-year-old man who had received hormone therapy (testosterone) for 48 months and had socially transitioned for a year before he began taking testosterone. Andreas had some university experience but had not completed a bachelors. Andreas was originally from Hamburg but had resided in Frankfurt for several years before the interview was conducted. Andreas indicated that he did not speak Plattdeutsch (Low German dialect spoken by some in northern Germany) and that he only spoke Hochdeutsch.

Sabine: 38-year-old woman who had received hormone therapy (testosterone blocker and estrogen) for just over 13 years and had socially transitioned for several years before beginning hormone therapy. Sabine completed a bachelor's degree and was working in an office job at the time of her interview. She had begun her transition further in the past than any of the other participants and mentioned that she hardly takes part in the transgender community due to not needing that sense of community anymore. She had recently visited the local LGBT center due to CSD[17] (Pride festival) in her city.

[17] The German CSD is an abbreviation of the English "Christopher Street Day"', an early name for what is today called Pride in the US and other English-speaking regions. The Stonewall Inn, the site of the Stonewall Riots in 1969 that began the modern LGBT rights movement, is located on Christopher Street in New York City.

Sabine had resided in Hannover for most of her adult life and was originally from Helmstedt, a city about 100 km east of Hannover. She mentioned that she spoke *Hochdeutsch* natively when asked about dialect.

Anna: 32-year-old woman who had not received hormone therapy and had only begun socially transitioning for a month. She was unsure whether she wanted to undertake any medical transition and viewed the social side as the most important aspect of transition for her. She had just begun her bachelor's studies and was newly living in an apartment with other college students. Anna had plans to change her documentation to remove her dead name from identification cards and university enrollment but had not begun that process. Anna lived and attended university in Hannover, but was originally from Kaiserslautern, Rhineland-Palatinate, a city about 450 km south of Hannover.

Julia: 56-year-old woman who had not received hormone therapy but had been socially transitioned for just over 5 years. Julia was against medically transitioning due to an underlying medical condition. She was very interested in producing stereotypically feminine speech and had been seeing a speech therapist for 3 years. She was generous enough to allow the researcher to observe a therapy session. Julia was focusing on and practicing methods to alter her speech primarily in two ways: pitch raising and laryngeal raising. She also did some airflow work, but this was in conjunction with the laryngeal training.

Sascha: 18-year-old person who had not received any hormone therapy but had completed all the requirements and was set to begin receiving testosterone injections in the next month. Sascha identifies as *beides* which may best be translated as nonbinary or genderfluid in English. Sascha described their speech as being more feminine with the

goal of a middle ground between masculine and feminine. Sascha had recently finished secondary school and was to begin their studies in the fall at a *Berufsschule* (vocational school) in technology. Sascha was from and resided in Duisburg, North Rhine-Westphalia. When asked about language usage, they said they spoke *Hochdeutsch* primarily and did not speak Low German or Meuse-Rhenish (*Rheinmaasländisch*), a dialect spoken in Duisburg, despite being aware of the dialect and being able to understand it.

5.2 FUNDAMENTAL FREQUENCY

This section is divided into four segments. First a brief overview of findings for all German speakers is given, highlighting the most salient trends shown by the data. The following three sections are separated by gender. Within each section, a more detailed analysis of each group's members is given, comparing both within and outside of that group. The data is also further subdivided into individual speech tasks, to highlight differences influenced by task type.

5.2.1 OVERALL

As discussed in previous chapters, fundamental frequency (F0) is often a salient marker of gender, both in the literature (Mennen, 2012; Traunmüller, 1995) as well as general cultural knowledge. As noted previously, hormonal therapy has a noticeable effect on the speech of transmen, primarily a lowering of F0 (Nygren 2016), while showing no analogous effect, that being raising of F0, for transwomen. Differences in F0 ranges for men and women are often language specific. The below figure shows a plot of the overall range, interquartile range, and median value for F0 for each speaker:

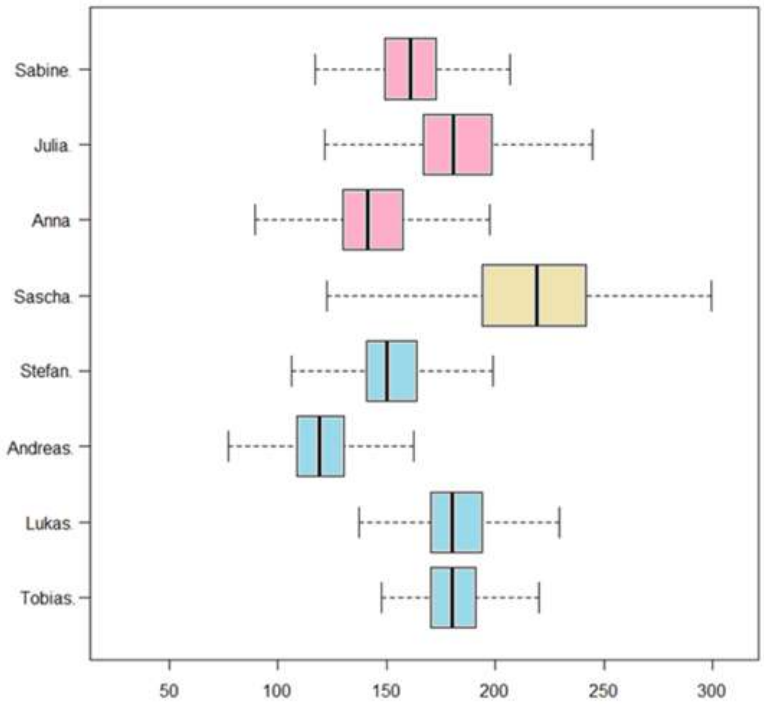

Figure 5.1: F0 of German Speakers

Figure 5.1 above is a plot showing the F0 range for all vowels (whiskers), the box shows the interquartile range (which accounts for the second and third quarter of all sampled values), and the median F0 value (indicated with dark line within the box) for each German speaker. Likely the most striking detail shown, is the range shown by the nonbinary speaker. This speaker was very emotionally expressive, and the range for their F0 reflects that. It is also important to note that this speaker was also the youngest participant at 18 years old.

For the men, Tobias had received no hormonal therapy and Lukas had begun hormonal therapy one month prior to the interview. Length of time receiving testosterone and the dosage size leads to a thickening of the vocal folds, which would be reflected in a

lower F0. The final two men, Stefan and Andreas, had both been receiving hormonal therapy for four years, 49 and 48 months respectively. This is likely why these two speakers have F0 ranges that are the lowest of all the men. Additionally, months of hormone therapy can be used as a proxy for social transition, where speakers present according to their gender identity. Contrasting with the United States, transgender healthcare is financially and logistically more attainable and for most speakers, their social transition is temporally closely linked with hormone therapy.

For the women, we see that both Sabine and Anna show overall ranges comparable to the men (approximately 100 Hz) and are situated between 100 Hz and 200 Hz, with a median near 150Hz. Both Sabine's and Anna's F0 ranges and medians fall in a range indiscernible from the men in this study. The other woman, Julia, shows the highest range (from 150 Hz to just over 250 Hz) and highest median for all within her gender. Only the nonbinary speaker shows a higher range and median F0.

To determine the effect of gender and HRT on F0, I used a linear mixed model used Gaussian error structure and identity link function. In all cases, random effects were "participant ID" and "word", and fixed effects were "task" and "gender". For testing F0, I also used a second model, which included an interaction effect between "gender" and "HRT" where "HRT" is time spent on HRT in months, but only including a data set with men and women. The response variable tested was "F0". Where a significant effect was identified, I undertook post-hoc testing with the "emmeans" package to identify effect sizes and test pairwise comparisons. With this analysis, I found a significant effect of "Task" ($\chi_{22,9} = 102.6$, $p < 0.001$), and no significant interaction effect of "Gender" and "HRT" ($\chi_{22,9} = 5.1$, $p = 0.078$). This indicates that the two groups are not distinct with

regard to F0. This is likely due to the very small sample size and the different effect of HRT on transmen and transwomen.

5.2.2 WOMEN

Focusing on the trans women in this study, we can see how voice therapy and conscious attention to speech affects F0. These two factors influence F0 to a greater degree than either length of time presenting as a woman and/or hormone therapy. This can be seen in Julia's speech, which has both the highest range as well as the highest median and interquartile range of all the German-speaking women. Sabine had received hormone therapy for 13 years as well as presented as a woman for around 16 years. Sabine's speech is not as high in F0 as Julia's, but is higher than Anna's speech, as Anna had only begun socially transitioning one month prior and expressed no desire to pass regarding her speech. The below figure shows F0 for the three women.

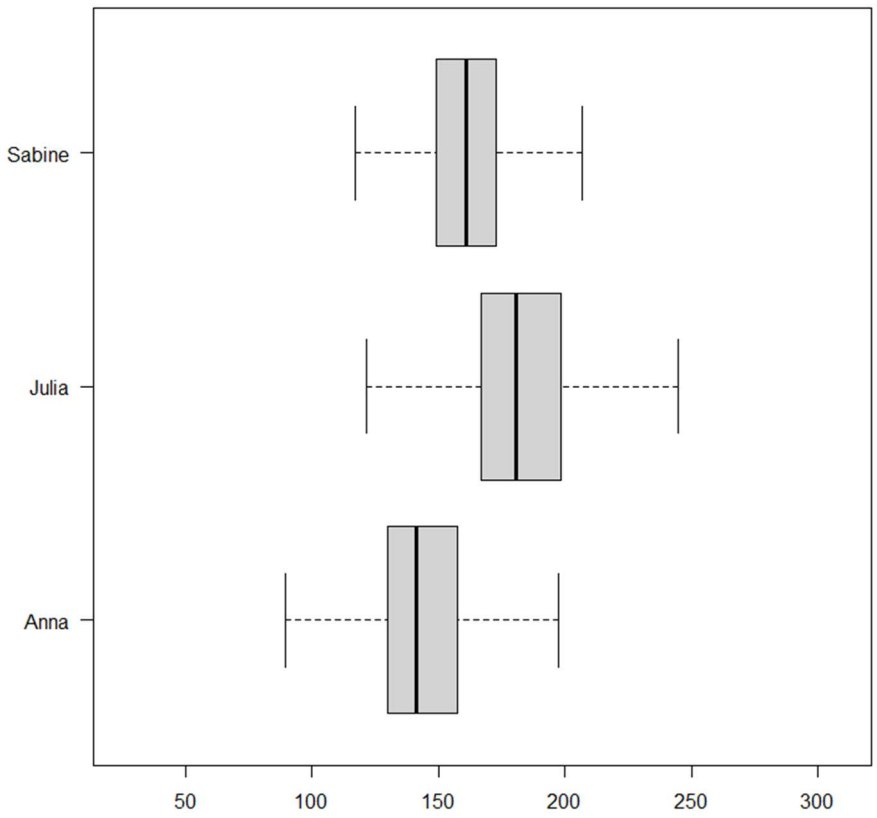

Figure 5.2: F0 Plots for German-Speaking Women

The above figure is a subset of Figure 5.2. While mentioned in a previous chapter that hormone therapy for transwomen has no notable effect on the vocal tract, it is unsurprising that Sabine and Anna have a lower median F0 measurement than their German-speaking cisgender women, which generally range from 180 Hz to 220 Hz (Mennen 2012). In fact, Sabine and Anna patterned similarly to the men in this study who had not started or only recently begun hormone replacement therapy (which does affect F0 in transmen). Notably, Julia exhibits a higher F0 than the other two women, likely due to the fact that Julia had attended weekly speech therapy for more than 2 years, focusing on producing more feminine speech, i.e., a higher F0. The researcher was given the opportunity to observe a therapy session and there were three primary methods employed

to alter her speech: the first was manipulating pitch to be higher, the second was explicit attention to raising the larynx, and the third was recording a passage daily to track progress and repetition of said passage to practice these techniques. It is not surprising then that Julia shows a notable F0 divergence from her peers.

To tease out further differences between the three women, the F0 measures can be sorted by task. Since each task might elicit a different speech style, this may provide insight into how context affects F0 production. The first task was reading a list in a carrier phrase, "*Sag ___ zweimal.*" (Say _ twice.) and only the vowel in the target word was sampled. A figure showing the range and median and interquartile range for the first task is shown below:

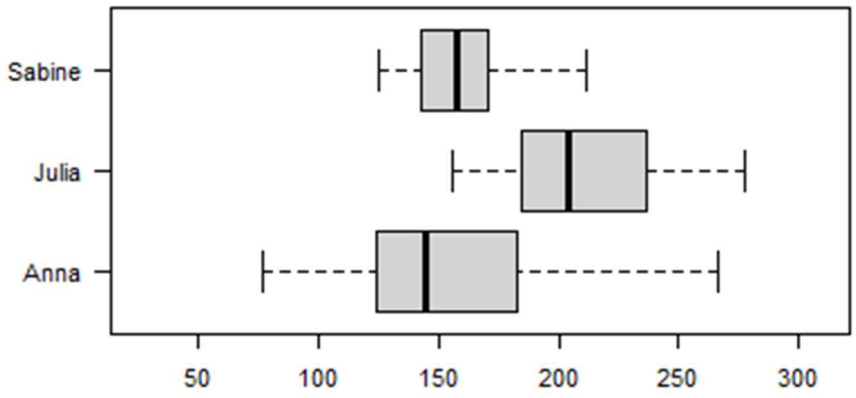

Figure 5.3: F0 for German-Speaking Trans Women (List)

In the above figure, we see that Sabine is very restrained in her F0 range production. Sabine mentioned during her interview that she had transitioned so long ago, that she no

longer focused on her speech, possibly influencing her range. Anna conversely has a wide F0 range. Impressionistically, Anna was the most expressive in her speech in this group of women, emphasizing each target word often with raised F0 and producing the carried phrase with a lower F0 for each iteration. She was also the youngest speaker of the group at 18 years old. It should also be noted that Julia had the highest mean and interquartile range. Julia had been undergoing speech therapy with the goal of producing more stereotypical feminine speech, primarily focused on pitch raising.

The second task was a short reading passage, *Der Skorpion* by Crista Reinig. This story was unfamiliar to each participant, and each read the passage cold, with no preparation. A figure showing the overall range, median, and interquartile range for the second task is shown below:

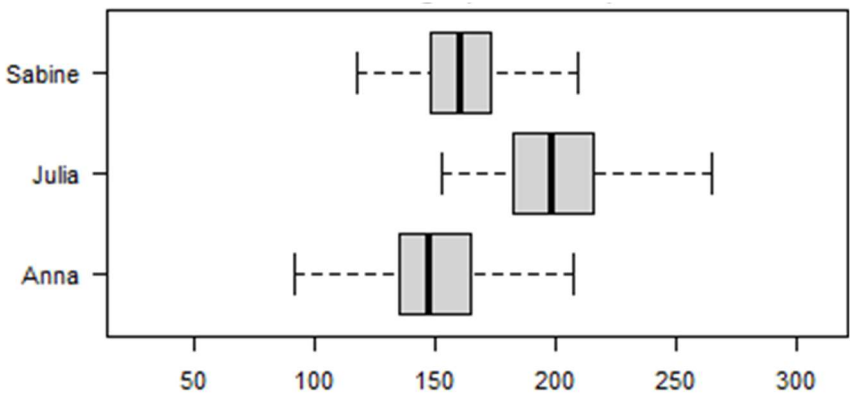

Figure 5.4: F0 for German-Speaking Trans Women (Passage)

In figure 5.4, we see patterns very similar to the overall F0 production, Julia producing the highest F0 and Anna producing the lowest F0. Both Julia and Anna show a wide F0

range (greater than 100Hz), and Sabine shows a range smaller than 100Hz. This can again be explained through Julia's active focus on F0 and pitch variation and Anna's expressiveness. Julia shows a lower F0 mean for this task and one possible explanation is vocal fold fatigue, as this task occurred after Task 1 and it was also durationally a longer task. Julia mentioned during her interview that to alter her pitch, it required consistent and constant focus on doing so.

The final task was a guided interview where participants were asked questions about their lives, transition, and general experience as a transwoman in German society. These interviews varied in length, as participants were welcomed to answer the questions as thoroughly or succinctly as they desired. The researcher also welcomed tangential discussion, both to increase collected data and to further grasp the life experiences of each participant. Julia spoke for nearly an hour and a half, so only the first 30 minutes of her speech were sampled, in order to be of similar length to the other participants in this study. The F0 measurements for this task can be seen in the figure below:

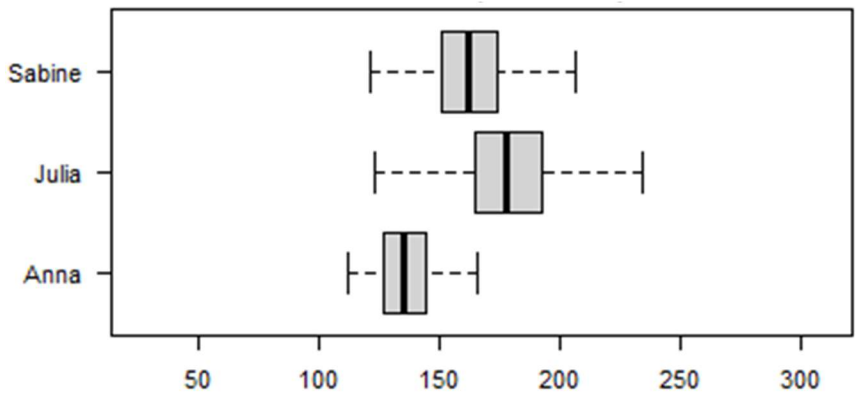

Figure 5.5: F0 for German-Speaking Trans Women (Interview)

The data shown in the above figure shows a departure from the measurements for Task 1 and Task 2. Anna, who in the previous sections had a wide range for F0, now only shows about a 70Hz range. Sabine shows a range of just under 100Hz, which is in line with her F0 production in previous tasks. For this task, Julia again shows a lower F0 than the other two tasks. This lends credence to the possibility of vocal fatigue.

5.2.3 MEN

This section focuses on F0 production by the transmen in this study. As discussed earlier, hormone therapy, specifically testosterone, causes physiological changes to the vocal tract including a thickening of the vocal folds, i.e., lowering F0. These men can be put into two groups: long term testosterone therapy and short-term. In the long-term group are Stefan and Andreas, having received 48 and 49 months of testosterone respectively. In the short-term group are Tobias and Lukas. Tobias had only begun socially transitioning and hoped to begin testosterone injections within the coming months. Lukas had received one month of testosterone injections, which is less than the time expected to see physiological changes to the vocal tract (Zimman 2017, Nygren 2016). The differences in F0 between long-term and short-term groups are unsurprisingly borne out in the data. The figure below shows the overall range, median, and interquartile range for the transmen in this study:

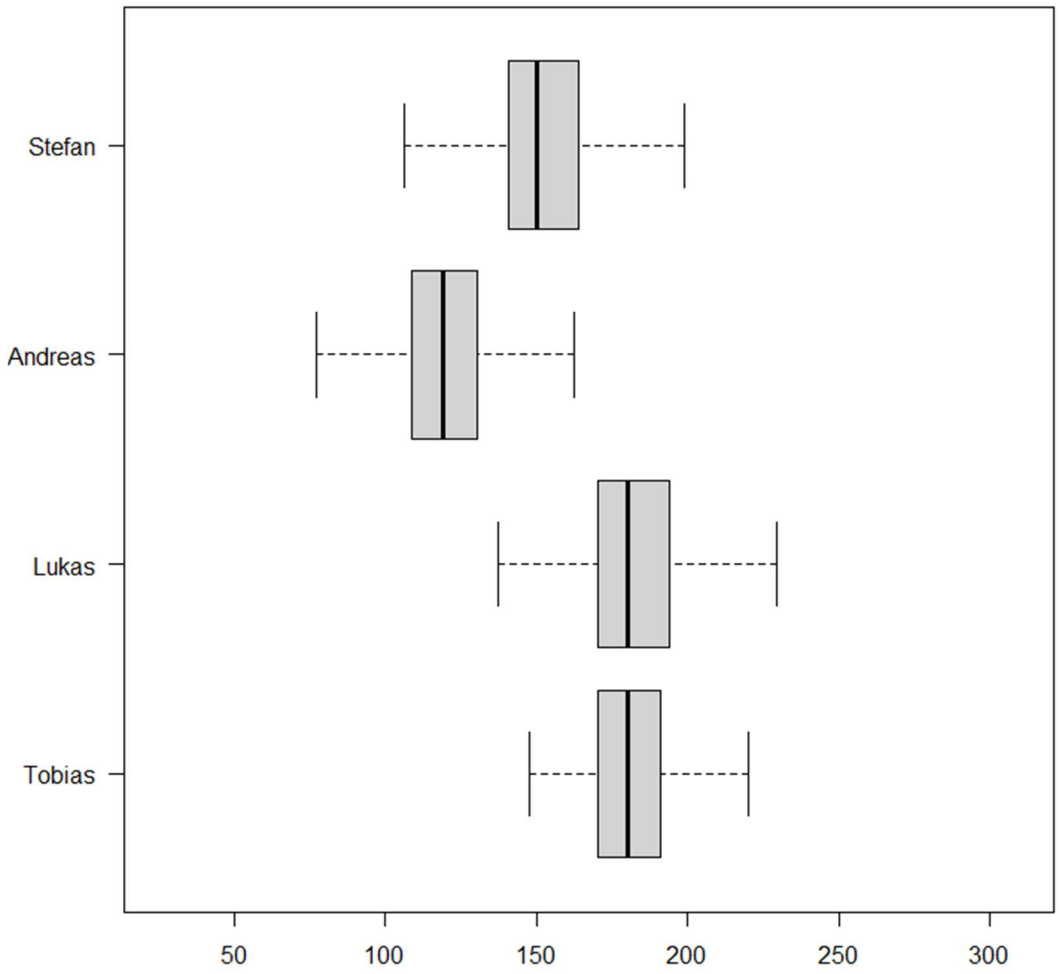

Figure 5.6: F0 for German-Speaking Men

In the above figure, Tobias and Lukas (short-term testosterone group) show nearly identical medians and interquartile ranges. Lukas has a wider overall range than Tobias, but not notably larger than that of the other men who all have ranges about 100Hz. Tobias shows the most contracted overall range for F0 of all the men, at about 75Hz. A wide range of F0 has been shown to be interpreted as more expressive and as more stereotypically feminine. Tobias may be employing a less expressive manner of speaking (i.e., smaller F0 range) in order for his speech to be perceived as more masculine. This is shown only in the overall range, as his interquartile range was nearly identical to Lukas'.

As with the women in the previous section, separating these measurements by task helps to highlight how these men produce F0 in different speech styles. For the first task, a list of words, some of the men produce F0 measurements in dramatically different ways. This is seen in the figure below:

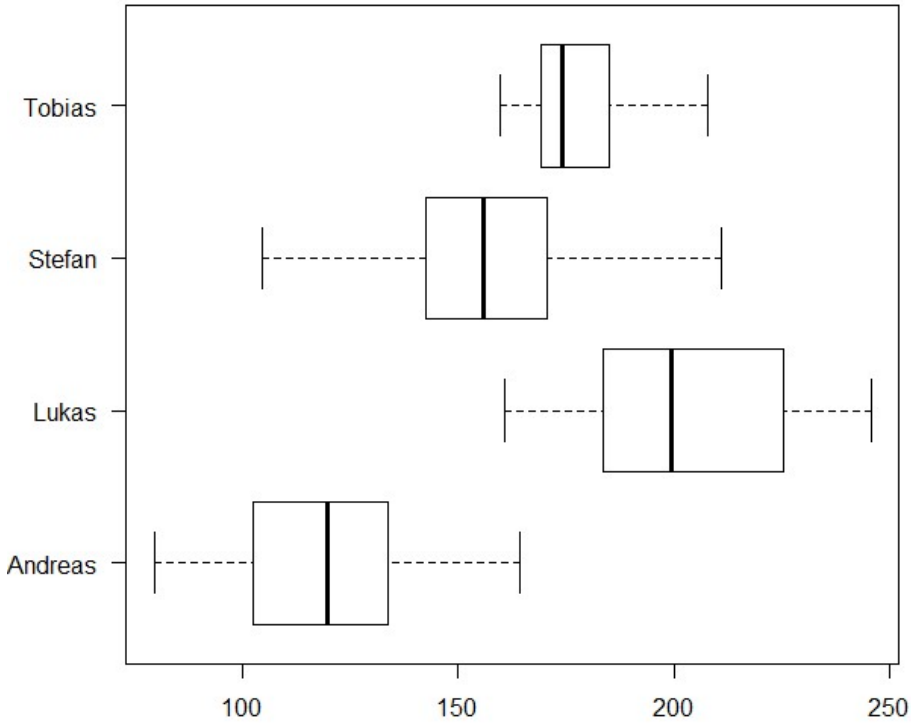

Figure 5.7: F0 for German-Speaking Men (List)

Of the short-term group, Lukas has an overall range of just under 100Hz, high median 200Hz, and an interquartile range of just over 40Hz. Contrasting with Lukas, Tobias has an overall range of about 50Hz, a lower median at 175Hz, and a notably smaller interquartile range of about 15Hz. Tobias' smaller F0 range, lower median, and smaller interquartile range are more pronounced in the word list than the entirety of his speech.

For Task 2, the short reading passage, the men showed different measures from Task 1. A figure showing the F0 for Task 2 by men is given below:

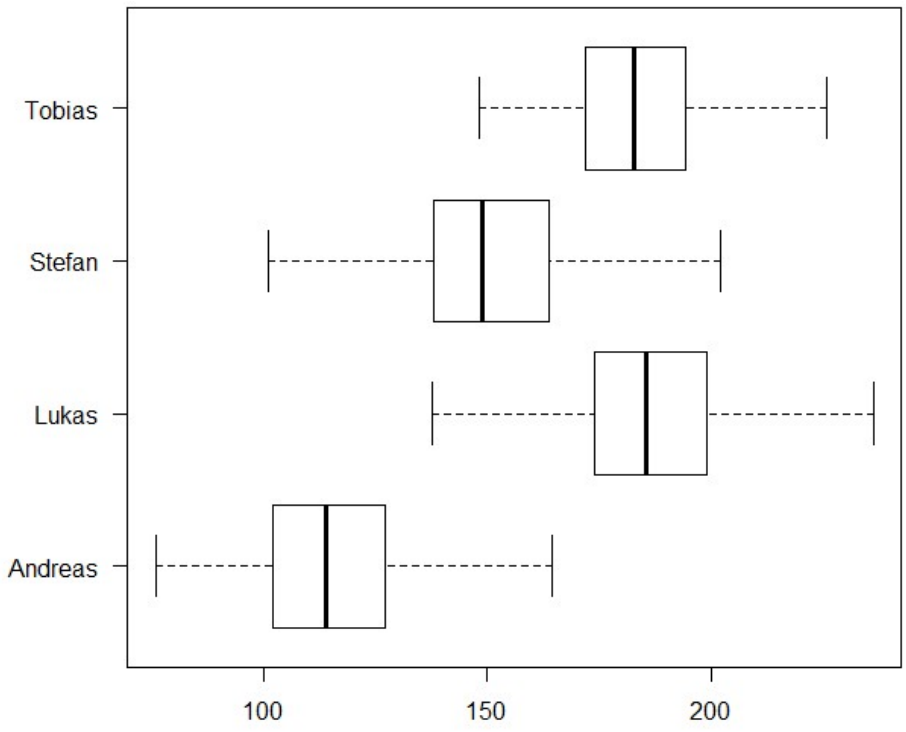

Figure 5.8: F0 for German-Speaking Trans Men (Passage)

The figure above shows that Andreas and Stefan both exhibit a lower F0 than the other two men. Noting again that Andreas and Stefan had both received hormone therapy for four years, this difference is likely due to physiological changes to the vocal tract. During the reading passage, Stefan was particularly expressive (giving distinct voices to certain characters in the story), so the higher F0 shown in this task is unsurprising, though still visibly lower than Tobias and Lukas. Both Tobias and Lukas show a higher median and

interquartile range than Andreas and Stefan, again tied to both their lack of hormone-related physiological changes, as well as both speakers only within the last month beginning their transitions socially.

Lastly, the men completed Task 3, which was a biographical interview. This task should produce the most naturalistic speech of all three tasks. A figure showing the F0 for the men is given below:

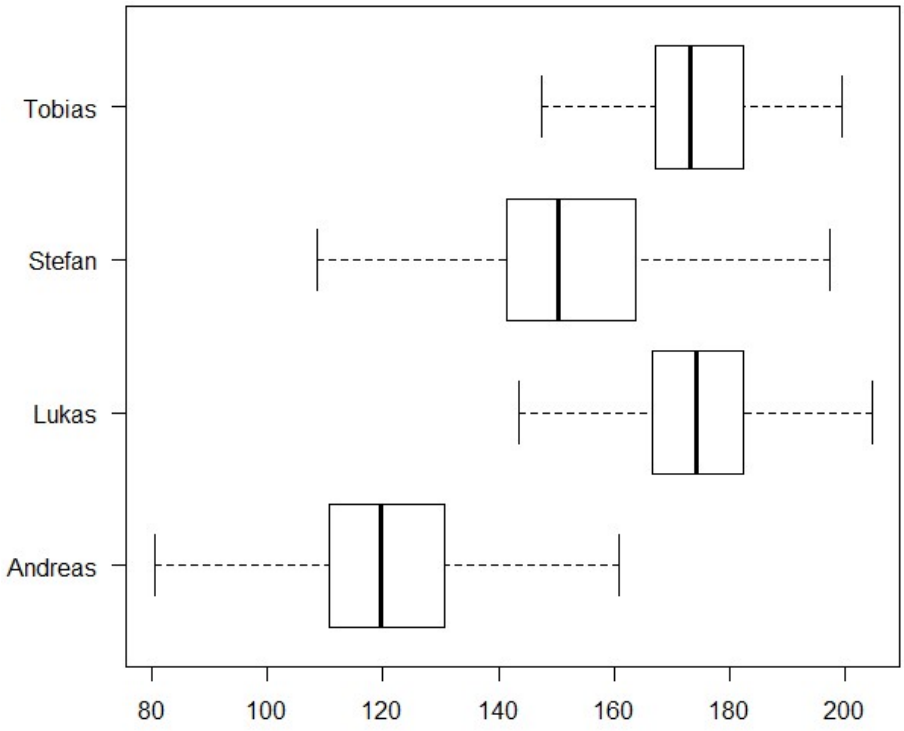

Figure 5.9: F0 for German-Speaking Trans Men (Interview)

The figure above shows similar trends to the previous tasks though some notable differences. Andreas has the lowest measurements for F0, followed by Stefan. Tobias and

Lukas show measurements strikingly similar to one another. The main difference that Tobias and Lukas show from Task 1 and Task two is their lower median and interquartile range. This task was the most casual and longest in terms of duration. These factors may have allowed Tobias and Lukas to produce relaxed speed that might be more representative of their daily speech. While still higher than both Andreas and Stefan, Tobias and Lukas show a drop in their measurements of F0 for Task 3.

5.2.4 NONBINARY

The one nonbinary speaker, Sascha, showed an F0 range and interquartile range that differed from both the men and women in this portion of the study. Their speech ranged from 125 Hz to nearly 300 Hz. This was the widest range of any of the German speakers and can somewhat be attributed to the expressiveness this speaker used with speaking. This expressiveness was most notable during the interview task. A figure showing the F0 measures for Sascha is shown below:

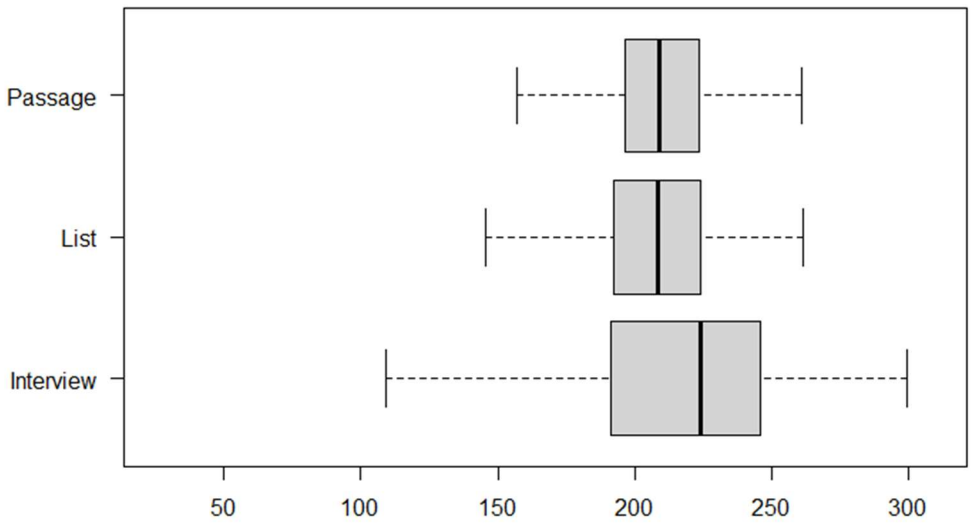

Figure 5.10: F0 for Nonbinary Speaker of German (Sascha)

Examining Task 1, we can see that this speaker's interquartile range is over 30 Hz. Only one other speaker, Anna, had an interquartile range larger than Sascha presented. In terms of overall F0 range for Task 1, Sascha again comes in second to Anna. For Task 1one, Sascha shows in the above figure an extremely wide range, only being exceeded by Anna. To contrast Sascha and Anna's speech, it is important to examine the other tasks completed by the speakers. While Anna's F0 range was quite large for the word list, her other two tasks showed a notably smaller range: around 100 Hz for Task 2 (reading passage) and only about 50 Hz for Task 3 (the open-ended interview). Sascha in contrast shows a much different pattern. For Task 2, Sascha's range here is nearly identical to the same measure in Task 1. Additionally, Sascha's median F0 and interquartile range is also extremely similar to their F0 production in Task 1. This is a clear departure from F0 patterns shown by Anna. Anna showed smaller ranges, lower medians, and smaller interquartile ranges with each subsequent task. Sascha shows no such reduction between Tasks 1 and 2. For Task 3, Sascha again shows the greatest divergence from any of the other speakers in maintaining their wide F0 range. This indicates that Sascha's F0 range is consistently wide throughout all their speech, especially in Task 3, and is likely a tactic they use in their gender presentation. Again, this is likely due to the expressiveness they employed.

While the F0 range provides an insight into how speakers may use this phonetic feature to form their gendered speech, it is also important to examine other qualities of their vowels to see if clearer patterns may arise.

5.3 VOWEL SPACE

This section is divided into four segments. First a brief overview of all German speakers is given, highlighting the most salient trends shown by the data. This includes a measurement of all vowels which can be subdivided into an impressionistic presentation of vowel space with each token shown, overall vowel space area (VSA) calculated and represented as a quadrilateral, and lastly the distance of each vowel from the centroid as a linear distance. These three sections are then divided into a more detailed analysis of each group's members, comparing both within and outside of that group. As in the previous section, each individual speech task is analyzed, to highlight any differences influenced by task type.

5.3.1 OVERALL

As discussed in Chapter 2, Standard German is generally recognized as having 10 monophthongs and 5 diphthongs. In this analysis, only monophthongs are examined. To visualize the distribution of vowels, a diagram of the vowel system of German is shown below:

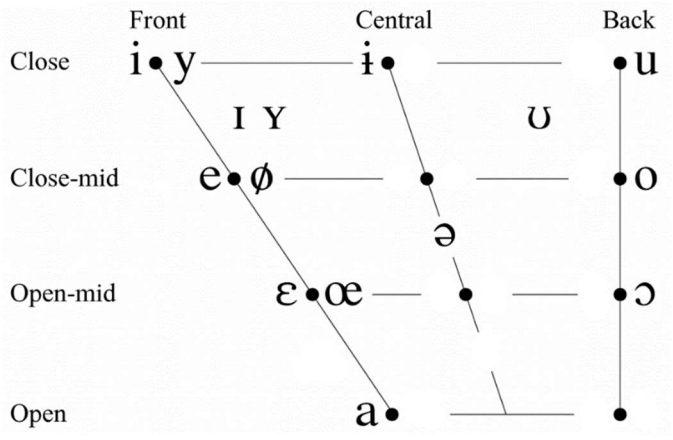

Figure 5.11: Vowel System of German (per Wiese 1996)

The figure above shows a vowel space with vowels, with the x-axis showing F1 with values ranging from 300-350 Hz and F2 values ranging from 1000-1200 Hz (per Simpson 2007). The vowels on the extreme ends of the vowel space can be used to represent the overall vowel space. Using these vowels as signposts for the edges of the vowel space, /i/, /e/, /a/, /o/, and /u/ were selected for inclusion in this analysis. German shows rounded front vowels in addition to unrounded front vowels, but those were excluded in the interest of parallels with the English vowels analysis shown in the previous chapter.

A figure showing the vowel system showing the five vowels (/i/, /e/, /a/, /o/, and /u/) for each participant is shown in the figure below. For each group, the plots are sorted by gender then ordered by length of time receiving hormone replacement therapy.

Figure 5.12: Vowel Space of German Speakers

This figure shows all the vowel plots for each speaker sampled in this research with each vowel corresponding to a color: pink representing /a/, blue representing /o/, orange representing /u/, red representing /i/, and green representing /e/.

Impressionistically, there are similarities between Sabine and Julia. For each of these speakers we see a larger vowel space when compared with participant Anna. It is important to note that for each participant, the period of time each participant presented as their gender differs. Sabine had presented as a woman for more than 13 years and Julia had presented for more than 6 years. These two had presented as women much longer than participant Anna, who had only begun presenting as a woman for 1 month. Additionally, participant Julia was actively pursuing vocal training and therapy with the intent to consciously feminize her voice. This is evident in her rather expanded vowel space. Despite this active training to feminize her voice, Julia shows a smaller vowel space than participant Sabine. Contrasting this with the previous section (F0), it seems that this feature is not as strongly affected by her therapy as F0. Conversely, Sabine may be using this feature of her speech as a stronger marker for gender in her speech than F0. This is evidenced by her lower overall F0 than Julia. Both features may be used to various degrees by cisgender women and perceived as feminine by listeners. Since both Sabine and Julia had the goal of producing more feminine speech, it seems that either F0 range or vowel space enhancement (or, perhaps, both) may be employed by German-speaking trans women.

5.3.2 VOWEL SPACE AREA (VSA)

The vowel measurements can also be reduced to mean values for each vowel, thus showing a simpler version of the vowel space. This reduction gives a singular mean F1

and F2 value for each vowel. These singular points for each vowel allow a pentagon to be drawn which shows the average bounds of the vowel space. This representation was modeled after an analysis done by Fougeron et al. (2011) to quantify vowel space. Vowel space was calculated using the formula from Fougeron et al. (2015): given F1 & F2 mean values of /i,e,a,o,u/, pVSA=0.5*ABS(F1i (F2e -F2u)+F1u (F2i -F2e)+F1e (F2u - F2i))+ABS(F1u (F2e -F2o)+F1o (F2u -F2e)+F1e (F2o -F2u))+ABS(F1a (F2e -F2o)+F1o (F2a -F2e)+F1e (F2o -F2a)). The VSA can then be quantified as an area measurement that gives an impression of each speaker's overall vowel space. This method of visualization also allows for speakers' vowel spaces to be compared in a more visually simplified way than the vowel plots shown in the previous section. A figure with this simplified vowel space is shown in the figure below, first grouped by gender then sorted by time on HRT:

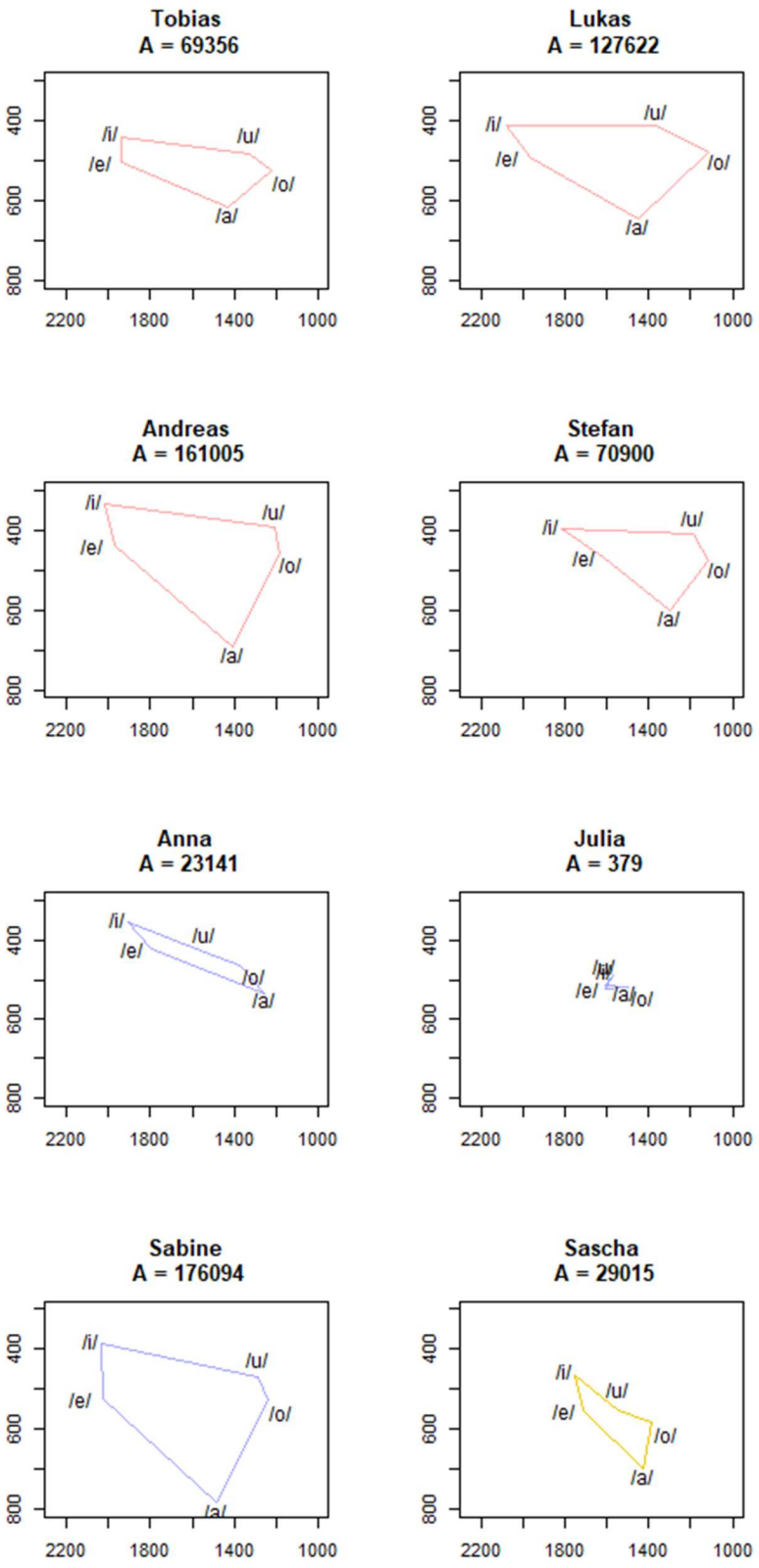

Figure 5.15: VSA of German Speakers

This figure shows the overall vowel space area for all the German speakers in this study. Each plot is colored according to the gender of the speakers, with red indicating a man, blue indicating a woman, and yellow to indicate Sascha as the nonbinary speaker. There was an issue with the sound signal from Julia's interview. Due to excess noise, her data was resampled twice and no adequate and consistent measurements for F1 and F2 could be determined for each vowel. This yields a vowel space that is clearly not representative of her speech or reality.

To determine if gender had an effect on vowel space, I used an analysis of variance with the predictor of "gender" and the corresponding response variable (VSA, Distance to Centroid from /i/, Centroid Range of F1, etc.) paired with Tukey's Honest Significant Difference test for pairwise comparisons. P-values in text are adjusted p-values. For men, the mean vowel space area was 107221 Hz^2 (± 34875), women have a mean VSA of 66538 Hz^2 (± 40270), and nonbinary speaker had a VSA of 29015 Hz^2 (± 69749). For VSA, there is no significant difference between the nonbinary speaker and men ($p = 0.607$), no significant difference between women and men ($p=0.739$), and no significant difference between women and nonbinary speakers ($p=0.890$).

Another metric presented in Audibert, et al. (2011) is the overall range for both F1 and F2. The Tukey's HSD test returned no significant differences: $p > 0.05$ in all cases. A table showing the range with the standard deviation is given below:

TABLE 5.1. German F1 and F2 Range

Formant range length (SD)	Men	Nonbinary	Women
F1	560 (30)	630 (61)	552 (35)
F2	1522 (46)	1514 (92)	1532 (53)

Because none of the F1 and F2 ranges show a significant effect of gender, this feature does not seem to be used by transgender speakers as a linguistic marker of gender.

5.3.2 DISTANCE TO CENTROID

Another method modeled after techniques from Audibert et al. (2015) for measuring vowel space is the distance of each vowel (mean values in this case) from the centroid of the vowel space overall. This provides a linear and measurable distance for each vowel. This is shown in the figure below with speakers grouped by gender then sorted by time on HRT:

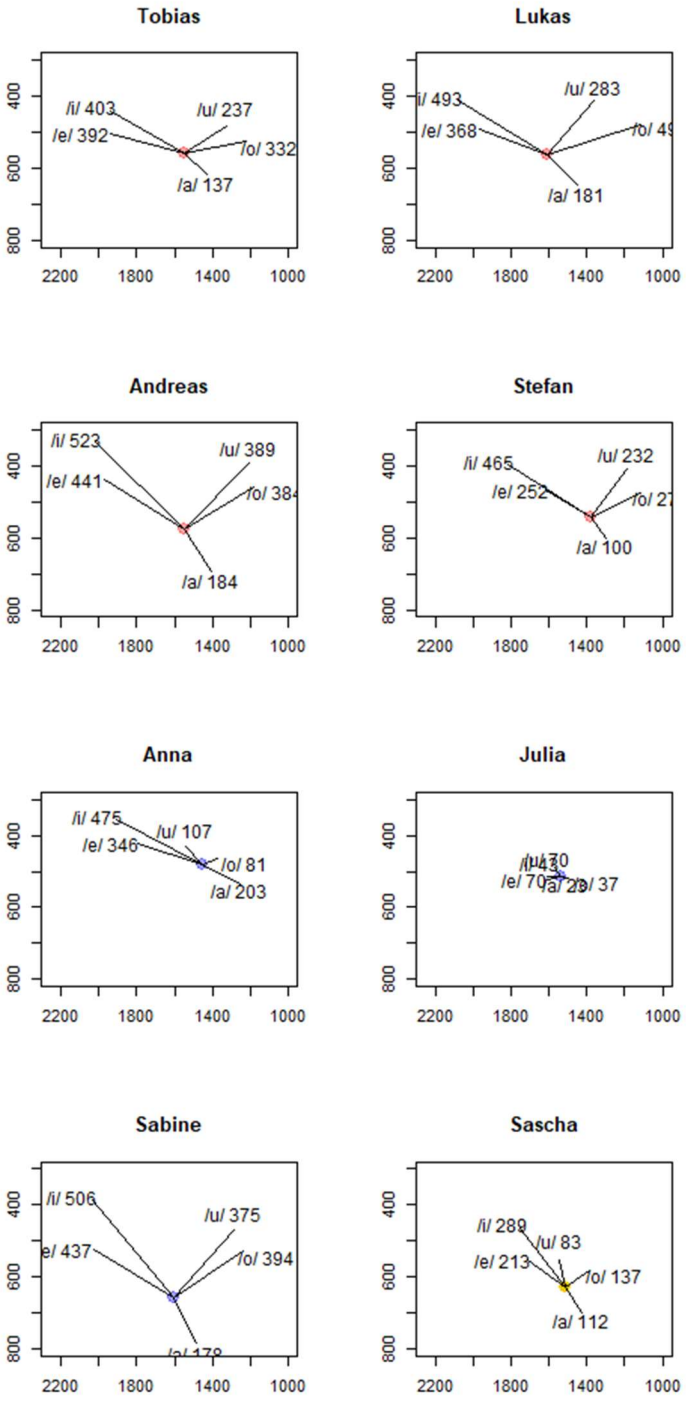

Figure 5.14: Distance to Centroid of German Speakers

This figure shows the distance from the centroid, or center of the vowel space, that each mean point for each edge vowel has. A longer line indicates a further perceptual distance from the center of the vowel space. To determine if gender had an effect on and vowel's distance to the centroid of the vowel space, I used an analysis of variance with the predictor of "gender" and the corresponding response variable (Distance to Centroid from /i/, etc.) paired with Tukey's Honest Significant Difference test for pairwise comparisons. P-values in text are adjusted p-values. For none of the distances to centroid was there any significance. A table showing the distances and standard deviation are given for each mean distance from the centroid for each vowel for each gender.

TABLE 5.2: German Distance to Centroid

Mean distance to centroid (SD)	Men	Nonbinary	Women
/i/	414 (84)	289 (168)	341 (97)
/u/	285 (60)	83 (119)	184 (69)
/o/	371 (72)	137 (144)	171 (83)
/e/	363 (68)	213 (136)	284 (78)
/a/	150 (35)	112 (69)	134 (40)

Because none of the distances to centroid, F1/F2 ranges, or VSA show a significant effect of gender, these features do not seem to be used by transgender speakers as a linguistic marker of gender.

5.4 SIBILANTS

This section is divided into four segments. First a brief overview of sibilants for all German speakers is given, highlighting the most salient trends shown by the data. This

includes measurements of center of gravity (COG), duration, skewness and kurtosis. The following three sections are a detailed examination of each gender. These genders are mentioned in detail earlier.

Within each section, a more detailed analysis of each group's members is given, comparing both within and outside of that group. The data is also further subdivided into individual speech tasks, to highlight differences influenced by task type.

5.4.1 OVERALL

German exhibits 4 sibilant sounds, [s] [z] [ʃ] [ʒ], as well as three affricates, /ts/ /tʃ/ and /dʒ/. Sibilants have been shown in English to mark differences in gender and sexual orientation for many speakers of English. While there is some literature examining German sibilants with respect to gender (Boyd et al 2021, Simpson 2015), there is much less work in this arena than in English.

As the two languages share a common ancestor and show some phonotactic similarities, it may be productive to examine these sounds to determine if there are patterns that emerge. In order to simplify metrics and ease in analysis, only the sibilants were analyzed, with affricates being excluded on the basis of them actually consisting of two phones, despite being one phoneme. The sibilant [ʒ] is a rare sound in German, is only present in some loanwords, and while some Germans do produce this sound, it is again rare and thus some speakers in this research did not produce enough tokens for a reliable measurement in the following sections.

5.4.2 CENTER OF GRAVITY

Center of gravity is a measurement of a fricative that shows where the highest intensity of frication energy is present within the speech signal. A representation of this measure can be seen in the data below:

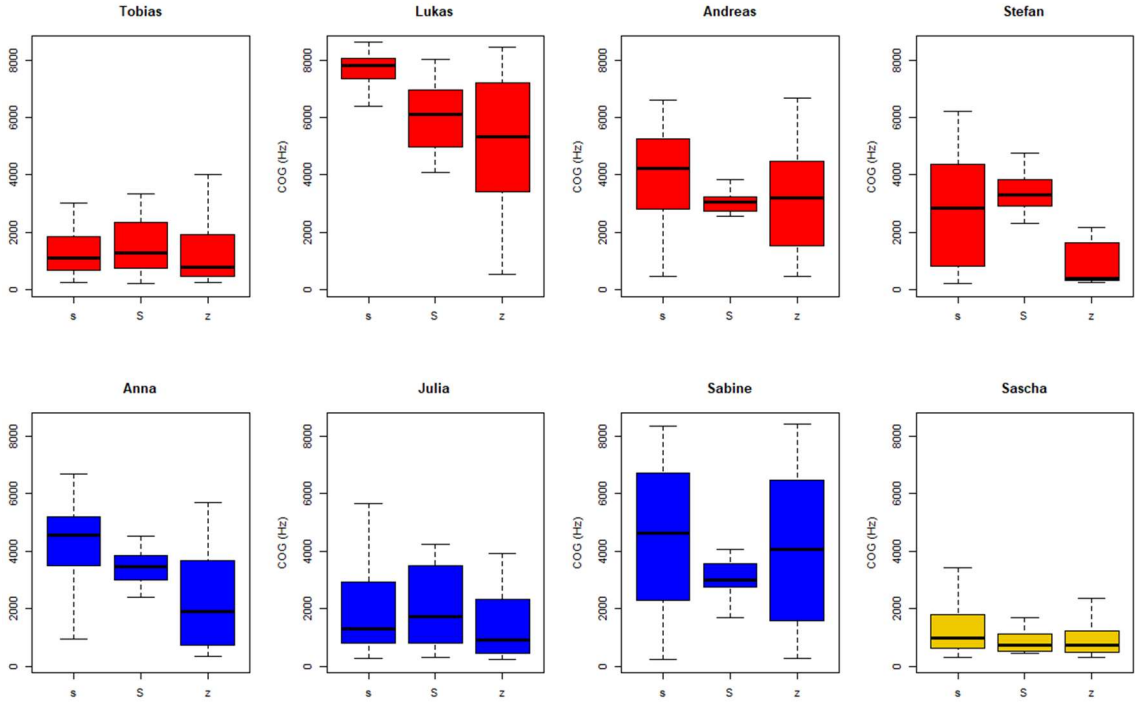

Figure 5.15: Center of Gravity of German Speakers

This figure shows the center of gravity for each speaker of German and shows that men and women use nearly identical productions, indicating no gender difference as one might hope for, since previous research shows this as possibly being a weak indicator of

gender perceptually (Simpson 2015). In fact, center of gravity for any sibilant is not significant with regard to gender.

A linear mixed model using Gaussian error structure and identity link function was used to test for significance. Random effects were “participant ID” and “word”, and fixed effects were “task” and “gender. Response variables tested was Center of Gravity, For COG, I tested each sibilant sound separately. Where a significant effect was identified, I undertook post-hoc testing with the “emmeans” package to identify effect sizes and test pairwise comparisons.

For COG of /s/, I found a significant effect of Task ($\chi_{22,7}$ = 34.5, p less than 0.001), but and no significant effect of gender ($\chi_{21,7}$ = 0.1, p = 0.759) for the COG of /ʃ/, I found a significant effect of Task ($\chi_{22,7}$ = 49.5, p < 0.001) and no significant effect of gender ($\chi_{21,7}$ = 0.74, p = 0.389), For the COG of /z/, I found a significant effect of Task ($\chi_{22,7}$ = 11.1, p = 0.04) and no significant effect of gender ($\chi_{21,7}$ = 0.2, p = 0.688).

5.4.3 DURATION

Sibilant duration has been shown in the literature to show marked gender differences in German, though less so than English (Simpson 2015) and perhaps some indications as to sexual orientation (Boyd 2018). The primary differences between men and women are that women show a slightly longer duration for /s/ and /ʃ/ than men. Competing voiced and voiceless sibilants, voiced fricatives are longer than voiceless ones.

The duration was measured for three sibilants (/s/, /ʃ/, and /z/) and a plot generated showing the overall range, and median duration. These plots are shown in the

figure below and grouped by gender (men, women, nonbinary) then sorted by time on HRT:

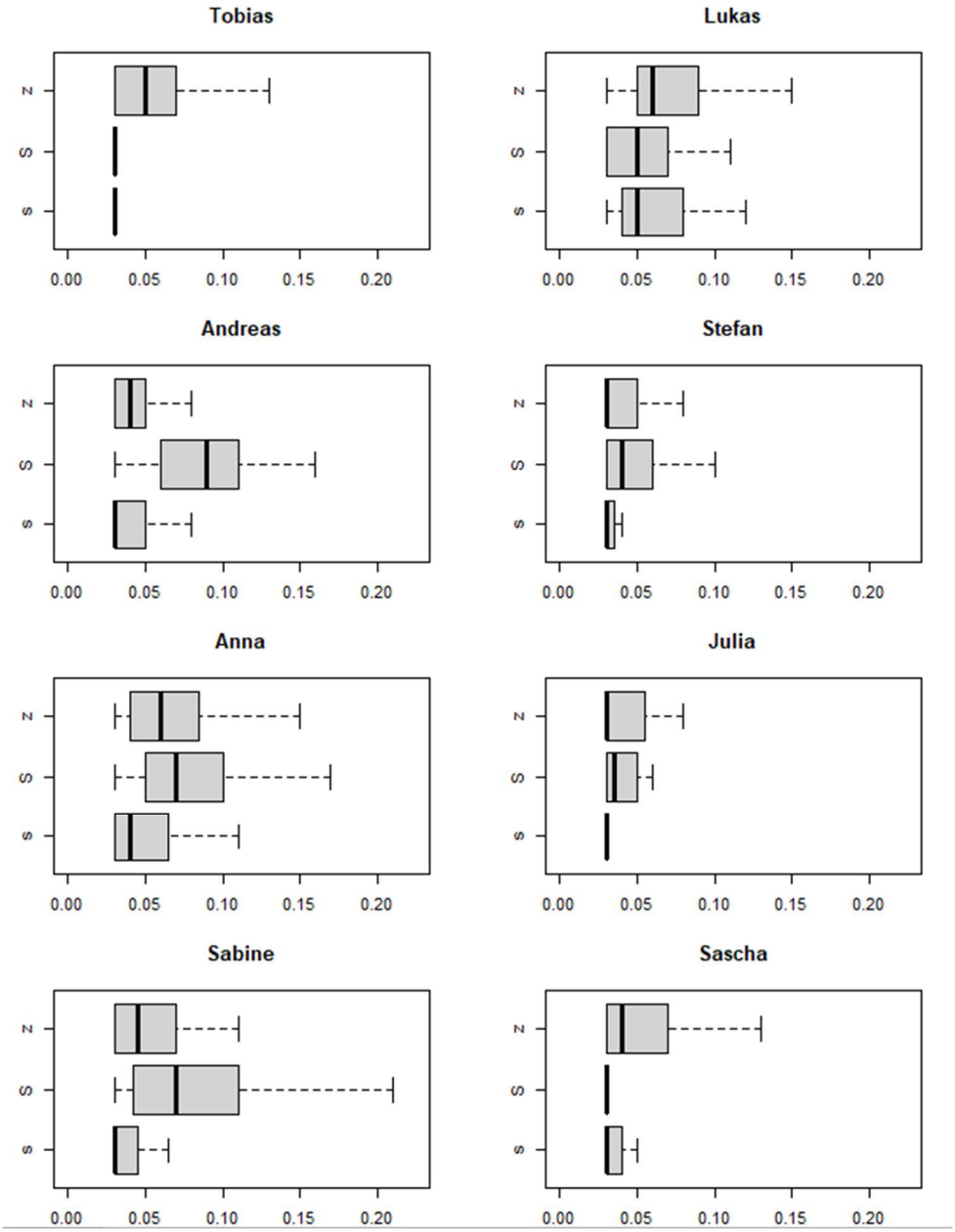

Figure 5.16: Sibilant Duration of German Speakers

As is evident in the above figure, there are few trends within the speakers. For many speakers (Sabine, Anna, Julia, Stephan, Andreas), the median duration for /ʃ/ seems to be slightly longer than the alveolar fricatives /s/ and /z/. The remaining speakers seem to show no difference in these sounds or even a shorter mean duration for /ʃ/. This is borne out in statistical analysis of the duration of these sounds. Gender and duration do not show a significant interaction for any of the sibilants. To test this, I used a linear mixed model using Gaussian error structure and identity link function. In all cases, random effects were "participant ID" and "word", and fixed effects were "task" and "gender". The response variables tested was duration. For duration, I tested each sibilant sound separately. Where a significant effect was identified, I undertook post-hoc testing with the "emmeans" package to identify effect sizes and test pairwise comparisons.

For the duration of /s/, I found a significant effect of task ($\chi_{22,7} = 11.8$, $p = 0.003$) and no significant effect of gender ($\chi_{21,7} < 0.1$, $p = 0.990$). For the duration of /ʃ/ I found a significant effect of task ($\chi_{22,7} = 21.4$, $p < 0.001$) and no significant effect of gender ($\chi_{21,7} = 0.2$, $p = 0.642$). And lastly, for the duration of /z/, I found a significant effect of task ($\chi_{22,7} = 36.1$, p less than 0.001), but no significant effect of gender ($\chi_{21,7} = 1.0$, $p = 0.327$). This indicates that speakers do not seem to use sibilant duration as a marker for gender. As this feature was very weakly marked for cisgender speakers in German, it is unsurprising that there is no such pattern shown here, compounded then by the fact that the sample size is relatively small.

5.5 SUMMARY OF FINDINGS

This section summarizes all the findings for this chapter. Firstly, regarding F0, men and women are not statistically different. Examining vowel space, two

measurements were used: VSA and vowel distance from centroid. It was shown that gender has no significant effect on gender for VSA in each case (men, women, nonbinary). Regarding distance from centroid, the statistical tests showed no significant effect of gender, meaning that the distance from the center of the vowel space to each vowel was not distinct for each group and vowel. The centroids themselves were not significantly different based on gender. For sibilant sounds, there was no significant effect of gender on center of gravity or duration, which was expected based on the literature.

5.6 CONCLUSION

This chapter examined data for vowels and sibilants for German speakers who identify as transgender, and trends were identified for fundamental frequency and vowel space, and sibilants. For all men and women, gender had no significant interaction with F0 or time on HRT. Gender did not have a significant effect on VSA. Gender did not influence distance from centroid The German data collected for showed no significant effect of gender on any of the measures for sibilant sounds.

CHAPTER 6

CONCLUSION

6.1 INTRODUCTION

This chapter summarizes the findings of this dissertation. It discusses the main findings of the English and German chapters previously presented and highlights the important trends shown through the data. Then the trends of each language are briefly compared to possibly illustrate cross-linguistic trends in transgender speech. Lastly, potential shortcomings of this research are discussed followed by potential avenues for future research.

6.2 ENGLISH FINDINGS

This section goes into detail about the English data and what trends were shown throughout the data. Particular attention is given to fundamental frequency and vowel space area. Less attention is given to sibilant duration and center of gravity, as those measures showed no statistical variation between the genders.

Firstly, trans men and trans women do not differ statistically for F0, but the effect of HRT and gender is significant for trans men. This confirms previous studies indicating that HRT (testosterone) affects men by lowering their F0, but that HRT (estrogen) does not affect women's F0. Nonbinary speakers in this research do not show trends, since this group is composed of speakers assigned either male or female at birth. Due to this, for the speakers that did receive HR, some received either estrogen or testosterone, which would have varying effects on the vocal tract. Most nonbinary speakers did not receive any form

of HRT. This lack of trend is expected then because these hormones have differing effects on the vocal tract and F0, some had no HRT, and different individuals received different hormones as therapy.

The two vowel space measurements used in this research were VSA and distance from centroid. Gender has no significant effect on VSA in each case (men, women, nonbinary). Impressionistically, some men exhibit a smaller smallest VSA, some women show a VSA larger than men, and nonbinary speakers have large overall VSA. The distance from centroid for every boundary vowel (/i/ /u/ /a/ /æ/) showed no significant effect of gender. This means that the distance from the center of the vowel space to each vowel was not distinct for any group nor vowel. Lastly, the centroid points were not significantly different for each gender. For sibilant sounds, there was no significant effect of gender on duration center of gravity. Previous studies indicated that gender and center of gravity may have an interaction (Boyd 2021, Simpson 2015), but that was not borne out in this research.

6.3 GERMAN FINDINGS

Firstly, regarding F0, men and women are not statistically different. German speakers showed no noticeable differences in their fundamental frequencies when compared with each other. Though the group was small, it was clear that F0 does not clearly indicate more feminine or more masculine speech. Per the literature on German and F0, German cisgender speakers differ in a smaller degree F0 with regard to gender when compared with English speakers. It is expected then that German transgender speakers show no large difference for F0 related to gender.

Concerning vowel space, two measurements were used – VSA and distance from centroid. It was shown that gender has no significant effect on gender for VSA in each case (men, women, nonbinary). Finally, the average centroids for men and women were not significantly different based on gender. This means that the centroids for men and women each showed no significant difference for the F1 centroid value and F2 centroid value. For sibilant sounds, there was no significant effect of gender on center of gravity or duration, which was expected based on the literature.

6.4 COMPARISONS

This section compares the English and German-speaking groups. Notably, English speakers in this research show a larger difference in F0 between transgender women and transgender men, which parallels the greater differences between cisgender men and women who speak English (Pépiot 2014, Simpson 2009). The measure of F0 is statistically significant for English speakers but not for German speakers. Although previous research on German-speaking men and women show that the two groups do differ, with a small sample size (n = 7), the findings for this measure should be treated cautiously. Germans are expected to have a less strong distinction between genders for F0 (Simpson 2015, Boyd et al 2021), so the null result is in fact not surprising. For neither group were sibilant qualities linked to gender, but the lack of difference is most important for the English speakers, as sibilant sounds are used to mark gender and sexual orientation much more prominently in English than in German.

6.5 IMPLICATIONS FOR THE TRANS SPEECH COMMUNITY

Though many speakers in this research were not concerned with matching linguistic norms of cisgender members of their gender identity, some of the speakers

were. This research indicates that for some speakers, therapies may help reach these linguistic goals they have, primarily regarding F0. For men, receiving HRT (testosterone) has a statistically significant effect for English speaking men and an effect (though not significant) for German speaking men. This has to do with changes to the vocal tract and is already well known within the community. For trans women who wish to reach stylistic norms of cisgender women, vocal therapy or training does seem to have a notable effect on raising F0, though much therapy is needed to achieve this. This was shown by Julia in German producing a notably higher F0 that the other German-speaking women, despite gender in German being less strongly marked via F0 than in English.

6.6 OPPORTUNITIES FOR FUTURE STUDY

This line of inquiry is very large in terms of future study. To reach a clearer representation of the significant and nonsignificant features across genders, especially for German, a larger sample size would help illuminate what trends indeed exist. The phonetic trends shown in the English data are likely more representative of English transgender speech overall, whereas the German data may show trends or lack thereof due to the small sample size obtained and analyzed in this study. Another shortcoming is the potential interaction of the researcher with the participants in the study. Due to the researcher's nationality (American) and native language (English), there may be some effect on the speech of German participants, as the researcher was an outsider in three regards: not a transgender man/woman, not the same nationality, and nonnative speech during data collection. To ameliorate this, a native German speaker conducting the data collection portion would potentially lead to more naturalistic data.

Future study on the topic of transgender phonetics has a multitude of options to further corroborate or discount the findings of this dissertation. Firstly, a larger scale study of German, including the use of a native German speaker for data collection, would help clarify the trends found in the German data. Because the sample size was so small, there is a likelihood that some trends were simply missed because there was not enough representation of each gender.

Another furtherance of this line of inquiry would be to include not only English and German. As the two languages are related, they share some phonological similarities and there is not a sure way to differentiate those similarities/differences without the addition of other languages. The prevalence of nonbinary systems of gender in many parts of the world, as mentioned in Chapter 2: Gender and Phonetics, means that there are ample environments to collect data on transgender and nonbinary speakers to compare the English and German findings.

6.7 SUMMARY

Transgender speakers of English and German use differing phonetic features to construct their linguistic identities within the context of their respective languages and cultures. English speakers show stronger influences of gender on their speech, especially for F0 in men and VSA, whereas German speakers only show a relationship between gender and F0. Lastly, for neither language was there any evidence of sibilant measures being used by any of the genders to form a unique gender identity.

BIBLIOGRAPHY

Acker, M., Fleig, A., & Lüthjohann, M. (2019). Affect and accent. Public Spheres of Resonance: Constellations of Affect and Language.

Adler, Richard K., Hirsch, S., & Mordaunt, M. (2012). Voice and communication therapy for the transgender/transsexual client: A comprehensive clinical guide. Plural Publishing.

American Psychiatric Association. (2013). Gender Dysphoria. In Diagnostic and statistical manual of mental disorders (5th ed.). Washington, DC: https://doi.org/10.1176/appi.books.9780890425596.dsm14

Anonymous v. Weiner, 50 Misc. 2d 380, 270 N.Y.S. 2d 319 (1966)

Anonymous, 57 Misc. 2d 813, 293 N.Y.S.2d 834 (1968)

Audibert, N., Fougeron, C., Gendrot, C. and Adda-Decker, M., 2015. Duration-vs. style-dependent vowel variation: A multiparametric investigation. 18th International Congress of Phonetic Sciences (ICPhS'15) (p. 5).

Avery, J. D., & Liss, J. M. (1996). Acoustic characteristics of less-masculine-sounding male speech. The Journal of the Acoustical Society of America, 99(6), 3738-3748.

Babel, M., & Munson, B. (2010). Teaching and learning guide for Loose lips and silver tongues: projecting sexual orientation through speech. Linguistics and Language Compass, 4, DOI:10.1111/j.1749-818x.2009.00028.x.

Bartlett, Nancy & Paul Vasey. (2006). A retrospective study of childhood gender-atypical behavior in Samoan fa'afafine. Archives of Sexual Behavior, 35(6), 659-666.

Bezerra de Mello, M. C. M., & del Campo Rivas, M. N. (2021). Effectiveness of vocal therapy versus thyroplasty in the voice of transgender women: an integrative review. Revista de investigación e innovación en ciencias de la salud, 3(1), 48-60.

Blizzard, R. M. (2002). Intersex issues: a series of continuing conundrums. Pediatrics, 110(3), 616-621.

Boersma, Paul & David Weenink (2013): Praat: doing phonetics by computer [Computer program]. Version 5.3.15, Retrieved from http://www.praat.org/

Bockting, W. O., & Coleman, E. (2007). Developmental stages of the transgender coming out process: Toward an integrated identity. Principles of transgender medicine and surgery, 1, 185-208.

Bockting, Walter, Autumn Benner & Eli Coleman. (2009). Gay and bisexual identity development among female-to-male transsexuals in North America: Emergence of a transgender sexuality. Archives of Sexual Behavior, 38(5), 688-701.

Boyd, Z. (2018). Cross-linguistic variation of/s/as an index of non-normative sexual orientation and masculinity in French and German men.

Bradford, J., Reisner, S. L., Honnold, J. A., & Xavier, J. (2013). Experiences of transgender-related discrimination and implications for health: results from the Virginia Transgender Health Initiative Study. American journal of public health, 103(10), 1820-1829.

Brewer, C. (1999). Baylan, asog, transvestism, and sodomy: gender, sexuality, and the sacred in early colonial Philippines. Intersections: Gender, history and culture in the Asian context, 2, 1-5.

Brockhaus, W. G. (1992). Final devoicing: principles and parameters (Doctoral dissertation).

Bultynck, C., Cosyns, M., T'Sjoen, G., Van Borsel, J., & Bonte, K. (2021). Thyroplasty type III to lower the vocal pitch in trans men. Otolaryngology–Head and Neck Surgery, 164(1), 157-159.

Busby, P. A., & Plant, G. L. (1995). Formant frequency values of vowels produced by preadolescent boys and girls. The Journal of the Acoustical Society of America, 97(4), 2603-2606.

Campbell-Kibler, Kathryn, Robert Podesva, Sarah Roberts, and Andrew Wong, eds. 2002. Language and Sexuality: Contesting Meaning in Theory and Practice. Stanford: CSLI Publications.

Chodroff, E., & Wilson, C. (2020). Acoustic–phonetic and auditory mechanisms of adaptation in the perception of sibilant fricatives. Attention, Perception, & Psychophysics, 82, 2027-2048.

Clements-Nolle, Kristen, Rani Marx, and Mitchell Katz. "Attempted suicide among transgender persons: The influence of gender-based discrimination and victimization." Journal of homosexuality 51.3 (2006): 53-69.

Colmant, C., Morin-Surroca, M., Fuchs, F., Fernandez, H., & Senat, M. V. (2013). Non-invasive prenatal testing for fetal sex determination: is ultrasound still relevant?. European Journal of Obstetrics & Gynecology and Reproductive Biology, 171(2), 197-204.

Cranny-Francis, Anne, et al. (2003): Gender Studies: Terms and Debates. Pallgrave Macmillan.

Dabbs Jr, J. M., & Mallinger, A. (1999). High testosterone levels predict low voice pitchamong men. Personality and individual differences, 27(4), 801-804.

Deaux, K. (1985). Sex and gender. Annual review of psychology, 36(1), 49-81.

Diamond, Milton. (2002). Sex and gender are different: Sexual identity and gender identity are different. Clinical child psychology and psychiatry, 7(3), 320-334.

Diehl, R. L., Lindblom, B., Hoemeke, K. A., & Fahey, R. P. (1996). On explaining certain male-female differences in the phonetic realization of vowel categories. Journal of Phonetics, 24(2), 187-208.

Ehrlich, S., & Conrad, F. (2021). » Das reinste Deutsch wird in Hannover gesprochen.«Ergebnisse einer repräsentativen Umfrage zu einem linguistischen Mythos. Muttersprache, 131. Jahrgang, Heft .1, 61–74. https://doi.org/10.53371/60192

Ellis, L., & Hardcastle, W. J. (1999). An instrumental study of alveolar to velar assimilation in fast and careful speech. In Proceedings of the XIVth International Congress of Phonetic Sciences.

Enbytex. (2019, June 23). Everything I know about my voice masculinizing surgery coming up [blog post] Retrieved from https://myphallodiary.home.blog/2019/06/23/everything-i-know-about-my-voice-masculinizing-surgery/.

Epprecht, M. (2021). Boy-wives and female husbands: Studies in African homosexualities. State University of New York Press.

Fairbanks, G. (1960). Voice and articulation drillbook, 2nd edn. New York: Harper & Row. pp124-139.

FAVE-Extract (Rosenfelder et al. 2014) and Prosodylab-Aligner (Gorman et al. 2011) using the DARLA web interface (Reddy & Stanford 2015) and the Vowels R package (Kendall & Thomas 2010).

Fox, R. A., & Nissen, S. L. (2005). Sex-related acoustic changes in voiceless English fricatives.

Fox, R.A. and Jacewicz, E., 2008. Analysis of total vowel space areas in three regional dialects of American English. Journal of the Acoustical Society of America, 123(5), p.3068.

Forrest, K., Weismer, G., Milenkovic, P., & Dougall, R. N. (1988). Statistical analysis of word-initial voiceless obstruents: preliminary data. The Journal of the Acoustical Society of America, 84(1), 115-123.

Fougeron, Cécile & Nicolas Audibert. 2011. Testing various metrics for the description of vowel distortion in dysarthria. In Proceedings of the 17th International Congress of Phonetic Sciences, 1–4. Hong Kong.

Frisch, M. (2021). A queer reading of the United States census. The Life and Afterlife of Gay Neighborhoods: Renaissance and Resurgence, 61-85.

Fuchs, S., Brunner, J., & Busler, A. (2007). Temporal and spatial aspects concerning the realizations of the voicing contrast in German alveolar and postalveolar fricatives. Advances in Speech Language Pathology, 9(1), 90-100.

Furman, B. L., Metzger, D. C., Darolti, I., Wright, A. E., Sandkam, B. A., Almeida, P., ... & Mank, J. E. (2020). Sex chromosome evolution: so many exceptions to the rules. Genome biology and evolution, 12(6), 750-763.

Gallup (2002) The Gallup Organization. Washington, D.C.: Gallup Organization. [Web.] Retrieved from Gallup website, https://news.gallup.com/poll/389792/lgbt-identification-ticks-up.aspx

Gaudio, R.P., 1994. Sounding gay: Pitch properties in the speech of gay and straight men. American speech, 69(1), pp.30-57.

Gelfer, M. P., & Mikos, V. A. (2005). The relative contributions of speaking fundamental frequency and formant frequencies to gender identification based on isolated vowels. Journal of Voice, 19(4), 544-554.

Gelfer, M. P., & Tice, R. M. (2013). Perceptual and acoustic outcomes of voice therapy for male-to-female transgender individuals immediately after therapy and 15 months later. Journal of Voice, 27(3), 335-347.

Giegerich, H. J. (1992). English phonology: An introduction. Cambridge University Press.

Glaser, R., York, A., & Dimitrakakis, C. (2016). Effect of testosterone therapy on the female voice. Climacteric, 19(2), 198-203.

Glaspey, A. M., & Macleod, A. A. (2010). A multi-dimensional approach to gradient change in phonological acquisition: A case study of disordered speech development. Clinical Linguistics & Phonetics, 24(4-5), 283-299.

Graddol, D., & Swann, J. (1983). Speaking fundamental frequency: Some physical and social correlates. Language and Speech, 26(4), 351-366.

Grant, J. M., Mattet, L. A., Tanis, J., Harrison, J., Herman, J. L., & Keisling, M. (2010). Injustice at every turn: A report of the national transgender discrimination survey. Retrieved February 12, 2012.

Griffin, T. D. (1981). German affricates. Lingua, 53(2-3), 175-198.

Hagai, E. B., Annechino, R., & Antin, T. (2022). Comparing conceptions of gender, sexuality and lesbian identity between Baby Boomers and Millennials. Journal of lesbian studies, 26(3), 216-234.

Haggerty, G. E. (2000). Gay histories and cultures: An encyclopedia (Vol. 2). Taylor & Francis.

Hancock, Adrienne, et al (2011). “How did she say that?”: An examination of male-to-female transgender voice physiology. 161st Acoustical Society of America Meeting.

Hancock, Adrienne, and Lauren Helenius. (2012). Adolescent male-to-female transgender voice and communication therapy. Journal of Communication Disorders, 45(5), 313-324.

Hancock, Adrienne B., Julianne Krissinger and Kelly Owen. (2011). Voice perceptions and quality of life of transgender people. Journal of Voice, 25(5), 553-558.

Hester, J. D. (2004). Intersex (es) and informed consent: how physicians' rhetoric constrains choice. Theoretical medicine and bioethics, 25, 21-49.

Hickey, R. (2000). On the phonology of gender in Modern German. TRENDS IN LINGUISTICS STUDIES AND MONOGRAPHS, 124, 621-664.

Hossain, A. (2017). The paradox of recognition: hijra, third gender and sexual rights in Bangladesh. Culture, Health & Sexuality, 19(12), 1418-1431.

Ikenaga, H. (2020). Keine Sonderstellung [k] für Hannover als Zentrum des Hochdeutschen. Muttersprache, 130(2), 4.

Irwig, M. S., Childs, K., & Hancock, A. B. (2017). Effects of testosterone on the transgender male voice. Andrology, 5(1), 107-112.

Jacobs, Greg, Ron Smyth, and Henry Rogers. "Language and sexuality: Searching for the phonetic correlates of gay-and straight-sounding male voices. "Toronto Working Papers in Linguistics 18 (2000).

Jannedy, S., Weirich, M., Brunner, J., & Mertins, M. (2010). Perceptual evidence for allophonic variation of the palatal fricative/ç/in spontaneous Berlin German. The Journal of the Acoustical Society of America, 128(4), 2458-2458.

Jannedy, S., & Weirich, M. (2016). The acoustics of fricative contrasts in two German dialects. Proceedings of Phonetics and Phonology in German Speaking Areas, 70-73.

Johnson, Keith, Elizabeth A. Strand, and Mariapaola D'Imperio. "Auditory–visual integration of talker gender in vowel perception." Journal of Phonetics 27.4 (1999): 359-384.

Johnson, K. (2004). Acoustic and auditory phonetics. Phonetica, 61(1), 56-58. [not correct, it's a textbook that you have, it's purple]

Jongman, A. (1989). Duration of frication noise required for identification of English fricatives. The Journal of the Acoustical Society of America, 85(4), 1718-1725.

Jongman, A., Wayland, R., & Wong, S. (2000). Acoustic characteristics of English fricatives. The Journal of the Acoustical Society of America, 108(3), 1252-1263.

Kabak, B., & Maniwa, K. (2007, August). L2 perception of English fricatives in clear and conversational speech: The role of phonemic, phonetic, and acoustic factors. In

Proceedings of the 16 th International Congress of Phonetic Sciences (pp. 781-784).

Kachel, S., Simpson, A. P., & Steffens, M. C. (2018). “Do I sound straight?”: Acoustic correlates of actual and perceived sexual orientation and masculinity/femininity in men's speech. Journal of Speech, Language, and Hearing Research, 61(7), 1560-1578.

Käng, D. B. C. (2016). Ladyboys. The Wiley Blackwell Encyclopedia of Gender and Sexuality Studies, 1-3.

Kendall, Tyler and Erik R. Thomas. 2010. Vowels: vowel manipulation, normalization, and plotting in R. R package. cran.r-project.org/web/packages/vowels/index.html.

Kisler, T. and Reichel U. D. and Schiel, F. (2017): Multilingual processing of speech via web services, Computer Speech & Language, Volume 45, September 2017, pages 326–347.

Koch, J. M., McLachlan, C. T., Victor, C. J., Westcott, J., & Yager, C. (2020). The cost of being transgender: where socio-economic status, global health care systems, and gender identity intersect. Psychology & Sexuality, 11(1-2), 103-119.

Kohler, K. J. (1995). Einführung in die Phonetik des Deutschen. 2., neubearb. Aufl. Berlin, 57.

Kruse, S. A., Lascheit, T., Houben, D. (2016). Stimmtherapie mit Mann-zu-Frau-Transsexuellen. Germany: ProLog.

Labov, William. 2006. A sociolinguistic perspective on sociophonetic research. Journal of Phonetics 34. 500–515.

Labov, W., Ash, S., & Boberg, C. (2008). The atlas of North American English: Phonetics, phonology and sound change. Walter de Gruyter.

Ladefoged, P., & Johnson, K. (2014). A course in phonetics. Nelson Education.

Ladefoged, Peter & Donald E. Broadbent. 1957. Information conveyed by vowels. Journal of the Acoustical Society of America 29. 98–104.

Levon, E., 2007. Sexuality in context: Variation and the sociolinguistic perception of identity. Language in Society, 36(4), pp.533-554.

Levon, E. (2006). Hearing "gay": Prosody, interpretation, and the affective judgments of men's speech. American speech, 81(1), 56-78.

Linville, Sue Ellen. "Acoustic correlates of perceived versus actual sexual orientation in men's speech." Folia Phoniatrica et Logopaedica (1998).

Lyninger, H. (2019). Genetic counseling for transgender patients: Perspectives on terminology, disclosure of transgender status, and proposed pedigree nomenclature. University of California, Irvine.

Mack, S., & Munson, B. (2012). The association between /s/ quality and perceived sexual orientation of men's voices: implicit and explicit measures. Journal of Phonetics, 40, 198–212.

MacKinnon, K. R., Lefkowitz, A., Lorello, G. R., Schrewe, B., Soklaridis, S., & Kuper, A. (2021). Recognizing and renaming in obstetrics: How do we take better care with language?. Obstetric Medicine, 14(4), 201-203.

Malatino, H. (2019). Queer embodiment: Monstrosity, medical violence, and intersex experience. U of Nebraska Press.

Maniwa, K., Jongman, A., & Wade, T. (2009). Acoustic characteristics of clearly spoken English fricatives. The Journal of the Acoustical Society of America, 125(6), 3962-3973.

Mallory, C., Vasquez, L. A., & Meredith, C. (2020). Legal protections for LGBT people after Bostock v. Clayton County.

McAuliffe, Michael, Michaela Socolof, Sarah Mihuc, Michael Wagner, and Morgan Sonderegger. 2017. Montreal Forced Aligner: trainable text-speech alignment using Kaldi. In Proceedings of the 18th Conference of the International Speech Communication Association.

McNeill, Emma JM. (2006). Management of the transgender voice. The Journal of Laryngology & Otology, 120(7), 521-523.

McNeill, Emma JM., Wilson, J. A., Clark, S., & Deakin, J. (2008). Perception of voice in the transgender client. Journal of Voice, 22(6), 727-733.

Medicine, B. (1999). Directions in gender research in American Indian societies: Two spirits and other categories. In Merging Past, Present, and Future in Cross-Cultural Psychology: Selected Papers from the Fourteenth International Congress of the International Association for Cross-Cultural Psychology (pp. 63-72). Swets & Zeitlinger Publishers.

Mennen, I., Schaeffler, F., & Docherty, G. (2012). Cross-language differences in fundamental frequency range: A comparison of English and German. The Journal of the Acoustical Society of America, 131(3), 2249-2260.

Minneapolis, Minnesota. Code of Ordinances, Title 7, Chapter 139, 1975.

Mixdorff, H., & Fujisaki, H. (1994). Analysis of voice fundamental frequency contours of German utterances using a quantitative model. In ICSLP.

Munson, B., Crocker, L., Pierrehumbert, J. B., Owen-Anderson, A., & Zucker, K. J. (2015). Gender typicality in children's speech: A comparison of boys with and without gender identity disorder. The Journal of the Acoustical Society of America, 137(4), 1995-2003.

Munson, Benjamin, Sarah V. Jefferson, and Elizabeth C. McDonald. "The influence of perceived sexual orientation on fricative identification." The Journal of the Acoustical Society of America 119.4 (2006): 2427-2437.

Munson, B., McDonald, E.C., DeBoe, N.L., & White, A.R. (2006). Acoustic and perceptual bases of judgments of women and men's sexual orientation from read speech. Journal of Phonetics, 34, 202-240.

Munson, B. (2007). Lexical characteristics mediate the influence of talker sex and sex typicality on vowel-space size. In J. Trouvain & W. Barry (Eds.), Proceedings of the International Congress on Phonetic Sciences (p. 885-888). Saarbrucken, Germany: University of Saarland.

Munson, Benjamin, and Molly Babel. "Loose lips and silver tongues, or, projecting sexual orientation through speech." Language and Linguistics Compass 1.5 (2007): 416-449.

Munson, Benjamin. "The acoustic correlates of perceived masculinity, perceived femininity, and perceived sexual orientation." Language and Speech 50.1 (2007): 125-142.

Munson, B. (2010). Levels of phonological abstraction and knowledge of socially motivated speech-sound variation: a review, a proposal, and a commentary on the Papers by Clopper, Pierrehumbert, and Tamati; Drager; Foulkes; Mack; and Smith, Hall, and Munson. Journal of Laboratory Phonology, 1, 157-177.

Munson, B. (2015) Gender typicality in children's speech; a comparison of boys with and without gender identity disorder. Journal of the Acoustical Society of America, 137. 1995(2015)

Nielsen, J., & Wohlert, M. (1991). Chromosome abnormalities found among 34910 newborn children: results from a 13-year incidence study in Århus, Denmark. Human genetics, 87(1), 81-83.

Nygren, Ulrike, Agneta Nordenskjöld, Stefan Arver, & Maria Södersten. (2016). Effects on voice fundamental frequency and satisfaction with voice in trans men during testosterone treatment—a longitudinal study. Journal of Voice, 30(6), 766-e23.

O'Keefe, C. (2016). "It's a Girl?": Sex Assignment at Birth and Autonomy (Doctoral dissertation).

Owen, K., & Hancock, A. B. (2010). The role of self-and listener perceptions of femininity in voice therapy. International Journal of Transgenderism, 12(4), 272-284.

Oxford English Dictionary. (n.d.). Cisgender. In Oxford English dictionary. Retrieved March 24, 2022, from https://www.oed.com/view/Entry/35015487?redirectedFrom=cisgender#eid.

Pausewang-Gelfer, M. & Schofield, K 2000. ‘Comparison of acoustic and perceptual measures of voice in male-to-female transsexuals perceived as female vs. those perceived as male’. Journal of Voice 14, pp. 22-33.

Pausewang-Gelfer, M 1999. ‘Voice therapy for the male-to-female transgendered client’. Am J. of Speech-Language Pathology 8, pp. 201-208.

Pennington, S. Transgender Passing Guides and the Vocal Performance of Gender and Sexuality. In The Oxford Handbook of Music and Queerness. [in Stryker 2006]

Pépiot, Erwan (2014). Male and female speech: a study of mean f0, f0 range, phonation type and speech rate in Parisian French and American English speakers. Speech Prosody 7, May 2014, Dublin, Ireland. pp.305-309, 2014. <halshs-00999332>

Pierrehumbert, J.B., Bent, T., Munson, B., Bradlow, A.R., & Bailey, J.M. (2004). The influence of sexual orientation on vowel production. Journal of the Acoustical Society of America, 116, 1905-1908.

Plotkin, V. Y. (1972). Dynamics of the English Phonological System. De Gruyter Mouton.

Podesva, Robert J., Sarah J. Roberts, and Kathryn Campbell-Kibler. "Sharing resources and indexing meanings in the production of gay styles." Language and sexuality: Contesting meaning in theory and practice (2002): 175-189.

Podesva, Robert J. 2004. The Significance of Phonetic Detail in the Construction of Social Meaning. Presentation given at the Annual Meeting of the Linguistic Society of America, 8–11 January, Boston, MA.

Podesva, Robert J. "Phonation type as a stylistic variable: The use of falsetto in constructing a persona." Journal of sociolinguistics 11.4 (2007): 478-504.

Podesva, Robert J. "The California vowel shift and gay identity." American speech 86.1 (2011): 32-51.

Podesva, Robert J. "Gender and the social meaning of non-modal phonation types." Annual Meeting of the Berkeley Linguistics Society. Vol. 37. No. 1. 2011.

Podesva, Robert J. and Patrick Callier. 2015. Voice quality and identity. Annual Review of Applied Linguistics.

Poteat, T., German, D., & Kerrigan, D. (2013). Managing uncertainty: a grounded theory of stigma in transgender health care encounters. Social science & medicine, 84, 22-29.

RStudio Team (2015). RStudio: Integrated Development for R. RStudio, Inc., Boston, MA URL http://www.rstudio.com/.

Ramsey, Trevor. 2018. Examining phonetic trends in transgender speech: A series of tubes. Athens: University of Georgia, MS.

Reddy, Sravana and James Stanford. 2015. Toward completely automated vowel extraction: Introducing DARLA. Linguistics Vanguard.

Robinson, O. W. (2001). Whose German?: The ach/ich alternation and related phenomena in standard and colloquial (Vol. 208). John Benjamins Publishing.

Rosenfelder, Ingrid; Fruehwald, Josef; Evanini, Keelan; Seyfarth, Scott; Gorman, Kyle; Prichard, Hilary; Yuan, Jiahong; 2014. FAVE (Forced Alignment and Vowel Extraction) Program Suite v1.2.2 10.5281/zenodo.22281.

Rosenthal, S. M. (2016). Transgender youth: current concepts. Annals of Pediatric Endocrinology & Metabolism, 21(4), 185.

Salas-Humara, C., Sequeira, G. M., Rossi, W., & Dhar, C. P. (2019). Gender affirming medical care of transgender youth. Current problems in pediatric and adolescent health care, 49(9), 100683.

Schiel, F. (1999). Automatic Phonetic Transcription of Non-Prompted Speech. In Proc. of the ICPhS (pp. 607-610).

Seelman, K. L. (2015). Unequal treatment of transgender individuals in domestic violence and rape crisis programs. Journal of Social Service Research, 41(3), 307-325.

Sell, R. L., Wells, J. A., & Wypij, D. (1995). The prevalence of homosexual behavior and attraction in the United States, the United Kingdom and France: Results of national population-based samples. Archives of sexual behavior, 24, 235-248.

Simpson, A. P. (2001). Dynamic consequences of differences in male and female vocal tract dimensions. The journal of the Acoustical society of America, 109(5), 2153-2164.

Simpson, A. P. (2002). Gender-specific articulatory–acoustic relations in vowel sequences. Journal of Phonetics, 30(3), 417-435.

Simpson, A., & Ericsdotter, C. (2007). Sex-specific differences in f0 and vowel space. In XVIth international congress of phonetic sciences (pp. 933-936).

Simpson, A. P. (2009). Phonetic differences between male and female speech. Language and Linguistics Compass, 3(2), 621-640.

Simpson, A. P., & Weirich, M. (2015). Gender-specific differences in sibilant contrast realizations in English and German. In ICPhS.

Skuk, V. G., & Schweinberger, S. R. (2014). Influences of fundamental frequency, formant frequencies, aperiodicity, and spectrum level on the perception of voice gender.

Smyth, Ron, Greg Jacobs, and Henry Rogers. "Male voices and perceived sexual orientation: An experimental and theoretical approach." Language in Society 32.03 (2003): 329-350.

Smyth, R., & Rogers, H. (2002). Phonetics, gender, and sexual orientation. In Proceedings of the Annual Meeting of the Canadian Linguistics Association (pp. 299-301). l'University du Quebec au Montreal.

Smith, D. R., & Patterson, R. D. (2005). The interaction of glottal-pulse rate and vocal-tract length in judgements of speaker size, sex, and age. The Journal of the Acoustical Society of America, 118(5), 3177-3186.

Stalp, M. C. (2015). Girls just want to have fun (too): Complicating the study of femininity and women's leisure. Sociology Compass, 9(4), 261-271.

Stephen, L. (2002). Sexualities and genders in Zapotec Oaxaca. Latin American Perspectives, 29(2), 41-59.

Strand, Elizabeth A. "Uncovering the role of gender stereotypes in speech perception." Journal of language and social psychology 18.1 (1999): 86-100.

Stryker, S., & Whittle, S. (Eds.). (2006). The transgender studies reader (Vol. 1). Taylor & Francis.

Thomas, W. (1997). Navajo cultural constructions of gender and sexuality. Two-spirit people: Native American gender identity, sexuality, and spirituality, 156-73.

Thomas, E. R. (2001). An acoustic analysis of vowel variation in New World English. Publication of the American Dialect Society.

Totman, R. (2011). The third sex: Kathoey: Thailand's ladyboys. Souvenir Press.

Tracy, Erik C. “Vowels or consonants: Which is more effective in distinguishing between self-identified gay and heterosexual male speakers or American English?” Journal of the Acoustic Society of America. Vol 137. 2015.

Traunmüller, H. and Eriksson, A., 1995. The frequency range of the voice fundamental in the speech of male and female adults. Unpublished manuscript.

Turban, J. L., Dolotina, B., King, D., & Keuroghlian, A. S. (2022). Sex assigned at birth ratio among transgender and gender diverse adolescents in the United States. Pediatrics, 150(3).

Van Borsel, J., De Cuypere, G., Rubens, R. and Destaerke, B., 2000. Voice problems in female-to-male transsexuals. International Journal of Language & Communication Disorders, 35(3), pp.427-442.

Vasey, P. L., & VanderLaan, D. P. (2009). Materteral and avuncular tendencies in Samoa: A comparative study of women, men, and fa’afafine. Human Nature, 20, 269-281.

Warner, N., & Tucker, B. V. (2011). Phonetic variability of stops and flaps in spontaneous and careful speech. The Journal of the Acoustical Society of America, 130(3), 1606-1617.

Weirich, Melanie & Simpson, Adrian. (2015). Gender-specific differences in sibilant contrast realizations in English and German.

Wilde, A., & Diekman, A. B. (2005). Cross-cultural similarities and differences in dynamic stereotypes: A comparison between Germany and the United States. Psychology of Women Quarterly, 29(2), 188-196.

Ziegler, A., Henke, T., Wiedrick, J., & Helou, L. B. (2018). Effectiveness of testosterone therapy for masculinizing voice in transgender patients: A meta-analytic review. International Journal of Transgenderism, 19(1), 25-45.

Zimman, L. and Hall, K., (2009). Language, embodiment, and the 'third sex'. Language and identities, pp.166-178.

Zimman, L., (2009). 'The other kind of coming out': Transgender people and the coming out narrative genre. Gender & Language, 3(1).

Zimman, L., (2012). Voices in Transition: Testosterone, Transmasculinity, and the Gendered Voice among Female-to-Male Transgender People.

Zimman, L., (2013). Hegemonic masculinity and the variability of gay-sounding speech: The perceived sexuality of transgender men. Journal of Language and Sexuality, 2(1), pp.1-39.

Zimman, L. (2017). Gender as stylistic bricolage: Transmasculine voices and the relationship between fundamental frequency and/s. Language in Society, 46(3), 339-370.

Zimman, L. (2017). Variability in /s/ among transgender speakers: Evidence for a socially grounded account of gender and sibilants. Linguistics, 55(5), 993-1019.

Zimman, Lal. (2018) "Transgender voices: Insights on identity, embodiment, and the gender of the voice." Language and Linguistics Compass 12, no. 8: e12284.

APPENDIX A

ENGLISH CALL FOR PARTICIPANTS

SPEECH OF TRANSGENDER INDIVIDUALS

UNIVERSITY OF GEORGIA LINGUISTICS PROGRAM

- Are you over 18 years old?
- Do you speak English as your first language?
- Do you identify as transgender, non-binary, or gender non-conforming?

If you answered YES to these questions you are eligible to participate in this linguistics research study.

The purpose of this research study is to discover trends in the speech of transgender, non-binary, and gender nonconforming individuals. You will be recorded answering short questions, read a list of words, read a short passage and answer some questions about your life. This experiment will take 15-20 minutes. Participants will receive an incentive of **$10** for participating. Transgender, non-binary, and gender non-conforming adults (over 18yo) are invited to participate.

This study is being conducted at Gilbert Hall, 210 Herty Dr. Athens, GA 30602.

Please contact **Trevor Ramsey** at **rovert@uga.edu** for more information.

APPENDIX B

GERMAN CALL FOR PARTICIPANTS

SPEECH OF TRANSGENDER INDIVIDUALS
UNIVERSITY OF GEORGIA LINGUISTICS PROGRAM

- Bist du mehr als 18 Jahre alt?
- Ist Deutsch deine Muttersprache?
- Bist du Transgender?

Wenn Sie JA auf diese Fragen beantwortet haben, sind Sie berechtigt, an dieser Sprachforschungsstudie teilzunehmen.

Der Zweck dieser Forschungsstudie ist es, Trends in der Rede von transgender Individuen zu entdecken. Sie werden aufgehört, kurze Fragen beantworten, eine Liste von Wörtern lesen, eine kurze Passage lesen und einige Fragen über Ihr Leben beantworten. Dieses Experiment dauert 30-45 Minuten. Es gibt keine direkten Vorteile für die Durchführung dieser Studie und die Teilnehmer erhalten keinen Anreiz oder Belohnung. Transgender, nicht-binäre und geschlechtsUNspezifische Erwachsene (mehr als 18 Jahre alt) sind eingeladen, teilzunehmen.

Senden Sie bitte eine Email an: Trevor Ramsey
rovert@uga.edu

APPENDIX C

ENGLISH CONTACT EMAILS

Dear [Name of Organization/Head of Organization],

I am writing to inform you of an ongoing research project currently searching for participants. I am a graduate student in Linguistics at the University of Georgia working on a research project that involves analyzing the fine details of the speech of transgender individuals. This research aims to help discover trends in the speech of transgender individuals, such as pitch and tone variations.

The Primary Investigator for this study is Dr. Margaret Renwick, Associate Professor, Linguistics Program at the University of Georgia. Her email address is: mrenwick@uga.edu, and her phone number is +1 706.542.1995. The Primary Contact for this research is Trevor Ramsey, doctoral graduate student, Linguistics Program at the University of Georgia. His email address is: rovert@uga.edu, and his phone number +1 405.831.8401.

Anyone participating in this study will remain completely anonymous. The study itself will consist of 15-20 minute interviews where participants will read a list of words, a short reading passage, and answer some basic biographical information. Participants will receive a $10 compensation for their time. Interviews can be conducted in person in Athens, GA, or via Skype/Google Hangouts.

If you know anyone who might be interested in participating, please forward their information to the contact. I am happy to answer any and all questions related to this study.

Primary contact:	Trevor Ramsey	University of Georgia
	rovert@uga.edu	405-831-8401

APPENDIX D

GERMAN CONTACT EMAILS

Sehr geehrte(r) Frau/Herr,

Ich schreibe, um Sie über ein laufendes Forschungsprojekt zu informieren, dass derzeit nach Teilnehmern sucht. Ich bin ein Student in Linguistik an der Universität von Georgia, die an einem Forschungsprojekt arbeitet, das die Analyse der feinen Details der Sprache der transgender Einzelpersonen beinhaltet. Diese Forschung zielt darauf ab, Trends in der Rede von Transgender Individuen, wie Tonhöhe und Ton-Variationen zu entdecken.

Das "Primary Investigator" für diese Forschungsprojekt ist Dr. Dr. Margaret Renwick, Associate Professor, Linguistics Program an der Universität von Georgia. Ihre E-Mail-Adresse lautet: mrenwick@uga.edu. Der primäre Kontakt für diese Forschung ist Trevor Ramsey, Linguistics Program an der Universität von Georgia. Seine E-Mail-Adresse lautet: rovert@uga.edu.

Jeder, der an dieser Studie teilnimmt, bleibt völlig anonym. Die Studie selbst besteht aus 30-45 Minuten Interviews, wo die Teilnehmer eine Liste von Wörtern, eine Kurzgeschichte lesen und einige grundlegende biographische Informationen beantworten werden. Es wird keine Entschädigung für die Teilnahme an diesem Experiment geben.

Wenn Sie jemanden kennen, der an der Teilnahme interessiert sein könnte, bitte schicken Sie mir meine Kontaktinformationen zu. Ich freue mich auf alle Fragen im Zusammenhang mit dieser Studie zu beantworten.

Primärer Kontakt: Trevor Ramsey
rovert@uga.edu

Mit freundlichen Grüßen,

Trevor Ramsey

APPENDIX E

ENGLISH SOCIAL MEDIA POST

Greetings!

I am writing to inform you of an ongoing research project currently searching for participants. I am a graduate student in Linguistics at the University of Georgia working on a research project that involves analyzing the fine details of the speech of transgender individuals. This research aims to help discover trends in the speech of transgender individuals, such as pitch and tone variations.

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If you know anyone who might be interested in participating, please forward them my contact information. I am happy to answer any and all questions related to this study.

Primary contact: Trevor Ramsey rovert@uga.edu

Cordially,

Trevor Ramsey

Facebook post (in private and public groups):

Hello! I'm currently conducting research for my dissertation and I'm looking for trans folks to participate. My current study is on trans voices in the south, specifically the vowels and consonants. If you (or someone you know) is interested in participating, please contact me via messenger or email (rovert@uga.edu). I am happy to answer any questions you may have about my research as well as keeping you posted with my findings if you'd like. There is a $10 compensation for participating! Interviews can be conducted in person in Athens, GA, or via Skype/Google Hangouts.

Reddit post:

Hello! I'm currently conducting research for my dissertation and I'm looking for trans folks to participate. My current study is on trans voices in the south, specifically the vowels and consonants. If you (or someone you know) is interested in participating, please contact me via email (rovert@uga.edu). I am happy to answer any questions you may have about my research as well as keeping you posted with my findings if you'd like. There is a $10 compensation for participating! Interviews can be conducted in person in Athens, GA, or via Skype/Google Hangouts.

Twitter post:

Linguistics Study of Transgender Voices in the South: Searching for participants. Must be 18+. $10 compensation for participation. (trans, GNC, non-binary, gender-fluid

participants welcome!) Please visit trevorramsey.com/research for contact info! #transgender #trans #gnc #gendernonconforming #genderfluid #linguistics #research

Athens Craigslist: Transgender Research Study of Southern Voices - $10

Hello! I'm currently conducting research for my dissertation and I'm looking for trans, non-conforming, gender-fluid, and non-binary folks to participate. My current study is on trans voices in the south, specifically the vowels and consonants. If you (or someone you know) is interested in participating, please contact me via email (rovert [at] uga dot edu). I am happy to answer any questions you may have about my research as well as keeping you posted with my findings if you'd like. There is a $10 compensation for participating! Interviews can be conducted in person in Athens, GA, or via Skype/Google Hangouts.

Instagram

(small version of flyer as photo/transgender symbol)

Searching for trans+ participants for a linguistic study of southern voices. $10 compensation. Interviews can be conducted in person in Athens, GA, or via Skype/Google Hangouts. Please email rovert [at] uga dot edu for more information! #trans #transgender #gnc #gendernonconforming #genderfluid #linguistics #research

APPENDIX F

GERMAN SOCIAL MEDIA POST

Hallo!

Ich schreibe, um Sie über ein laufendes Forschungsprojekt zu informieren, das derzeit nach Teilnehmern sucht. Ich bin ein Student in Linguistik an der Universität von Georgia, die an einem Forschungsprojekt arbeitet, das die Analyse der feinen Details der Sprache der transgender Einzelpersonen beinhaltet. Diese Forschung zielt darauf ab, Trends in der Rede von Transgender Individuen, wie Tonhöhe und Ton-Variationen zu entdecken.

Das "Primary Investigator" für diese Forschungsprojekt ist Dr. Dr. Margaret Renwick, Associate Professor, Linguistics Program an der Universität von Georgia. Ihre E-Mail-Adresse lautet: mrenwick@uga.edu. Der primäre Kontakt für diese Forschung ist Trevor Ramsey, Linguistics Program an der Universität von Georgia. Seine E-Mail-Adresse lautet: rovert@uga.edu.

Jeder, der an dieser Studie teilnimmt, bleibt völlig anonym. Die Studie selbst besteht aus 30-45 Minuten Interviews, wo die Teilnehmer eine Liste von Wörtern, eine Kurzgeschichte lesen und einige grundlegende biographische Informationen beantworten werden. Es wird keine Entschädigung für die Teilnahme an diesem Experiment geben. Wenn Sie jemanden kennen, der an der Teilnahme interessiert sein könnte, bitte schicken Sie mir meine Kontaktinformationen zu. Ich freue mich auf alle Fragen im Zusammenhang mit dieser Studie zu beantworten.

Primärer Kontakt: Trevor Ramsey rovert@uga.edu

Vielen Dank!

Trevor

APPENDIX G

ENGLISH BIOGRAPHICAL SURVEY

Participant # _____ date: _____

Please fill out this survey to the best of your abilities. If you do not feel comfortable answering any of the questions, please leave them blank.

Gender assigned at birth:

female male other: _____

Gender identity:

female male other: _____

Age:

_____

Highest level of education:

high school some college college degree technical degree other

Hometown: (where most of your childhood occurred)

_____ _____ _____

city state country

Current residence:

_____ _____ _____

city state country

Are you currently receiving (prescribed or otherwise) hormone replacement therapy?

yes no

If yes, how long have you been receiving this therapy?

_____ (*no. of months or years*)

APPENDIX H

GERMAN BIOGRAPHICAL SURVEY

Participant # _____ date: _____

Bitte füllen Sie diese Umfrage aus. Wenn Sie sich nicht wohl fühlen, irgendwelche Fragen zu beantworten, lassen Sie sie bitte leer.

Geschlecht bei der Geburt zugewiesen:

weiblich männlich sonstiges: _____

Geschlechtsidentität:

weiblich männlich sonstiges: _____

Alter:

_____

Ausbildungsniveau:

Hauptschule Realschule Gymnasium akademische Abschluß sonstiges

Heimstadt:

_____ _____ _____

Stadt Bundesland Land

Gewöhnlicher Aufenthalt:

_____ _____ _____

Stadt Bundesland Land

Bekommen Sie derzeit eine Hormonsubstitutionstherapie?

ja nein

Wenn “ja”, wie lange haben Sie diese Hormonsubstitutionstherapie erhalten?

_____ (seit ___ *Monaten/Jahren*)

APPENDIX I

ENGLISH EXPERIEMENTAL MATERIALS

Interview Guide

This interview will consist of four parts: A brief oral biographical interview, a list of words, a short reading passage and a set of open-ended discussion questions.

Biographical interview:

How old are you?

Where are you from?

Where do you live now?

What languages do you speak?

What do you do (as a job)?

How do you identify in terms of gender?

Word list:

Please read the following words in the sentence.

Please repeat _____ to me. (ex: tomato Please repeat tomato to me.)

1. measure
2. cages
3. paddle
4. singer
5. there
6. tired
7. family
8. zipper
9. volumes
10. shipping

Please take a brief moment to breathe.

11. thoughtful
12. happened
13. ready
14. cherries
15. laughter
16. toilet
17. booking
18. about
19 soapy
20. shopping

Short reading passage:

Please read the following passage in a normal relaxed manner:

The Rainbow

When the sunlight strikes raindrops in the air, they act as a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon.

There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow.

Throughout the centuries people have explained the rainbow in various ways. Some have accepted it as a miracle without physical explanation. To the Hebrews it was a token that there would be no more universal floods. The Greeks used to imagine that it was a sign from the gods to foretell war or heavy rain. The Norsemen considered the rainbow as a bridge over which the gods passed from earth to their home in the sky.

Others have tried to explain the phenomenon physically. Aristotle thought that the rainbow was caused by reflection of the sun's rays by the rain. Since then physicists have found that it is not reflection, but refraction by the raindrops which causes the rainbows.

Many complicated ideas about the rainbow have been formed. The difference in the rainbow depends considerably upon the size of the drops; the width of the colored band increases as the size of the drops increases. The actual primary rainbow observed is said to be the effect of a super-imposition of a number of bows. If the red of the second bow falls upon the green of the first, the result is to give a bow with an abnormally wide yellow band, since red and green light when mixed form yellow. This is a very common type of bow, one showing mainly red and yellow, with little or no green or blue.

Prompted discussion:

How old were you when you realized that you were transgender?

Have you shared your gender identity with family? Friends? Coworkers?

Are you currently taking hormone replacement therapy? Is this something you would like to start in the future?

If you could give one piece of advice to a younger version of yourself, what would it be?

What are you most proud of today?

APPENDIX J

GERMAN EXPERIMENTAL MATERIALS

Interviewanleitung

Dieses Interview besteht aus vier Teilen: Ein kurzes biographisches Interview, eine Wortliste, eine Kurzgeschichte, und eine Reihe von offenen Diskussionsfragen.

Biographisches Interview:

Wollen Sie miteinander siezen oder duzen?

Wie alt sind Sie?/Wie alt bist du?

Woher kommen Sie?/Woher kommst du?

Wo wohnen Sie jetzt?/Wo wohnst du jetzt?

Welche Sprachen sprechen Sie?/Welche Sprachen sprichst du?

Was machen Sie als Beruf?/Was machst du als Beruf?

Was ist Ihre Geschlechtsidentität?/ Was ist deine Geschlechtsidentität?

Wortliste:

Lesen Sie bitte die folgende Wörter und benutzen Sie das Satz:

Sag das Wort _____ zwei mal. (z.B. Tomate Sag das Wort Tomate zwei mal.)

1. fassen
2. Säuger
3. China
4. Hasen
5. Genie
6. Imbiss
7. sicher

8. waschen
9. rauchen
10. schatzen

Nehmen Sie bitte eine kurze Pause.

11. Garage
12. Austausch
13. Teppich
14. Podest
15. Bauch
16. Aufstieg
17. hängen
18. Bayern
19. jodeln
20. Kutsche

Kurzgeschichte:

Bitte lesen Sie locker die folgende Kurzgeschichte:

Skorpion

Er war sanftmütig und freundlich. Seine Augen standen dicht beieinander. Das bedeutete Hinterlist. Seine Brauen stießen über der Nase zusammen. Das bedeutete Jähzorn. Seine Nase war lang und spitz. Das bedeutete unstillbare Neugier. Seine Ohrläppchen waren angewachsen. Das bedeutete Hang zum Verbrechertum. Warum gehst du nicht unter die Leute?, fragte man ihn. Er besah sich im Spiegel und bemerkte einen grausamen Zug um seinen Mund. Ich bin kein guter Mensch, sagte er. Er verbohrte sich in seine Bücher. Als er sie alle ausgelesen hatte, musste er unter die Leute, sich ein neues Buch kaufen gehen. Hoffentlich gibt es kein Unheil, dachte er und ging unter die Leute.

Eine Frau sprach ihn an und bat ihn, ihr einen Geldschein zu wechseln. Da sie sehr kurzsichtig war, musste sie mehrmals hin- und zurücktauschen. Der Skorpion dachte an seine Augen, die dicht beieinander standen, und verzichtete darauf, sein Geld hinterlistig

zu verdoppeln. In der Straßenbahn trat ihm ein Fremder auf die Füße und beschimpfte ihn in einer fremden Sprache. Der Skorpion dachte an seine zusammengewachsenen Augenbrauen und ließ das Geschimpfe, das er nicht verstand, als Bitte um Entschuldigung gelten. Er stieg aus und vor ihm lag eine Brieftasche auf der Straße. Der Skorpion dachte an seine Nase und blickte sich nicht und drehte sich auch nicht um. In der Buchhandlung fand er ein Buch, das hätte er gern gehabt. Aber es war zu teuer. Es hätte gut in seine Manteltasche gepasst. Der Skorpion dachte an seine Ohrläppchen und stellte das Buch ins Regal zurück. Er nahm ein anderes.

Als er es bezahlen wollte, klagte ein Bücherfreund: Das ist das Buch, das ich seit Jahren suche. Jetzt kauft's mir ein anderer weg. Der Skorpion dachte an den grausamen Zug um seinen Mund und sagte: Nehmen Sie das Buch. Ich trete zurück. Der Bücherfreund weinte fast. Er presste das Buch mit beiden Händen an sein Herz und ging davon. Das war ein guter Kunde, sagte der Buchhändler, aber für Sie ist auch noch was da. Er zog aus dem Regal das Buch, das der Skorpion so gern gehabt hätte. Der Skorpion winkte ab: Das kann ich mir nicht leisten. - Doch, Sie können, sagte der Buchhändler, eine Liebe ist der anderen wert. Machen Sie den Preis. Der Skorpion weinte fast. Er presste das Buch mit beiden Händen fest an sein Herz und, da er nichts mehr frei hatte, reichte er dem Buchhändler zum Abschied seinen Stachel. Der Buchhändler drückte den Stachel und fiel tot um.

Diskussionsfragen:

Wie alt waren Sie, als Sie erkannt haben, dass Sie Transgender waren? /
Wie alt warst du, als du erkannt hast, dass du Transgender warst?

Haben Sie Ihre Geschlechtsidentität mit der Familie geteilt? Freunde? Mitarbeiter? /
Hast du deine Geschlechtsidentität mit deiner Familie geteilt? Freunde? Mitarbeiter?

Nehmen Sie derzeit Hormonersatztherapie? Ist das etwas, das Sie in Zukunft beginnen möchten? /
Nimmst du derzeit Hormonersatztherapie? Ist das etwas, das du in Zukunft beginnen möchtest?
Sind Sie religiös? / Bist du religiös?
Wenn Sie einen Ratschlag einer jüngeren Version von Ihnen geben könnten, was wäre das? /
Wenn du einen Ratschlag einer jüngeren Version von dir geben könntest, was wäre das?
Worauf sind Sie heute stolz?
Worauf bist du heute stolz?