NORTHWESTERN UNIVERSITY

The effect of experience and attitudes on heritage bilinguals' language processing

A DISSERTATION

SUBMITTED TO THE GRADUATE SCHOOL
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

for the degree

DOCTOR OF PHILOSOPHY

Linguistics

By

Maria Fernanda Gavino

EVANSTON, ILLINOIS

September 2023

Abstract

This project explores how the variation in language experiences and attitudes that Mexican American Spanish heritage speaker bilinguals in the United States have affects their speech perception in both their languages. Heritage language bilinguals speak as a first language a minority language that they have cultural ties to (e.g., Spanish in the U.S.), but, because of societal reasons, have become dominant in the majority language (e.g., English in the U.S). After English, Spanish is the most frequently spoken language in the United States. Many Spanish speakers in the U.S. (i.e., children and descendants of immigrants) are heritage speakers, yet, Spanish heritage speakers of Mexican descent are an underrepresented population in research. Conducting this project will broaden the participation of Mexican Americans and will help showcase how the variety of positive and negative experiences and attitudes these individuals have affects their language processing.

Variation in language experiences affects bilinguals' perceptual abilities, including the language exposure they received in their early years, as well as throughout their lives. Heritage language bilinguals offer a unique insight into this individual variation as they exhibit significant variation in both experiences and attitudes. Although they are mainly exposed to their heritage language in their early lives, once they begin school, there is a shift to more majority language input and interactions, leading to a switch in dominance. Like many bilinguals, heritage speakers code-switch (i.e., use both of their languages in one sentence or conversation), and there is variation in code switching practices based on experience and attitudes. Two studies examine how variation in language experience and attitudes affects Spanish heritage speakers speech perception in both their languages. Study 1 focuses on better understanding how heritage speakers' experience and attitudes with Spanish and English affects their speech perception when

they interact with prestigious versus stigmatized talkers (labeled by the experimenter as monolingual versus L2-talker) in each of their languages. Study 2 investigates how heritage speaker' experiences and attitudes impacts perception of a stigmatized way of speaking (code-switched versus single language speech). Results showed speech perception variability depending on participants' language experience and attitudes, but, depending on the study, the experiences or attitudes that modulated speech perception varied. These findings provide evidence for the importance of taking the variation of language experiences and attitudes into consideration when investigating heritage bilinguals' language processing.

Acknowledgments

I would not have gotten through graduate school without the professional, intellectual, and emotional support of many people. I would like to take the time to thank you all.

For starters, I want to thank my wonderful advisor Matt Goldrick. You have been the absolute best advisor and mentor I could have had. I have learned so much from you from working with you for the past six years. Your guidance helped me become the researcher I am today. When I think back to when we first met to discuss potential research projects for my QP to the end of the dissertation, I can see my growth. You were always so enthusiastic to talk through papers, questions, experiments etc., as well as challenged me to think of theories and results in different perspectives. It's because of you that I am the psycholinguist I am today, and I truly appreciate all the professional as well as emotional support you provided. Without you this dissertation would not have been possible. I aspire to be as good a mentor as you are and I will miss working with you and speculating about what the bilinguals are up to with you.

I want to thank my committee members Ann Bradlow and Annette D'Onofrio. Your input helped make this project the best it could be. Ann, thank you for providing your expertise with speech in noise and speech perception work, as well as your thought provoking questions and encouragement. Annette, thank you for your sociolinguistic expertise, as well as being so accepting of researchers like me dabbling in sociolinguistics.

Besides my committee members, I want to thank the members of SoundLab for providing feedback at various stages of this project, as well as hearing my various questions and opinions throughout the years about bilingualism. I especially want to thank Zehra Rizvi for being an incredible research assistant. You provided invaluable feedback on questionnaires and thematic coding, as well as so much help with stimuli processing and thematic analysis. I'll miss our discussion about heritage bilinguals, and am so excited to see how your own research journey

goes. I would also like to thank Chun Liang Chan for your technical support, without it the creation and implementation of these experiments would have been so much more difficult.

I feel very lucky in having started this journey with Jaime Benheim, Wes Orth, and Amelia Stecker, the best cohort mates and [kə.'ligz] I could have asked for. You are all the [ful] geese in my heart, and we have so many shared moments that I will always cherish. To Jaime, thank you for always being ready to help me with any resources you could share, as well as providing a logical voice when needed. I'll very much miss our gossip sessions in the cubes. To Wes, my desk bestie, thank you for your consistency, you were always there when I needed you, be it to bounce experiment ideas off of, to grab a coffee (RIP Dunkin), or a drink. And to Amelia, thank you for so openly extending your friendship to me. It was so needed, especially in our early years, and you helped keep me sane.

I would also like to thank fellow graduate students in the department for their support. A special shout out to the following people. To the best colleague, roommate, and friend, thank you Chantal De Leon. Our friendship was instant, and it feels like we've known each other forever. You've been there for so many professional and personal ups and downs, and I'm so grateful you've been such a support for me. I'm so excited to be future material girls together! To Thomas Sostarics, thank you for your friendship as well as being the best stats (and soon to be business) bro to have in my corner. To Kate Sandberg, thank you for your support. I'm happy to have found a book buddy in you, and look forward to chatting about so many more historical fictions. To Cassie Davenport, my fellow Capricorn, I'm grateful for your friendship and for having someone to chat music, hobbies, and shows with. Maybe one day we'll finish our PPL rewatch.

I also want to thank my long-distance besties, who have been integral part of my support network. To Jennifer Lopez, my future comadre, mil gracias por todo tu apoyo, both emotionally and also with participant recruitment. We have grown together so much, and it brings me so much joy to see us both achieve some of our big career goals this year. Here's to many more chisme sessions! To Marcus Gabriel Martinez, we started our linguistics journey together, and I feel so incredibly fortunate to have made a lifelong friend through our major. Thank you for all your support, including hearing me rant and piloting my studies. And last, but certainly not least, to Megan Tamez, my dear bestie. I am so happy we ended up at Whitis because look at this beautiful friendship we've built, as well as all the hyper fixations we've shared. Thank you for all your support, I am so lucky I get to call you a friend.

I could not have gotten through graduate school without the unconditional support from my family. To my mom Esmeralda, mil gracias por todo lo que has hecho por mí. Me has apoyado incondicionalmente toda mi vida y siempre sabes que decirme para animarme. Tu amor y consejos son indispensables para mí y no hay suficientes fonemas en este mundo para poder expresar lo tanto que te amo. And to my sister Issayana, thank you for all your support and belief in me. You've taught me to not take life so seriously and try to "go with the flow" (or well my version of that). I am so happy to have you just a phone call away. Thank you for all your support Guna, my professional unknotter of both yarn and life for all your love and support. Here's to many more walks and fermentations, as well as yarn cakes.

Finally, I want to thank the National Science Foundation for their generous funding of this dissertation (BCS 2141430).

Para mi mamá. Tu fortaleza, ingenio y sabiduría son mi inspiración.

Table of Contents

List of Figures

List of Table

Chapter 1: Introduction

What does it mean to be bilingual? To say that a bilingual is an individual that speaks two languages erases the incredible amount of diversity encompassed in this term. Bilinguals vary in the languages they speak, the age they acquired each of their languages, the types of environments they use each of their languages in, their language proficiency, among many other factors. Yet, because of the belief that linguistic processes occur without the influence of social effects, until recently, bilinguals' language processing was typically studied and analyzed separated from their experiences – as well as the attitudes that shape (and reflect) differences in experiences. However, the lack of replication across populations (likely varying in experiences and attitudes; e.g., Bak, 2016), as well as variation in behavioral task performance based on social information (e.g., Vaughn, 2019), participant differences in language experiences (e.g., Beatty-Martínez & Dussias, 2017), and attitudes (e.g., Neuliep & Speten-Hansen, 2013) suggests these individual differences are important for understanding bilingual language processing. These findings mirror the growth of the literature in experimental sociolinguistics, which provided extensive evidence that variation in experiences and attitudes influence language processing in many populations (e.g., papers reviewing work in Chevrot et al., 2018).

A particularly interesting type of bilingual to investigate in order to better understand the effects of experience and attitudes is heritage language bilinguals. They are defined here as L1 speakers of a minority language that they have cultural ties to (e.g., Spanish in the U.S.), but, because of societal reasons, have become dominant in the majority language (e.g., English in the U.S.; Montrul, 2016). Although they are mainly exposed to the heritage language in their early lives, once they begin schooling, there is a shift to more majority language input and interactions, causing a switch in language dominance (Hulsen et al., 2002; Montrul, 2010; Rothman, 2007;

Stoessel 2002). In this dissertation, I aim to investigate the consequences that language attitudes and experiences has for heritage bilinguals' language processing. Below, I will introduce previous work on bilingual sound systems, social information manipulation, and code-switching in order to contextualize the project. Then, a series of perception studies testing how experiences and attitudes affect heritage listeners' perception of stigmatized speakers (Study 1) and stigmatized ways of speaking (i.e., code-switching; Study 2) in both their language will be explained.

Variation in language experiences affects bilinguals' language processing, specifically their perceptual abilities. The language exposure they received in their early years affects how sound systems were established (for discussion of patterns across multiple bilingual populations, see Flege, 1995; Flege et al., 1999; Sebastián-Gallés et al., 2005). Furthermore, the exposure they receive throughout their lives affects the updating of the sound system. Their perceptual abilities reflect experiences within their social networks, or the range and types of individuals they interact with (Lev-Ari, 2017), as well as the amount and type of speech variation individuals receive (e.g., Bradlow & Bent, 2008). These are experiences which vary across the dominant (i.e., language with greatest proficiency) versus the non-dominant (i.e., language with least proficiency) language, with more input and interactions with other speakers in the dominant language (Tiv et al., 2020). There is evidence suggesting that both early experiences and social network size affect their ability to perceive their languages, especially in unfavorable listening conditions (i.e., noisy environments) that are especially difficult for bilinguals (even when they are highly proficient; Krizman et al., 2017). Heritage bilinguals' experience of switching dominance during their formative years affects their speech perception. Although they are mainly exposed to the heritage language in their early lives, once they begin schooling, there is a shift to

more majority language input and interactions, causing smaller social networks for the heritage language than the majority language and a switch in language dominance (Castelló et al., 2008; Hulsen et al., 2002; Montrul, 2010; Rothman, 2007; Stoessel 2002). Blasingame and Bradlow (2020) show that heritage Spanish – English bilingual speakers are equal in their perception of the heritage and majority language when listening in favorable listening conditions, but they perform worse in the perception of their heritage language (i.e., Spanish) than their dominant language (i.e., English) in unfavorable listening conditions.

In addition to experience-driven differences, there is also evidence that the knowledge and attitudes a listener has about a talker can facilitate or interfere with their perception of the talker (e.g., Babel & Russell, 2015; McGowan, 2015; Niedzielski, 1999). Several studies have shown that listeners who are told that the talker is someone with a more familiar accent outperform listeners who are told that the talker is someone with a less familiar accent (e.g., Vaughn, 2019). For example, when native English listeners have to perceive talkers in unfavorable listening conditions, Vaughn (2019) reported that they more accurately perceive talkers when they are given robust information about a talker's background (i.e., a paragraph describing a talker's language background), when compared to listeners that are given no information about a talker's background (i.e., only information provided is a name that is ambiguous as to language background). Critically, Vaughn (2019) also showed that these native English listeners are more likely to more accurately perceive a talker when they are given information that a talker learned English as an L1 than when they are given information that a talker learned English as an L2, even though it is the same talker speaking. There has been one study that has investigated the impact of social manipulation on heritage listeners' speech perception (Staggs et al., 2022). Heritage listeners were given paragraphs stating the talkers'

country of origin (e.g., Mexican American, Cuban American) as well as age of learning Spanish (e.g., from birth, in college). Staggs et al. (2022) did not find an effect of social information on perception. However, this study only tested perception in one language (i.e., Spanish), and did not take into the language attitudes bilinguals have towards each of their languages.

Previous work has shown that the ideologies listeners have can affect their attitudes towards talkers. For example, Neuliep and Speten-Hansen (2013) had native English listeners complete an ethnocentrism survey to measure how ethnocentric these listeners were. The listeners were then shown a video of a talker who was instructed to speak with a "standard American [English] accent" or a "non-native accent" (the origin of the non-native accent was left ambiguous). Listeners who showed higher levels of ethnocentrism perceived the talker more negatively when the talker spoke with a non-native accent. Latinos have also been shown to vary in their attitudes towards their languages, their usage, and other Latinos' usage of English and Spanish. Many times, Latinos who are considered low proficiency in English or Spanish are perceived negatively and as being overly or not assimilated to U.S. culture (e.g., García Bedolla, 2003). This feeds into "standard language" ideologies and the myth of not having an accent. Talkers who are perceived as being "accentless" are typically seen more positively and as the ideal to achieve, even though everyone has an accent (Lippi-Green, 2012). The variation in heritage bilinguals language ideologies, as well as participants attitudes towards their own dialects, could potentially affect how their perceive other speakers of English and Spanish.

Unfavorable listening conditions not only impact speech within a single language, but also the perception of speech in contexts where multiple languages are used (Kaan et al., 2020; Marian & Spivey, 2003). In particular, code-switched speech (where multiple languages are used within a single utterance) is difficult to perceive in noise (Garcia et al., 2018). Community-

specific practices for code-switching (Bullock et al., 2017; Woolard, 2007; Zentella, 1997) are an important source of variation in bilingual experience that may also contribute to variation in perception. Code-switches can be broadly categorized (Muysken, 2000) as alternations (i.e., stretches of words of one language alternate within a conversational turn), insertions (i.e., words or constituents from one language are inserted into an utterance), or congruent lexicalization (i.e., shared language structure is realized with words/morphemes of different languages). Different communities may favor one switching type (e.g., stable bilingual communities that typically separate their languages may prefer alternations; Green and Wei, 2014). These variations have been reported to impact the control mechanisms that they use to process representations in each of their languages (Beatty-Martínez & Dussias, 2017; Green & Wei, 2014). For example, Beatty-Martínez and Dussias (2017) showed that Spanish-English bilinguals who habitually code-switch are more accurate at identifying ungrammatical code-switches than those who do not. Heritage speakers also vary in the types of code-switching they use depending on factors like proficiency levels, attitudes, and identity (Toribio, 2011; Zentella, 1997). Yet, there are negative attitudes associated with code-switching within the Latino community in the United States. Many believe that it shows deficient version of language that shows a lack of proficiency in English and Spanish, even though it is highly systemic and requires a high level of proficiency in both languages to use (Poplack, 1980; Toribio, 2002). However, some Latinos have been found to use it as a symbol of their cultural identity and see it in a positive light (e.g., Toribio, 2002). Other results suggest that heritage bilinguals' attitudes towards code-switching could affect perception. For example, Badolia et al. (2018) showed that the variation in positive or negative attitudes towards code-switching by Spanish-English bilinguals in the United States

affects their syntactic acceptability of code-switched sentences, with individuals with more positive perceptions having higher acceptability of certain kinds of code-switches.

Given the heterogeneity of Mexican-American Spanish heritage bilinguals' language experiences and attitudes, this project aims to investigate the consequences that this variation has for heritage listeners' language processing. A series of perception studies tested how experiences and attitudes affect heritage listeners' perception in both their languages. These experiments provide insight into what factors in bilingual experience affect the speech perception of stigmatized speakers (i.e., L2-talkers; Study 1) and stigmatized ways of speaking (i.e., code-switching; Study 2).

Study 1 investigated how heritage speakers' language attitudes and experiences affect their auditory perception of different heritage talkers in a speech in noise task. A social information manipulation task was conducted, where listeners are given a paragraph describing different language background social information about the talkers whose speech they are asked to transcribe. A total of 112 listeners were split across two talker groups (i.e., talker group 1 and talker group 2), with four talkers in each group. Each participant was presented with two talkers in an English block and two different talkers in a Spanish block. In each block, the paragraphs indicated to the listeners that one talker is a monolingual speaker and the other is an L2-talker of the target language for that block. Listeners then typed the sentence they heard, and their transcription accuracy was analyzed, as well as questionnaires that measured different aspects of their language experiences and attitudes. In the main model, I analyzed by-word transcription accuracy by language and social information. For talker group 1 and 2, replicating previous work I found that heritage speakers were better at perceiving speech in their dominant language (i.e., English) than their non-dominant language (i.e., Spanish; Blasingame & Bradlow, 2020). I then

conducted analysis with the following language attitudes and experiences: bilingualism index (i.e., a proficiency-based measure of relative language dominance), social network (i.e., a measure of how many individuals a participant interacts with), relative language positivity and negativity scores (i.e., a measure of individuals' self-perception in English and Spanish that is the sum of all English positive or negative responses subtracted from the sum of all Spanish positive or negative responses), and open ended attitudes questions. When these individual differences were taken into account, a robust social information effect was found in Spanish (higher accuracy when told a talker is monolingual versus an L2-talker), showing how controlling for experiences and attitudes can help clarify the effect of experimental manipulations. Additionally, bilingualism index, relative language positivity score, and certain types of patterns of attitudes revealed in open ended questions modulated accuracy in English and Spanish. The variation in attitudes showcased by the open ended questions also modulated accuracy when told a talker is a monolingual speaker, with higher accuracy when told a talker is a monolingual speaker than an L2-talker speaker. These results provide evidence that the heterogeneity within the language attitudes and experiences that the heritage bilingual population has affects their performance in experimental tasks.

Study 2 investigated how heritage speakers' experiences with their languages and their attitudes towards code-switching affect their auditory perception of code-switching and single-language speech in a speech in noise task. Listeners transcribed sentences in noise in an English-only, Spanish-only, and code-switched sentence block. Their transcription accuracy was analyzed, as well as questionnaires that measured different aspects of their language experiences and attitudes. We found that heritage speakers were better at perceiving speech in English-only and Spanish-only blocks than code-switched blocks (Garcia et al., 2018), as well as better at

perceiving their dominant language (i.e., English) than their non-dominant language (i.e., Spanish; Blasingame & Bradlow, 2020). As in study 1, we conducted analysis with bilingualism index, social network, relative language positivity and negativity scores, and open ended attitudes questions. Spanish social network size, as well as relative language positivity affected accuracy in the Spanish block. Additionally, the open ended question asking about code-switching and identity had an effect in overall transcription accuracy. Listeners who considered code-switched a part of their identity had higher accuracy in English than Spanish than those who did not consider code-switching part of their identity. Overall, the results of this study further support the findings of Study 1: individual differences within the heritage bilingual population may affect their performance in experimental tasks.

In summary, these studies showcase the way that the heterogeneity within Mexican-American Spanish heritage bilinguals' language experiences and attitudes can influence speech perception. Not only did the variation across experiences and attitudes modulate participants' performance in study 1 and 2, but the types of experiences and attitudes varied across studies. This shows how the variation that has been previously documented within this community (e.g., Fought, 2010; Martínez, 2006; Thomas, 2019), can impact perceptual behavioral tasks. For this reason, it is important to treat bilinguals as a heterogeneous group, since inaccurate conclusions regarding the nature of language processing may arise if studies treat heritage bilinguals as a homogeneous group. This suggests important directions for future research to focus on taking language attitudes and experience into account when investigating social effects. Additionally, these findings suggest that future work should explore the effects other diverse experiences (e.g., immigrant generation, education, etc.) and attitudes (e.g., different dialects, different types of speakers, etc.) in order to have a better understanding of how such factors influence perception.

Chapter 2: The effect of experience and attitudes on the perception of different talkers

2.1: Introduction

There is a wide range of experiences which affect bilinguals' language processing. These differences in experiences can affect bilinguals' sound systems and, therefore, their perceptual abilities. Bilinguals' knowledge of sound systems is shaped from birth, and the early input that they receive is important to creating sound categories that allow for robust perception of contrasts in both languages (Flege, 1995; Flege et al., 1999; Sebastián-Gallés et al., 2005). However, sound categories are dynamic and continuously updated based on experience. Previous work has provided evidence that perceptual abilities reflect experiences within their social networks, or the range and types of individuals they interact with (Lev-Ari, 2017), and, more generally, the amount of acoustic variability in the speech individuals receive (e.g., Bradlow & Bent, 2008). These experiences vary across the dominant versus the non-dominant language, with more input and interactions in the dominant language (Tiv et al., 2020). Both early experiences and social network size affect their ability to perceive their languages, especially in unfavorable listening conditions (i.e., noisy environments) that are especially difficult for bilinguals (even when they are highly proficient; Krizman et al., 2017).

In addition to experience-driven differences, there is also evidence that the knowledge and attitudes a listener has about a talker can facilitate or interfere with their perception of the talker (e.g., Babel & Russell, 2015; McGowan, 2015; Niedzielski, 1999). Listeners who are told or assume that the talker is someone with a more familiar accent outperform listeners who are told or assume that the talker is someone with a less familiar accent (e.g., Rubin, 1992; Vaughn, 2019). For example, when listeners have to perceive talkers in unfavorable listening conditions,

they more accurately perceive talkers when they are given robust information about a talker's background, when compared to listeners that are given no information about the talkers (Vaughn, 2019). The robust information is a paragraph detailing the talker's supposed language background, and, if the talker is said to be an L2-speaker, their language learning experience. Listeners are also more likely to more accurately perceive a talker when they are told they are a monolingual speaker than when told they are an L2-talker , even though it is the same talker speaking (Vaughn, 2019). Although its impact on speech perception has been not been directly explored, the language attitudes bilinguals have towards each of their languages can vary greatly (García Bedolla, 2003).

One type of bilingual that offers unique insight in to experience- and attitude-driven variation in speech perception is Spanish heritage speakers in the U.S. (Montrul, 2016). Although they are mostly exposed to the heritage language in their early lives, the type of input they receive differs from non-heritage speakers of the target language (Rothman, 2007). Once they begin schooling and begin building larger social networks, there is a shift to more majority language input and interactions, causing smaller social networks for the heritage language than the majority language and a switch in language dominance (Castelló et al., 2008; Hulsen et al., 2002; Montrul, 2010; Stoessel 2002). Their experience of switching dominance during their formative years affects their speech perception. Heritage speakers are equal in their perception of the heritage and majority language when listening in favorable listening conditions, but they perform worse in the perception of their heritage language (i.e., Spanish) than their dominant language (i.e., English) in unfavorable listening conditions (Blasingame & Bradlow, 2020).

This study brings together the three strands of work reviewed above, examining how the variation in Mexican-American Spanish heritage bilinguals' experience and attitudes impacts

their ability to accurately recognize speech in noise when given different social information about talkers. Transcription accuracy of sentences in English and Spanish was analyzed, as well as their language experiences (via language proficiency and social network measures) and their language attitudes (via Likert scales and opened ended questions).

The remainder of this chapter is structured as follows. We begin by reviewing previous work examining the effect of social information manipulation and language experience and attitudes on heritage bilinguals' speech perception. This motivates the design and methods of our current study. The results show a language dominance effect, but unreliable social information manipulation effects, as well as a modulation of effects based on language experience and attitudes, providing insight into heritage bilinguals' language processing. We conclude by discussing what aspects of bilingual speech perception this contributes to and what theories need to be revised and extended to account for these findings, including areas for future work.

2.2: Background

Bilingual sound systems

A bilingual's sound system is shaped from birth, and the early input that they receive is important to creating sound categories that allow for robust perception of contrasts in both languages (Flege, 1995; Flege et al., 1999; Sebastián-Gallés et al., 2005). There is evidence that simultaneous bilingual infants organize perceptual system differently than monolingual infants (Bosch & Sebastián-Gallés, 2003), providing evidence of the importance of early input for the creation of sound systems. Similarly, there is evidence that simultaneous bilinguals more accurately perceive a sound contrast when compared to early sequential bilinguals that acquired the language with this sound contrast second (Sebastián-Gallés et al., 2005). Given the importance early input has, it would be expected that all sequential bilinguals would perform

better in perceptual tasks in their first acquired language than second, yet, heritage bilinguals perform better in their second language than first in many perceptual task (e.g., Blasingame & Bradlow, 2020). A reason for this is that sound categories are dynamic and continuously updated based on who individuals interact with (Samuel & Kraljic, 2009).

Individuals' perceptual abilities can be affected by social network sizes (Lev-Ari, 2017) which can correlate with the amount of speech variation they are exposed to. Increased exposure to speech variation can aid in the perception of speech (e.g., Clopper & Pisoni, 2004), especially in unfavorable listening conductions (e.g., Bradlow & Bent, 2008). Bilinguals typically do not have the same social network size for each language, with their dominant language having a larger and denser social network than the non-dominant language (Tiv et al., 2020). Heritage bilinguals (Montrul, 2016) seem to follow the same pattern. Due to diglossia, or the usage of a language in specific social context (e.g., using English outside of the home, but only Spanish in the home), heritage speakers tend to have small social networks for their heritage language. Previous work has found that the smaller and sparser the social network is in the heritage language, the less the language is maintained (Castelló et al., 2008; Garcia, 2011; Hulsen et al., 2006; Stoessel 2002), which can affect their proficiency in their heritage language.

Age of acquisition and social networks are two of many factors that make up an individual's language experience. Their language experience (or lack of experience) has been found to affect their perception of speech, especially in unfavorable listening conditions. For example, bilinguals perception of linguistic input in noise is more affected than monolinguals, no matter the proficiency level (Krizman et al., 2017; Mayo et al., 1997; Shi, 2010). Similarly, heritage speakers are equal in their perception of heritage language and majority language when listening in favorable listening conditions, but they perform worse in the perception of their

heritage language than their dominant language in unfavorable listening conditions (Blasingame & Bradlow, 2020). However, no work has been conducted investigating if social network size in each language has an effect in speech perception in unfavorable listening conditions.

Language attitudes in the Mexican-American community and their effect on perception

Southwestern United States was originally part of the Spanish empire, and later became part of Mexico when it won its independence in 1810. Through the Texas Revolution (1836) and Mexican-American War (1846-1848), the United States gained this territory, along with Mexican citizens that lived in these lands ("Mexican: immigration and relocation", n.d.). When the United States took control of present day Southwestern United States, the Mexicans were categorized as a different ethnoracial category. This is partially because these Mexicans had been colonized by the Americans, therefore, they were inferior to their colonizer. Another factor is because scientific racism (i.e., eugenics) became popular at around this time. Because many Mexicans were of partial indigenous descent, scientific racism could not consider them to be White (Hayes-Bautista & Chapa, 1987). These ideologies about people of Mexican descent continued when there was a large influx of Mexican immigrants in 20th century (reflecting the Mexican Revolution and the United States' need for labor, among other reasons). Many of these Mexican immigrants were from a lower socio-economic class and from rural areas, leading to the development of intersectional ideologies combining race and socio-economic status (Farr, 2006; Silva-Corvalan, 2004; Urciuoli, 1996).

When it comes to the Mexican-American community in the United States, there is a stigmatization of both of their languages that stems from how language has been used to racialized this community. The racialization of both Spanish and English has caused a linguistic ideology of "languagelessness" in the community, since this is a community that speaks

stigmatized dialects of both of their languages. They are seen as not speaking a legitimate variety of either language: the English varieties they speak have too much Spanish influence, and the Spanish varieties they speak have too much English influence. Additionally, with regards to Spanish, many of the Mexican immigrants to the United States are considered to speak a less prestigious dialect of Spanish, and these ideologies are inherited from Mexico (either directly, in the case of first generation speakers, or indirectly, in the case of second generation speakers; Farr, 2006; Rosa, 2019; Silva-Corvalan, 2004; Urciuoli, 1996; Zentella, 2004). However, factors like generation, social network, and bilingualism in the overall community can affect the stigmatization of their languages, which leads to variation in how much each language is used. For example, Mendoza-Denton (2008) conducted an ethnography of teenage girls in two Mexican-American gangs. She showcased the difference sin language ideologies and use between first generation speakers and second generation and beyond speakers. The two gangs that Mendoza-Denton followed were the *Sureñas* ("female southerners") and *Norteñas* ("female northerners"). These gangs were composed of individuals from different generations. The *Sureñas* were mainly made up of first generation individuals, who were Spanish dominant and mainly used Spanish to communicate. Members of this gang were proud of being Mexican, and indexed it through speaking varieties of Mexican Spanish and refusing to linguistically assimilate to the United States. The *Norteñas* were mainly made up of second generation and beyond individuals, who were English dominant and use English more often to communicate. Members of this gang were proud of their biculturalism, and indexed it through speaking Chicano English (i.e., a variety of English spoken by Mexican-Americans that has influences from Spanish). Although these girls were a part of the same community, were the same age, and

attended the same school, the differences in generation led them to interact with different girls and view their languages differently.

García Bedolla (2003) proposed that there is a "Latino Paradox." In her study she finds that Mexican-Americans negatively perceived members of their community being Spanish dominant or monolingual because it demonstrates a lack of desire and drive to assimilate to the United States. Yet, they also negatively perceived individuals for being English dominant or monolingual because it demonstrates that they have over-assimilated. These over-assimilated individuals are perceived as being ashamed of their ethnoracial group, and as either distancing themselves or renouncing their membership in the Mexican-American community. The paradox is that even though there is a stigma to being Spanish dominant, knowing Spanish is a key way to index Mexican-American pride and membership. The perception of this paradox differs depending on where on the Spanish-English dominance spectrum the individual is. Latinos who are Spanish-dominant have more confidence in their Spanish dialect, but feel their English is stigmatized. Those who are very English dominant or monolingual have more confidence in their English dialect, and feel shame in their Spanish proficiency. Those who fall somewhere in the middle may differ depending on factors like their education levels in each language (which may correlate with dialect prestige).

Given the history of Mexican-Americans and their diverse relationships with both English and Spanish, their language attitudes bilinguals have towards each of their languages can vary greatly. Importantly, because attitudes can affect the social evaluations of different talkers, we expect this diversity to yield variation in the perception of speech. Previous work has shown that besides the language experiences, the knowledge a listener has about a talker can facilitate or interfere with their perception of the talker (e.g., Babel & Russell, 2015; McGowan, 2015;

Niedzielski, 1999). For example, there is evidence that the information listeners are given about a talker, either through pictures, paragraphs, can affect their perception in a social information manipulation task (i.e., a task where the same voice is used across participants, and participants are given different information about that voice; Babel & Russell, 2015; McGowan, 2015; Niedzielski, 1999; Vaughn, 2019). There is evidence that listeners who are told or assume that the talker is someone with a more familiar accent (e.g., a native speaker or L1-talker) outperform listeners who are told or assume that the talker is someone with a less familiar accent (e.g., a non-native speaker or L2-talker; Rubin, 1992; Vaughn, 2019). It is possible that this is because the perception of unfamiliar and L2 accents have been found to be heavily influenced by the listener's expectations of a talker instead of what they are hearing (i.e., more top-down perception), when compared to the perception of talkers with more familiar accents (i.e., more bottom-up; Lev-Ari, 2015). However, there is also evidence that if there is an incongruent expectation between the identity of the talker and their voice (e.g., a listener is told that X is an L2-talker, but the listener perceives them to be native or monolingual), listeners have a harder time perceiving speech than when there is a congruent expectation between the identity of the talker and their voice (e.g., a listener is told that X is an L2 or non-native talker, and the listener perceives them to be L2 or non-native; e.g., McGowan 2015; Vaughn, 2019).

With regards to heritage bilinguals, there is one previous study using social information manipulation (Staggs et al., 2022). In this study, Spanish heritage listeners heard Spanish heritage talkers speak in Spanish in either a speaker guise (i.e., listeners were told the speakers were L1 Spanish speakers who shifted from Spanish to English dominance in early childhood) or listener guise (i.e., listeners were told these same speakers were L2 Spanish speaker who learned Spanish in a classroom setting later in life). The results did not find an effect of social

information. However, if social information effects are modulated by experiences and/or attitudes, the failure to account for substantial differences in language experiences and attitudes Latinos have in the United States (much greater than variation in the listeners used in previous work) may have masked these effects. For example, there was variation in the Spanish variety the listeners spoke, which could have had influenced their experiences and attitudes, altering their perceptual accuracy. It is possible that controlling for Spanish dialect in both the talkers and listeners could allow the effect of social information to emerge, so that there is a difference in perceptual accuracy across different social information conditions.

2.3: Current Study

The current study examines how Spanish heritage speakers' experiences and attitudes in each of their languages affect their sensitivity to perceptual difficulties when speech is associated with more versus less prestigious social information. Based on prior work, we expect that listeners will perform better in the language they use the most and are dominant in, so listeners should perform better in the English block than Spanish block (Blasingame & Bradlow, 2020). Extending previous work, we will examine how the experience and attitudes heritage speakers have affects their perception of different talkers. We expect that listeners will overall perform better when provided a biographical paragraph that allows listeners to infer a talker is a monolingual speaker of the target language versus infer a talker is a non-native speaker of the target language (Rubin, 1992; Vaughn, 2019). However, we expect for there to be variation across the performance of talkers when listeners are told they are monolingual or L2-talkers based on individual's differences in experiences and attitudes. We expect that listeners with more experience and/or better attitudes towards L2-talkers speakers will show less difficulties with L2-

talkers speakers than listeners with less experiences and/or worse attitudes towards L2-talkers speakers.

2.4: Methods

Power Analysis

A Monte Carlo power analysis was run in order to determine the sample size for this experiment. A logistic mixed effects model, fit to the data of Blasingame and Bradlow (2020), was used to create simulated data. This previous study examined the same population in a speech-in-noise task, and the main effect of language they observed was weaker (and therefore required greater power) than the main effect of monolingual versus L2-talker social information in Vaughn (2019). A statistical model was re-fitted to the simulated data to test whether the crucial effect of language could be detected by a likelihood ratio test. Based on 1,000 simulations at each level of a participant sample size, we found that 25 participants being tested on 60 items per language yielded a β exceeding 0.8. Because we are also interested in measuring more subtle effects (e.g., an interaction of experiential measures with language), we decided to double the amount of participants (i.e., 50). In order to ensure that we had an equal amount of participants in each of the experimental lists (see below for details), 56 listeners were needed for each set of talkers.

Talkers

Eight Spanish heritage talkers of Mexican descent were recruited to record the stimuli in both English and Spanish (four each for talker groups 1 and 2). Their voices were used for both English and Spanish blocks between listeners. Listeners heard all four voices, but the information they were given for each voice (i.e. monolingual or L2-talkers) and the language they were presented in (i.e., English or Spanish) varied between participants.

All talkers were between the ages of 21-28 (mean: 24.9). Their average age of acquisition for Spanish was 0 years old and for English was 3.5 years old (range: 0-6). They all completed their education in English, and were all English-dominant according to both self-reports and the results of the MINT Sprint (Garcia and Gollan, 2022). All talkers self-reported English as their dominant language in the pre-screening questionnaire. In the language background questionnaire, their self-rating in reading, writing, speaking and listening to English (reading mean 6, range 4-7; writing mean 5.75, range 4-7; speaking mean 6, range 4-7; listening mean 6.1, range 4-7) was on average higher than Spanish (reading mean 4.9, range 4-7; writing mean 4.25, range 3-7; speaking mean 5, range 4-7; listening mean 6, range 4-7). For the MINT Sprint the mean score for English was 74 (range 68-80 out of 80) and the mean score for Spanish was 59 (range 48-71 out of 80). Note that one speaker (i.e., the author) was not eligible to take the MINT Sprint.

Norming

Norming of the talkers was conducted by a group of 21 heritage speakers (one excluded for not being Mexican-American) that did not participate in any other study. Each listener heard the talkers speak in either English or Spanish, and rated them on gender, ethnicity, and nativeness. They listened to a speaker read three sentences, and then rated them. They listened to one speaker at a time, and the order of the speaker was randomized across participants. For gender, participants were asked to choose between male, female, or other, and then rating how prototypical they thought the talker's voice was on a scale of 1 (not typical at all) to 5 (very typical). For ethnicity, participants were asked what ethnicity/race they perceive the speaker to be, and how confident they were on their answer on a scale of 1 (not confident at all) to 5 (very confident). For nativeness, participants were asked how old they thought the speaker was when

they learned the language, and then to rate how if the speaker sounded like a native speaker on a scale of 1 (strongly disagree) to 5 (strongly agree).

The results of norming showed that listeners accurately perceived the gender of each talker (mean 4.6; range 4.1-4.9). Listeners also believed that the talkers were native speakers of the language they were speaking, with results being comparable across each language (English mean 4, range 3.3-4.6; Spanish mean 4.3, range 3.2-4.9). When speaking Spanish, talkers were mostly identified as being Mexican, Mexican-American, or Hispanic/Latino (68 out of 80). Other responses included being identified as White (5 out of 80), Guatemalan (4 out of 80), Chilean (1 out of 80), Colombian (1 out of 80), or Argentinian (1 out of 80). When speaking English, talkers were mostly identified as being White (44 out of 80) or Hispanic/Latino (30 out of 80). Other responses included Asian (4 out of 80) and Black (2 out of 80).

Stimuli

A list of sentences taken from the ALLSTAR corpus (Hearing in noise test sentences; Bradlow, n.d.) were used as the stimuli. There are a total of 120 sentences, half in English (e.g., “A boy fell from the window.”) and half in Spanish (e.g., “El niño hace ruido en su cuarto.”). All stimuli can be found in Appendix A. To aid acoustic analyses, the sentences were forced aligned using the Montreal Forced Aligner (McAuliffe et al., 2017). Praat (Boersma and Weenik, 2021) was used to then edit the audio files. Praat scripts were implemented to chop the audio files so they had no silences before or after the speech, then to equalize them to 70dB, and then resampled to 44,100 hertz. 500 ms of silence was added at the beginning and end of each sentence. Then speech shaped noise based on the long term average speech spectrum of the stimuli was created and mixed into the sentences at 0SNR (Study 1A) or at -4 SNR (Study 1B) with the noise fading in during the first 250 ms of the sentence.

Acoustic Analysis

To ensure that talkers have differences between their English and Spanish productions, acoustic analyses of the vowel space and rate of speech were conducted on the stimuli sentences.

Vowels

The full vowel spaces for English and Spanish were measured for each talker. Praat (Boersma & Weenick, 2021) was used to analyze the phonetic properties of the first (F1) and second (F2) vowel formants (resonant frequencies of the vocal tract; Peterson & Barney, 1952). Following standard analysis methods (e.g., Mack, 1989), we focused on measurements of formants at the vowel midpoint. Formants were measured by a Praat script using Linear Predictive Coding.

As seen in figure 2.1, Spanish talkers showed five distinct vowels: /i/, /e/, /a/, /o/, and /u/. The shapes of the spaces varied by gender.

As seen in figure 2.2, English talkers showed more than five distinct vowels, providing evidence that they have a distinct vowel space for each language. There also seem to be similarities across talkers' vowel spaces like a merger between /ɑ/ and /ɔ/, clear differences between tense and lax vowels, and /u/ fronting.

Overall, the vowel analyses show that each talker has significant differences between their English and Spanish vowel spaces.

Figure 2.1: Spanish vowel space plots for each talker. Vowels are measured at 50 percent duration. The x-axis represents F2, while the y-axis represents F1. (vertical wings show standard error for F1 and horizontal wings show standard error for F2)

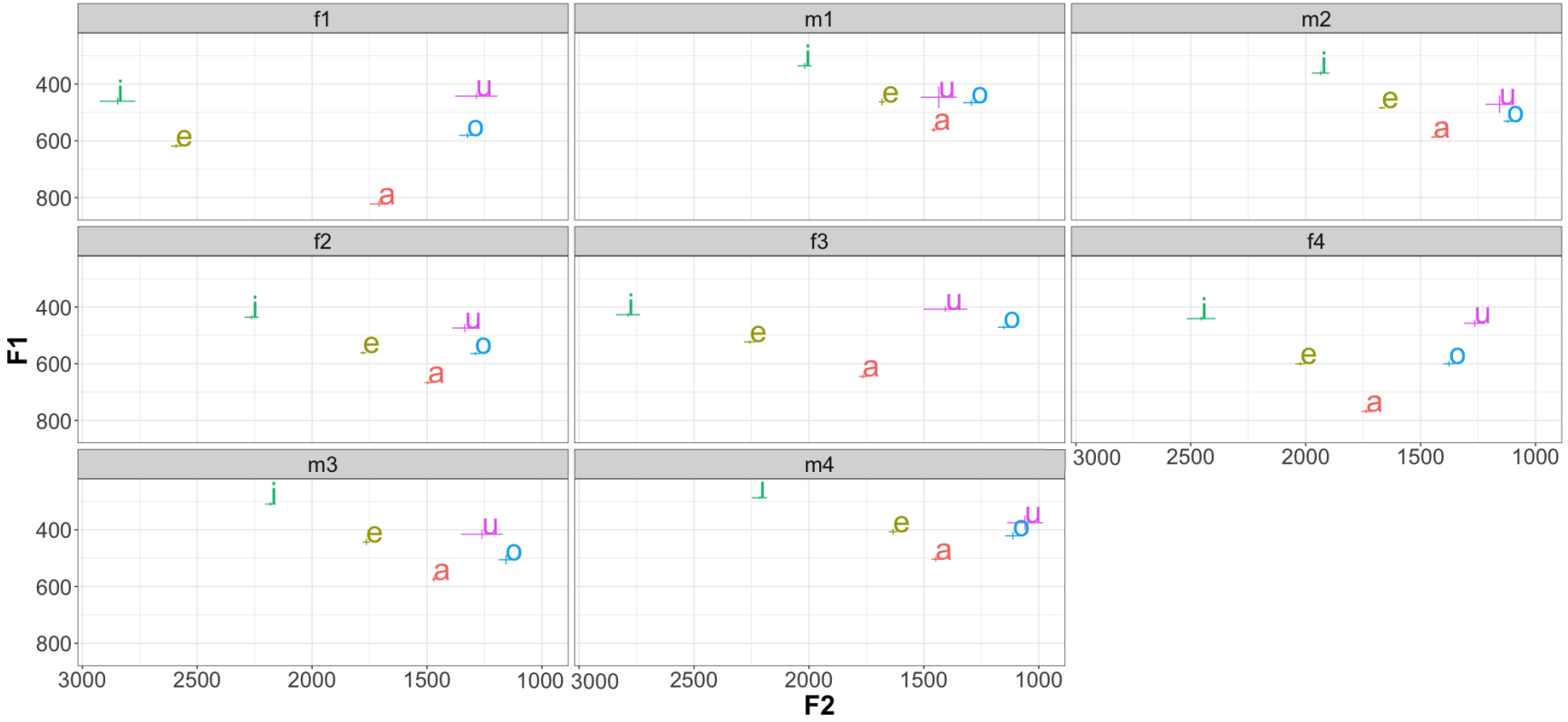
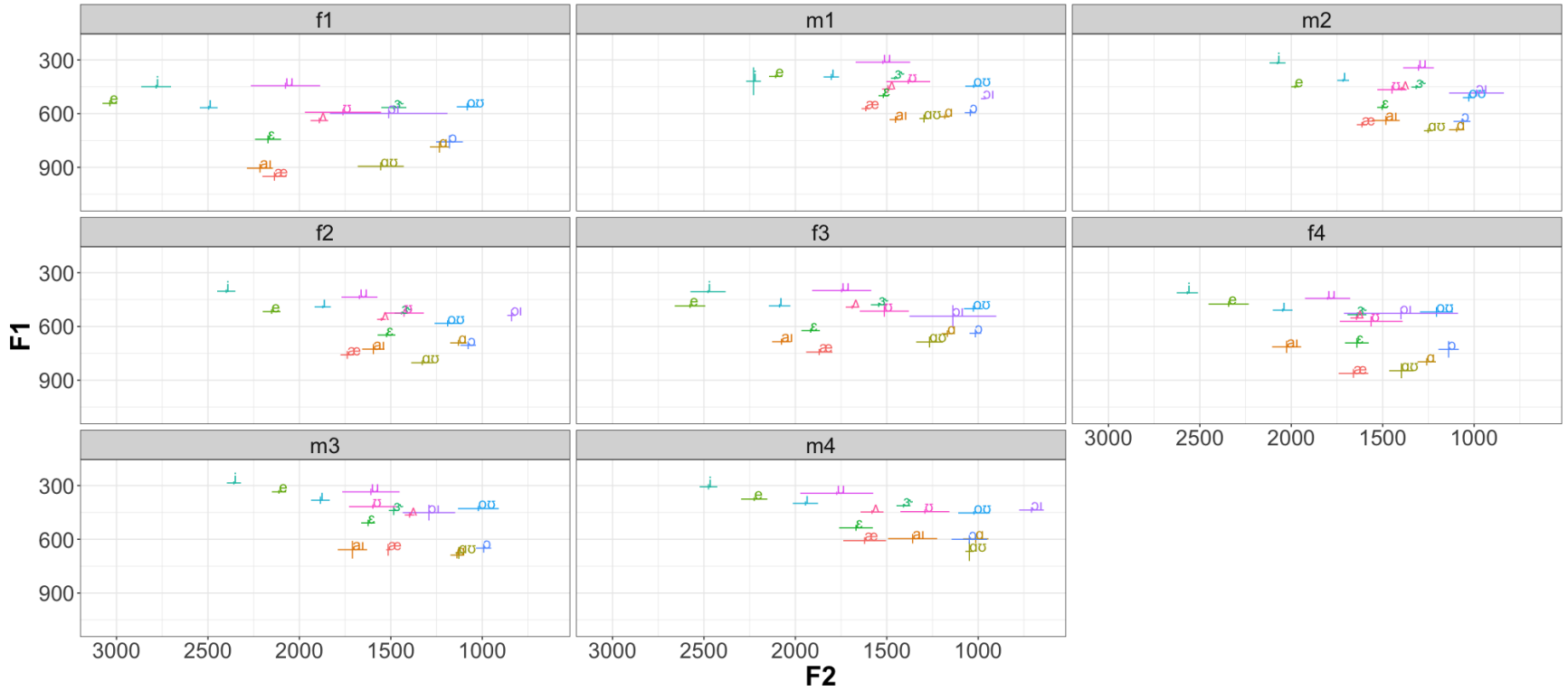


Figure 2.2: English vowel space plots for each talker. Vowels are measured at 50 percent duration. The x-axis represents F2, while the y-axis represents F1. (vertical wings show standard error for F1 and horizontal wings show standard error for F2)

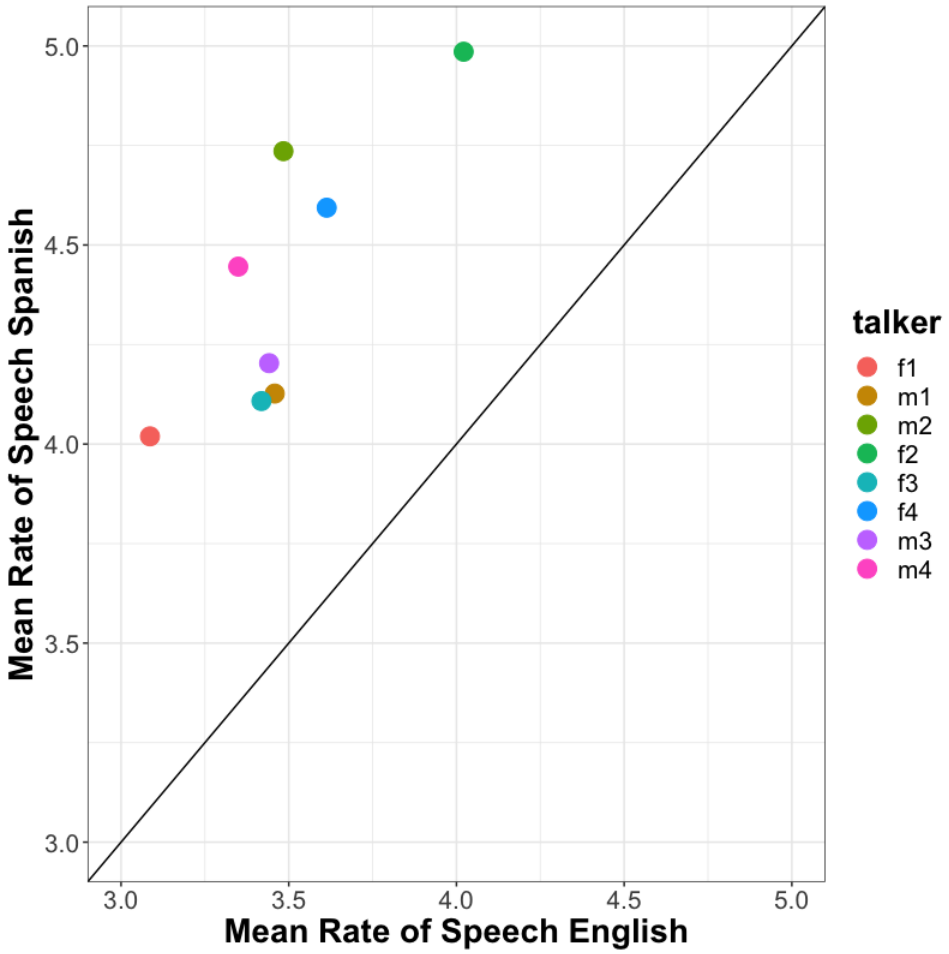


Rate of speech

The rate of speech in English and Spanish was measures for each talker. A Praat script (de Jong & Wempe, 2008) was used calculate rate of speech by measuring the number of acoustic syllables over the duration time of the sentence.

As seen in Figure 2.3, all talkers were faster at reading in English that in Spanish. Talker rate of speech tends to be the same across language; in other words, if talker X speaks faster in English than talker Y, then talker X speaker faster in Spanish than talker Y.

Figure 2.3: Average rate of speech measures calculated by the average rate of speech measured by acoustic syllables over duration for each talker for English (x-axis) and Spanish (y-axis). The colors represents talkers.



Listeners

Based on the power analysis and having an equal number of participants exposed to each list, 125 Spanish-English heritage speakers were recruited as listeners for this study (half for Study 1A, half for 1B). In order to be eligible to participate, listeners needed to be native Mexican Spanish speakers who are English dominant that received their schooling in the U.S. A total of 123 English-dominant Mexican-American Spanish-English heritage bilingual listeners were recruited through Prolific (www.prolific.co). Thirteen participants were excluded for either not being Mexican-American or having acquired English or Spanish after the age of 10. Their average age of acquisition for Spanish was 0 years old (range 0-7) and for English was 3.4 years old (range 0-10). They all completed their education in English, and were all English-dominant according to the results of the MINT Sprint (Garcia & Gollan, 2022). The mean score for English was 65 (range 43-78 out of 80) and the mean score for Spanish was 39 (range 13-66 out of 80). (Note that six listeners completed the task incorrectly, so they were excluded from the MINT Sprint analysis.) In the language background questionnaire, their self-rating in reading, writing, speaking and listening to English (reading mean 6.57, range 4-7; writing mean 6.17, range 4-7; speaking mean 6.28, range 3-7; listening mean 6.28, range 4-7) was on average higher than Spanish (reading mean 5.27, range 2-7; writing mean 4.49, range 2-7; speaking mean 5.15, range 2-7; listening mean 5.61, range 3-7), indicating that they identified English as their dominant language.

Social Information

At the beginning of each block, a paragraph with social information about each talker was given to the listener. The structure of the paragraph was similar to the L1-accent and L2-

accent guise social information paragraphs in Vaughn (2019), although the information varied since there were two talkers in each block instead of one. The paragraphs were given in the language of the block. There were two versions of the social information paragraph, which changed based on whether the male or female talker was a monolingual or L2-talker. Table 2.1 has all the social information paragraphs used in this study. Note that the Spanish instructions are in Spanish, but are the translated version of the English ones, just with different names.

Table 2.1: Social information paragraphs used in Study 1

Language and Version	**Paragraph Text**
English Version 1	Emily was born and raised in the United States and has been speaking English since birth. She does not speak any other language. Diego was born and raised in Mexico, and has been speaking Spanish from birth, and learned English later in life.
English Version 2	Oliver was born and raised in the United States and has been speaking English since birth. He does not speak any other language. Jimena was born and raised in Mexico, and has been speaking Spanish from birth, and learned English later in life.
Spanish Version 1	Fernando nació y creció en México y ha hablado español desde que nació. Él no habla otro idioma. Charlotte nació y creció en los Estados Unidos, habla inglés de nacimiento y aprendió español cuando ya estaba grande.
Spanish Version 2	Alicia nació y creció en México y ha hablado español desde que nació. Ella no habla otro idioma. James nació y creció en los Estados Unidos, habla inglés de nacimiento y aprendió español cuando ya estaba grande.

Following Vaughn (2019), after a participant read the social information, they were quizzed in order to ensure they remembered the information given. If listeners failed the quiz, they were returned to the screen with the social information, and given the opportunity to retake

the quiz. Listeners could not move on to the main task until they passed the quiz. Table 2.2 contains the quiz and possible responses. As with the social information, note that the Spanish instructions are in Spanish, but are the translated version of the English ones, just with different names.

Table 2.2: Social information quiz

Language and Version	**Quiz**
English Version 1- Monolingual	What do you know about Emily's knowledge of Spanish? (1) Emily speaks Spanish, (2) Emily only speaks English, and no Spanish <correct answer>, (3) Unknown—I was not told whether or not he speaks Spanish, and (4) I do not remember
English Version 1- L2-talker	What do you know about Diego's knowledge of Spanish? (1) Diego speaks Spanish <correct answer>, (2) Diego only speaks English, and no Spanish, (3) Unknown—I was not told whether or not he speaks Spanish, and (4) I do not remember
English Version 2- Monolingual	What do you know about Oliver's knowledge of Spanish? (1) Oliver speaks Spanish, (2) Oliver only speaks English, and no Spanish <correct answer>, (3) Unknown—I was not told whether or not he speaks Spanish, and (4) I do not remember
English Version 2- L2-talker	What do you know about Jimena's knowledge of Spanish? (1) Jimena speaks Spanish <correct answer>, (2) Jimena only speaks English, and no Spanish, (3) Unknown—I was not told whether or not he speaks Spanish, and (4) I do not remember
Spanish Version 1 – monolingual	¿Qué sabes acerca del conocimiento de inglés que tiene Fernando? (1) Fernando habla inglés, (2) Fernando nada más habla español, no inglés, <respuesta correcta> (3) Desconocido, No se informó si habla o no inglés y (4) No recuerdo
Spanish Version 1 – L2-talker	¿Qué sabes acerca del conocimiento de inglés que tiene Charlotte? (1) Charlotte habla inglés <respuesta correcta> (2) Charlotte nada más habla español, no inglés, (3) Desconocido, No se informó si habla o no inglés y (4) No recuerdo
Spanish Version 2 – monolingual	¿Qué sabes acerca del conocimiento de inglés que tiene Alicia? (1) Alicia habla inglés, (2) Alicia nada más habla español, no inglés, <respuesta correcta> (3) Desconocido, No se informó si habla o no inglés y (4) No recuerdo
Spanish Version 2 – L2-talker	¿Qué sabes acerca del conocimiento de inglés que tiene James? (1) James habla inglés <respuesta correcta> (2) James nada más habla español, no inglés, (3) Desconocido, No se informó si habla o no inglés y (4) No recuerdo

Lists

Within each set of talkers, there were eight lists in total. Half of the sentences in each list are read by one speaker, and the other half by the other (e.g., T1 reads English 1-30 and T2 reads English 31-60), and this is counterbalanced across lists. Each block always has a male and a female talker. Across blocks, the social information (i.e., monolingual vs. L2-talkers) is counterbalanced across gender (e.g., if a male speaker is in the monolingual context in the English block, the male speaker in the Spanish block will be in the L2-talkers context). The pairing of talkers is counterbalanced as well.

Questionnaires

Participants completed the following: a social network questionnaire, a language background and attitudes questionnaire, and a language proficiency test. All questionnaires can be found in Appendix B and C. The social network questionnaire was based on the ones used in Gonzales (2011) and Lev-Ari (2017; 2018), and included questions to gauge how many individuals are in participants' social networks, how strong their ties are with different members of their social network, and how many bilingual and monolingual interactions they have. The responses to this questionnaire provide information about participants' language experience and usage.

The language attitudes and background questionnaire focuses on gauging whether participants view their own language usage and experiences positively or negatively, including: the way they speak their languages, their use and other's use of code-switching, the individuals perception of their own dialect. It also examines the degree to which each of their languages are seen as important to their identity and sense of self and the strength of connection to cultures

associated with each language. The talkers provided feedback on this questionnaire in order to ensure that questions are accurately and respectfully eliciting responses. The attitude responses are measured using a combination of Likert scales and free response questions. The language attitude Likert scales were taken from Walker (2016), and the open ended questions were created specifically for this project. The language background questionnaire was developed at Northwestern by the Speech Communication Research Group (NUSUB-DB Paper Questionnaire, n.d.), and also asked general background questions like self-rated language dominance and proficiency, language of education, and geographic information. Other questions were taken from a combination of the Language History Questionnaire (Li et al. 2020), a code-switching questionnaire (Toribio, 2002), and the Bilingual Language Profile (Birdsong et al., 2012).

Finally, the Multilingual Naming Test Sprint (Garcia & Gollan, 2021) productive vocabulary test provides an objective measure of proficiency in both languages. The results from this task verified that participants are English dominant bilinguals.

Procedure

Participants completed two experimental blocks, one in English and one in Spanish. Instructions for each block will be in the language of the block (i.e., English instructions for the English block and Spanish instructions for the Spanish block), and they were tested on the same day. Language order is set across participants, and they complete the English block first, then Spanish. Participants completed a speech in noise task in which they have to type the sentence they hear after being given different social information about the two talkers in each block. At the end of both blocks in Study 1B, participants were be asked to rate the voices using semantic

differential scales (e.g., having “not intelligent at all” and “very intelligent” on opposite ends of a 7 point scale). Analysis of these responses will help us determine if effects are driven by participants’ attitudes towards a specific voice, rather than the attitudes listeners hold across groups of speakers. Afterwards, they completed the MINT Sprint, the social network questionnaire, and the language background and attitudes questionnaire.

Data Analysis

Performance was assessed using scoring by-word transcription accuracy. The transcriptions were all lowercased, as well as all accent markers were removed. Then Autoscore (Borrie et al., 2019) was used to score accuracy. Afterwards, a script was run to count accuracy by word. By word accuracy is what was used to measure performance.

Thematic Coding

A thematic coding of the four open-ended responses from the language attitudes and background questionnaire was conducted. The questions are listed in Table 2.3.

Table 2.3: Open ended questions

Question number	**Question**
1	What does English mean to you? What do you think about when you think about English? What does being an English speaker mean to you?
2	What does Spanish mean to you? What do you think about when you think about Spanish? What does being a Spanish speaker mean to you?
3	Do you consider code-switching to be an important part of your identity? Why or why not?
4	Do you think that Spanish and/or English are an important part of your culture? Of your identity? Why or why not?

The thematic coding was done by two annotators, myself and a research assistant, in the following phases. First, a subset of eight participants were chosen by picking the first participant from each list from Study 1A. Each annotator individually read all the responses for all four questions and took notes on major themes identified in each response. Identification of themes was informed by previous work investigating Mexican-Americans' and Latinos' relationships with their languages (e.g., García Bedolla, 2003; Gonzalez, 2011; Rosa, 2019), as well as bilingualism and accentedness in the United States (Lippi-Green, 2012). Then both annotators decided on a set of single words or short phrases to identify each theme (Tables 2.11, 2.14, 3.11 and 2.17 have the master list of all codes). Depending on the content of the response, a single sentence could encompass one or multiple themes. From there, annotators coded a total of 20 participant's responses. The two annotators then reviewed all participants and differences between their annotations were resolved through a discussion. This process was repeated until all participants' responses were coded.

If a response had a theme not covered by an already established code, the annotators discussed the response and then decided if a theme had to be added or not. An example of how codes were added can be given for question 4. For this question there are two similar codes: "both languages are important part of culture/identity" and "both languages are important part of culture". The reason for this is that most participants that indicated that "both languages are an important part of their culture/identity" would give a response like:

> Both languages are very important part of my culture because knowing both languages is testament to my dual identity… Both languages are useful for me, and I am a part of multiple cultures that use both/either Spanish and English…[1]

This participant indicated that both languages are an important part of their culture and also an important part of their identity. However, another participant said:

> … I think they are an important part of my culture because they are a reminder of the different lineages that my culture carries … But I do feel that both languages are not part of my identity. I feel like my identity is based on innate traits … and language is for communication.[2]

By explicitly saying that both languages are part of their culture, but language is not part of their identity, the code "both languages are important part of culture/identity" could not be used. Therefore, the code "both languages are important part of culture" was added. Whenever a new code was added, the previous responses were reviewed in order to ensure that the new code is not applicable to previous responses.

2.5: Results

Main model

R (R Core Team, 2022) was used to run a logistic mixed-effects model of the data from talker group 1, examining by-word accuracy depending on language (English versus Spanish) and social information (monolingual versus L2-talkers). All factors were contrast-coded. In all models reported here, the maximal random effects structure that converged was optimized to

[1] Quote is from a participant, but has been edited for clarity and to ensure anonymity.
[2] Quote is from a participant, but has been edited for clarity and to ensure anonymity.

guard against overfitting following the procedure described by Bates et al. (2015). There were two sets of correlated random effects factors: (1) by participant, with a random intercept and language as a random slope, and (2) by item, with a random intercept, and language as a random slope. Within each set, random effects were correlated. In all models reported here, model comparisons (likelihood ratio tests) were used to test the significance of fixed effects.

Results showed that English sentences were more accurately transcribed than Spanish sentences (β = -0.6, *SE* β = 0.15, χ^2 (1)= -4.32, $p < 0.001$). There was no main effect of social information (β = 0.006, *SE* β = 0.03, χ^2 (1)= 0.10, $p > 0.05$), but there was an interaction between language and social information (β = -0.18, *SE* β = 0.06, χ^2 (1)= -2.82, $p < 0.01$). Follow up regressions conducted on English and Spanish subsets of the data indicate that in Spanish transcription listeners more accurately transcribed talkers when they were told the talkers are monolingual speakers (β = -0.04, *SE* β = 0.099, χ^2 = -0.39, $p < 0.05$), but no difference when found in English transcription (β = 0.08, *SE* β = 0.17, χ^2 (1) = 0.5, $p > 0.05$).

Figure 2.4: Transcription accuracy in English and Spanish depending on monolingual or L2-talker social information for talker group 1. The x-axis represents language, while the y-axis represents the average by word accuracy in transcription. (wings show bootstrapped 95% confidence intervals)

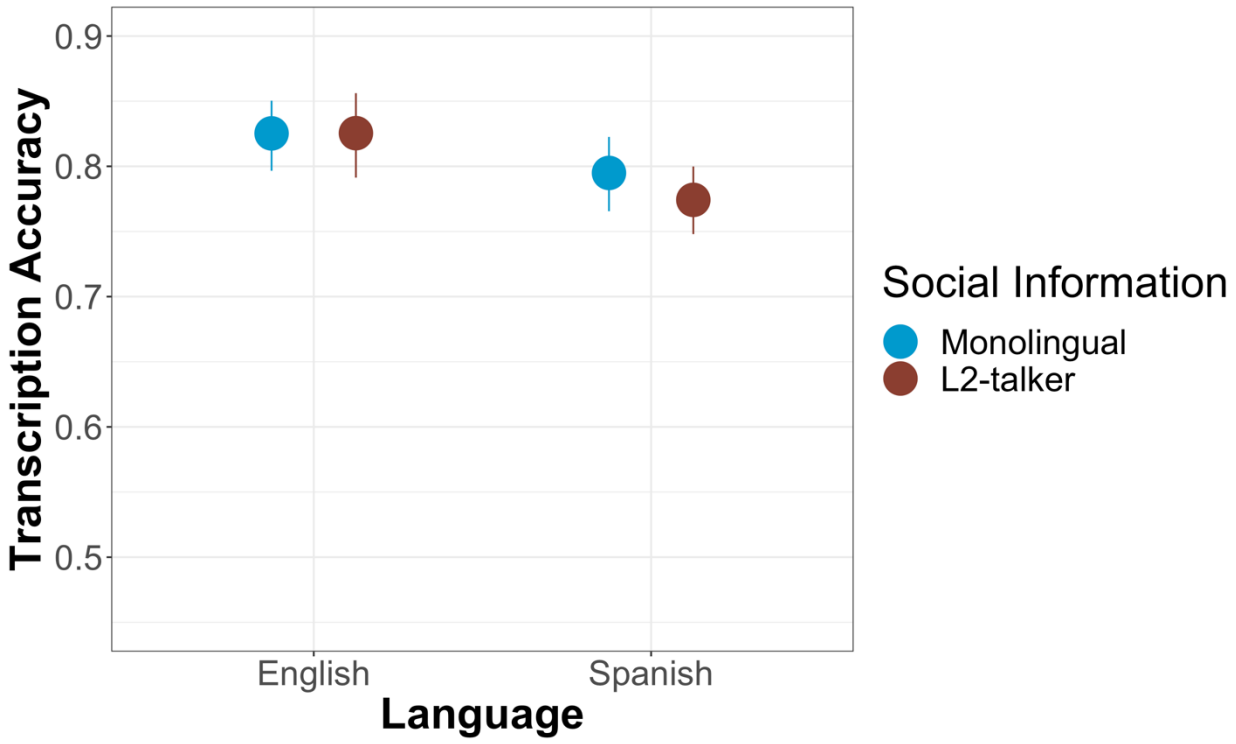


Table 2.4: Results for logistic mixed effects model for accuracy of word transcription for talker group 1

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
English versus Spanish	-0.63	0.15	-4.32	< 0.001***
Monolingual versus L2-talkers	0.006	0.03	0.19	0.85
English versus Spanish X Monolingual versus L2-talkers	-0.18	0.06	-2.82	<0.01**

This analysis was then repeated for the second set of talkers. As shown in Figure 2.5 and Table 2.5, results showed that listeners more accurately transcribed English sentences than Spanish sentences (β = -0.81, *SE* β = 0.18, χ^2 (1)= -4.61, p < 0.001). There was no difference in their accuracy when told that a talk was a monolingual versus an L2-talker (β = -0.04, *SE* β =

0.02, χ^2 (1)= -1.72, p > 0.05). There was no significant interaction in this model (χ^2(1) = -1.37, p > 0.05; see Table 2.5).

Figure 2.5: Transcription accuracy in English and Spanish depending on monolingual or L2-talker social information for talker group 2. The x-axis represents language, while the y-axis represents the average by word accuracy in transcription. (wings show bootstrapped 95% confidence intervals)

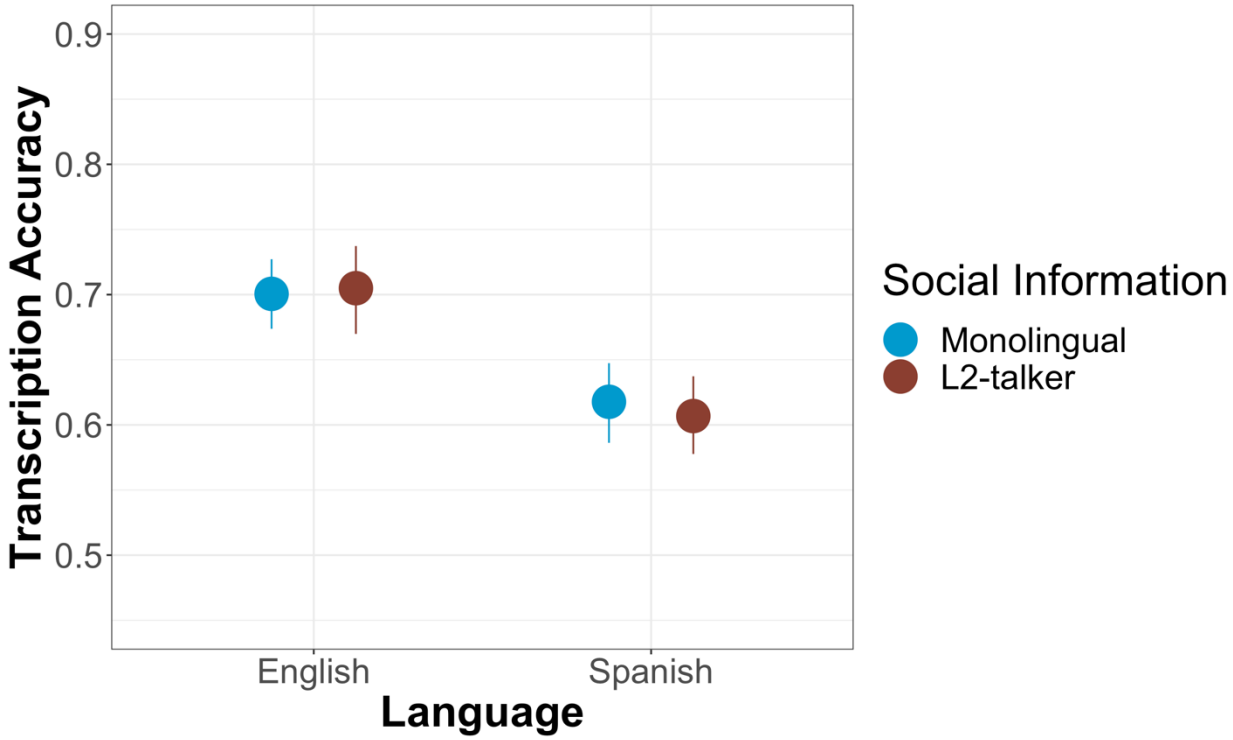


Table 2.5: Results for logistic mixed effects model for accuracy of word transcription for talker group 2

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
English versus Spanish	-0.81	0.18	-4.61	< 0.001***
Monolingual versus L2-talker	-0.04	0.02	-1.72	0.09
English versus Spanish X Monolingual versus L2-talkers	-0.06	0.05	-1.37	0.17

This analysis was again repeated for all talkers. The only difference is that this logistic mixed-effects model has two sets of correlated random effects factors: (1) by participant, with a

random intercept and language and social information as a random slope, and (2) by item, with a random intercept, and language and social information as a random slope. Within each set, random effects were correlated.

As shown in Table 2.6, results showed that listeners more accurately transcribed English sentences than Spanish sentences (β = -0.76, *SE* β = 0.13, χ^2 (1)= -5.71, p < 0.001). There was no difference in their accuracy when told that a talk was a monolingual versus an L2-talker (β = -0.02, *SE* β = 0.07, χ^2 (1)= -0.3, p > 0.05). There was no significant interaction in this model (χ^2(1) = -0.68, p > 0.05; see Table 2.6).

Table 2.6: Results for logistic mixed effects model for accuracy of word transcription for all talkers

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
English versus Spanish	-0.76	0.13	-5.71	< 0.001***
Monolingual versus L2-talker	-0.02	0.07	-0.3	0.77
English versus Spanish X Monolingual versus L2-talker	-0.08	0.12	-0.68	0.5

Overall, the results show a clear dominance effect; Mexican-American Spanish heritage bilinguals perform better in transcribing speech in noise when hearing English than Spanish, replicating previous work (Blasingame and Bradlow 2020). However, although there was evidence of better performance of monolingual social manipulation in Spanish for talker group 1, this effect was not replicated in talk group 2 nor in the all talker model. Additionally, these results do not replicate previous work's findings of social information manipulation (e.g., Vaughn, 2019). At minimum, this suggest that social information effects are not reliably observed across all talkers and listeners.

Study 1 monolingual

In order to better understand why the effect of social manipulation found in talker group 1 and talker group 2 did not replicate previous results, we decided to run the English block of talker group 2 with English monolinguals (as in Vaughn, 2019). The results of this study would give us a better understanding as to whether the lack of social manipulation effects are due to the listener population (i.e., heritage speaker vs monolingual) or due to the differences in the voices between this study and Vaughn (2019). Some differences include: the voices in this study are perceived as being native accented English and the manipulation in our study is being conducted within listeners instead of between listeners. If the findings show an effect of social information manipulation, it would suggest that the monolingual listeners perceive the heritage talkers differently than heritage listeners. However, if a lack of social information manipulation effect is found, it would suggest that this manipulation is sensitive to other differences between the studies (e.g., specific paragraph primes, difference voices used in each study,).

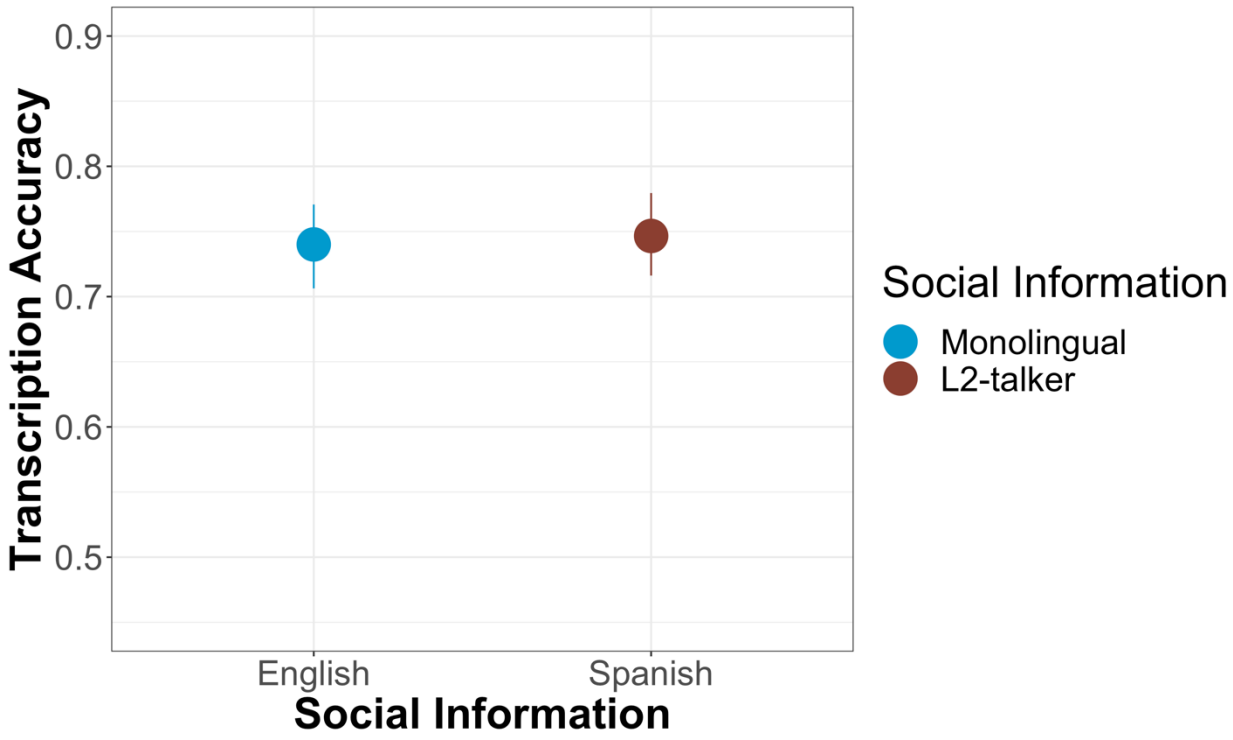
Fifty-six monolingual American English participants were recruited on Prolific (www.prolific.co) to participate in this study. The same 8 English lists and stimuli used in talker group 2 were used in this study. After completing the experimental block, participants completed a short language background questionnaire asking them identify what languages they speak, what languages they have used in different locations they've lived, and their primary language of education. Twenty-seven participants stated that they only knew English. The remaining 29 stated that they had learned one to five of the following languages in school or by using language learning software: Spanish (24), French (11), German (4), Japanese (4), Italian (2), American Sign Language (1), Korean (1), Mandarin (1), and/or Portuguese (1). They had all learned it for a

period of 0-22 years (average 4), with age of acquisitions between 7- 47 (average 17). Critically, all participants claimed not to actively use another language in their daily lives. Their primary language of education was English, and all participants had only lived in the United States. These participants appear to be functionally monolingual English speakers.

A logistic mixed-effects model that examined by-word accuracy depending on social information (monolingual versus L2-talker). All factors were contrast-coded. There were two sets of correlated random effects factors: (1) by participant, with a random intercept and social information as a random slope, and (2) by item, with a random intercept, and social information as a random slope. Within each set, random effects were correlated.

Results show that there is no effect of monolingual versus L2-talker social information ($\beta = 0.15$, β *SE* = 0.14, χ^2 (1)= 1.11, $p > 0.05$), therefore participants were not more accurate in their transcriptions when told a talker was a monolingual speaker of English versus an L2-talker of English.

Figure 2.6: Transcription accuracy in English depending on monolingual or L2-talker social information for Study 1B. The x-axis represents social information, while the y-axis represents the average by word accuracy in transcription. (wings show bootstrapped 95% confidence intervals)



Bilingualism index and accuracy

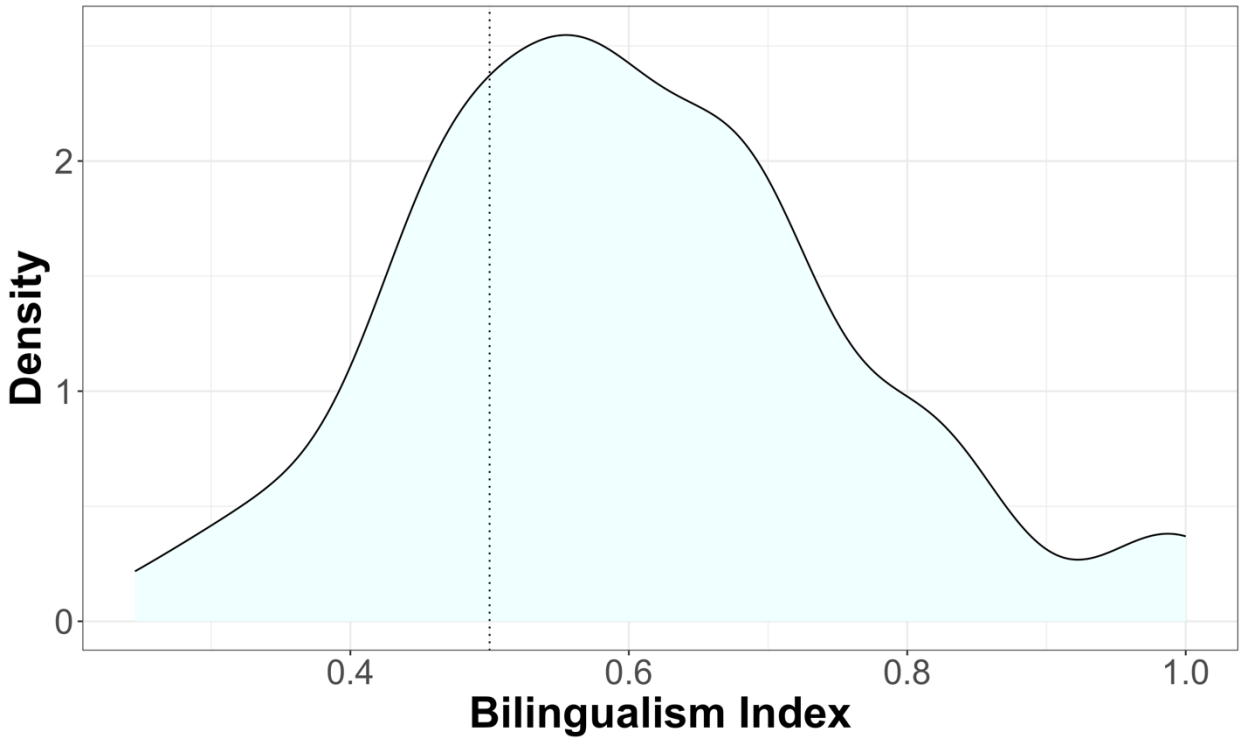
For this, as well as the rest of the individual difference models, the data sets from talker group 1 and talker group 2 were merged. The increased statistical power of this analysis will help detection of subtle differences between listeners.

In the previous analysis, all participants are categorized as English-dominant bilinguals. However, it does not provide a gradient view of the variation of language dominance across participants. The bilingual index (Gollan et al., 2012) can provide an objective and graded view of language dominance, which was important to better understand if the variability of language proficiency could affect sentence transcription. The bilingual index was calculated by dividing

the non-dominant language's MINT score with the dominant language's MINT score (i.e., Spanish divided by English; Gollan et al, 2012). A score closer to 1 indicates more balanced levels of proficiency, while a score closer to 0 indicates much higher levels of proficiency for the dominant than non-dominant language.

A density plot of bilingualism index was made to better understand the variation of it within this participant group. As seen in figure 2.7, the listeners in this study had indices ranging from 0.25 to 1, with a slight skewed towards smaller values. This indicates that participants are English dominant, but still have high proficiency in Spanish.

Figure 2.7: Density plot of bilingualism index, showing the overall distribution of bilingualism index for participants. Dotted vertical line shows the point at which Spanish proficiency is ½ that of English



This score was then used in a logistic mixed-effects model that examined by-word accuracy depending on language (English versus Spanish), social information (monolingual versus L2-talker), and language proficiency (bilingual index). All factors were contrast-coded. There were two sets of correlated random effects factors: (1) by participant, with a random intercept and language and social information as random slopes, and (2) by item, with a random intercept, and language, social information, and language proficiency as random slopes. Within each set, random effects were uncorrelated.

Results showed a main effect of language (β = -1.39, *SE* β = 0.29, χ^2 (1)= -4.71, p < 0.001), indicating better performance in English than Spanish. There was an interaction between language and social information (β = 1.33, *SE* β = 0.46, χ^2 (1)= 2.89, p < 0.01). Follow up

regressions conducted on English and Spanish subsets of the data show a (non-significant) trend of higher accuracy for monolingual social information in Spanish (β = -0.23, *SE* β = 0.35, χ^2 (1)= -0.66, p = 0.51), but not in English (β = 0.12, *SE* β = 0.38, χ^2 (1)= 0.31, p = 0.75). This shows an effect of social information in Spanish, but not English. There was also an interaction language and bilingualism index (β = 1.33, *SE* β = 0.46, χ^2 (1)= 2.89, p < 0.01). Follow up regressions conducted on English and Spanish subsets of the data show a (non-significant) trend of higher accuracy based on a bilingualism index in Spanish (β = 1.24, *SE* β = 0.69, χ^2 (1)= 1.81, p = 0.07). This is not found in English (β = -0.77, *SE* β = 0.66, χ^2 (1)= -1.17, p = 0.24). This suggest that participants with higher Spanish proficiency perform better in Spanish, but variation in proficiency does not affect accuracy in English. There were no other main effects or interactions found in the model (χ^2(1)s< 1.64, p > 0.102; see Table 2.7).

Figure 2.8: Transcription accuracy in English and Spanish blocks by bilingualism index. The x-axis represents language proficiency, the y-axis represents the average by word accuracy in transcription, and blue represents monolingual social information while brown represents L2-talker social information

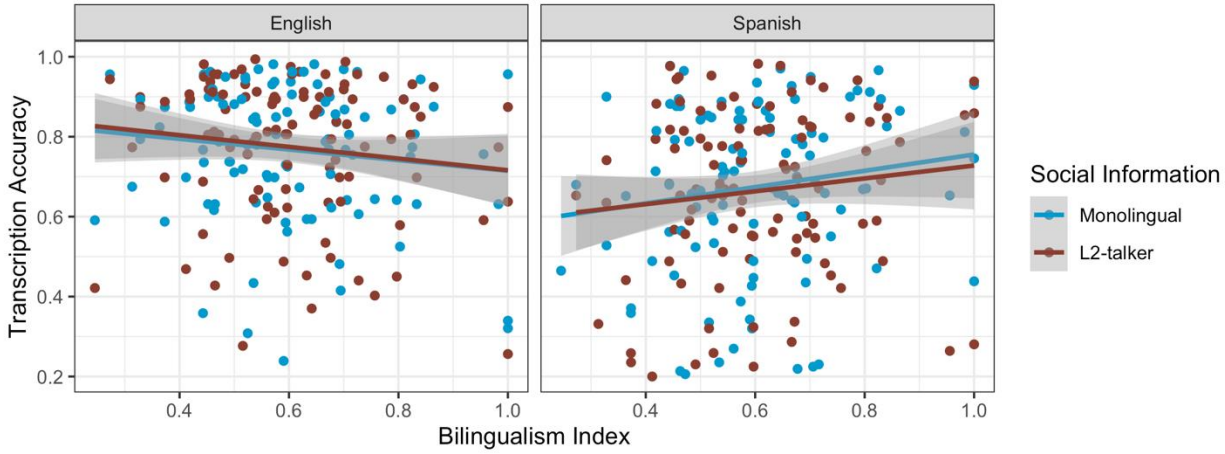


Table 2.7: Results for logistic mixed effects model for accuracy of word transcription and bilingualism index

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
English versus Spanish	-1.97	0.32	-6.06	< 0.001***
Monolingual versus L2-talker	-0.01	0.28	-0.04	0.97
Bilingualism Index	0.21	0.60	0.34	0.73
English versus Spanish X Monolingual versus L2-talker	-0.34	0.16	-2.19	<0.05*
English versus Spanish X Bilingualism Index	2.09	0.49	4.21	< 0.001***
Monolingual versus L2-talker X Bilingualism Index	0.04	0.44	0.09	0.92
English versus Spanish X Monolingual versus L2-talker X Bilingualism Index	0.37	0.25	1.48	0.14

Overall, the results show that there is better performance for the monolingual versus L2-talker social manipulation specifically in the Spanish block; this effect emerges when differences in language experience are taken into account in the regression. Additionally, there is evidence that participants who are closer to being balanced bilinguals perform better in the Spanish block than participants who are more English dominant. There are no other effects of bilingualism index.

Social network and accuracy

Social network size has been found to affect the speech perception of phonemes in monolinguals (Lev-Ari, 2017). Additionally, there's evidence that there's variation in language usage and heritage language maintenance depending on social networks (Castelló et al., 2008; Garcia, 2011; Hulsen et al., 2006; Stoessel 2002; Tiv et al., 2020). In order to see if there were individual differences in performance in the task based on the social network size of the target language, the data was split into English and Spanish subsets. Then, for each participant in each language, two measures of social network size were calculated: the number of people they spoke to in that language, including those they speak both languages with (English all and Spanish all); people they only spoke English or Spanish to, excluding those they speak both languages with (English only and Spanish only). The total number of people they spoke both languages with (both) was also calculated.

Two density plots of participants' English all and Spanish all languages social network was made to better understand the variation of it within this participant group. As seen in figure 2.9, the English social network density plot peaks at around 20 individuals in the social network, with a range of 0-85. As seen in figure 2.10, the Spanish social network density plot peaks at around 10 individuals in the social network, with a range of 0-55. Overall, the results of these plots show these participants have larger social networks in English than Spanish.

Figure 2.9: Density plot of English all social network, showing the overall distribution of English social network for participants

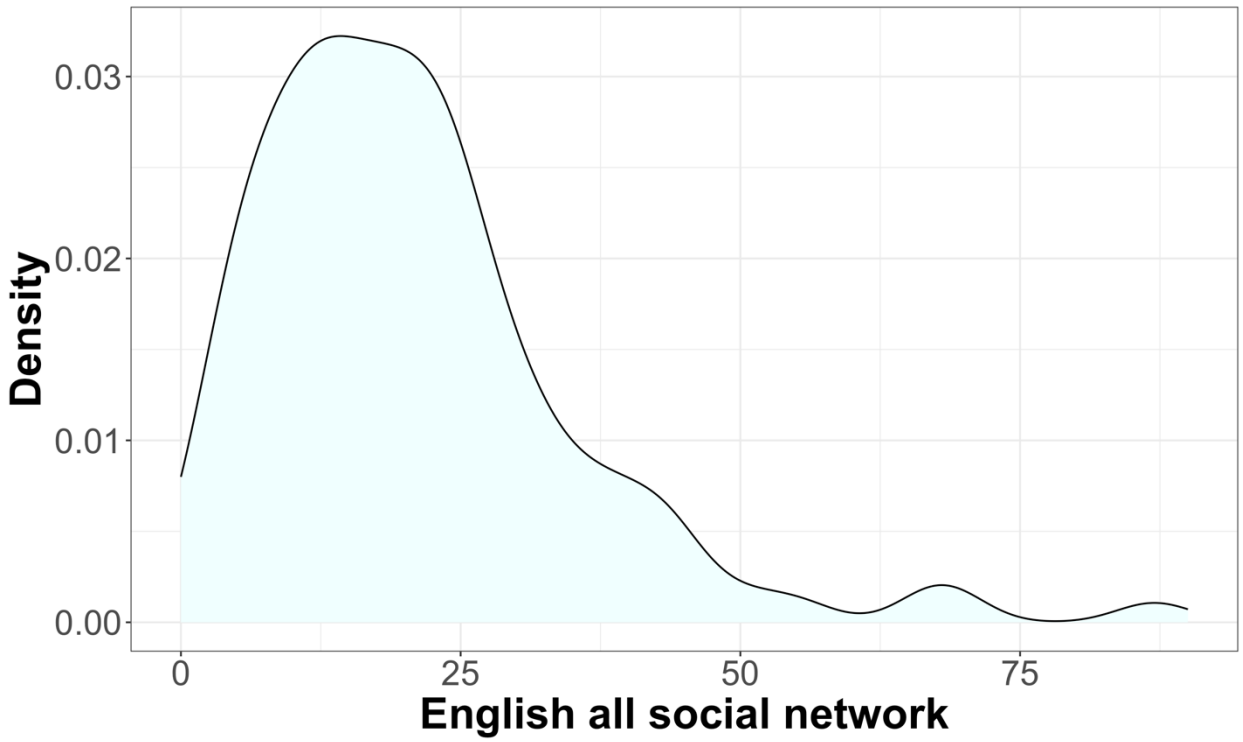
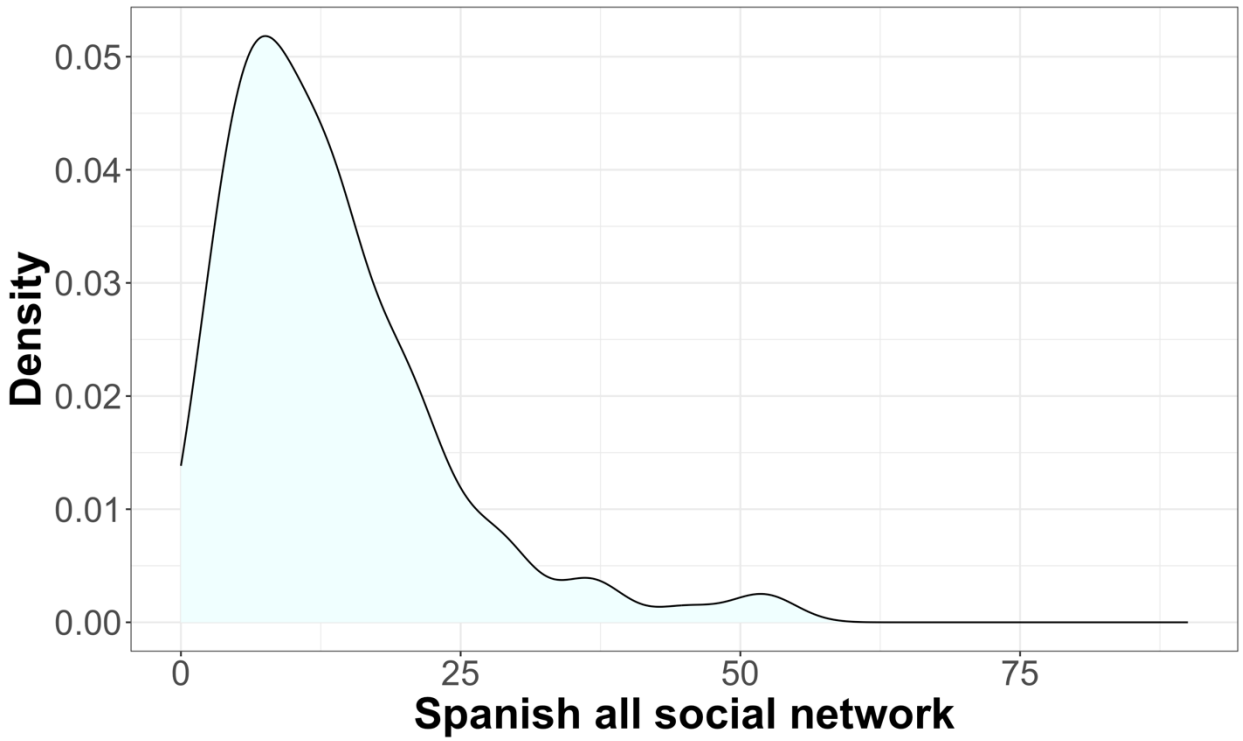


Figure 2.10: Density plot of Spanish all social network, showing the overall distribution of Spanish social network for participants



Below, a series of logistic mixed-effects models examine the effects of English all, Spanish all, English only and both, and Spanish only and both. None of these models show significant effects, suggesting that there is no effect of social network size on performance.

A logistic mixed-effects model that examined by-word accuracy of the English data depending on social information (monolingual versus L2-talker) and centered social network size (English all). All factors were contrast-coded. There were two sets of uncorrelated random effects factors: (1) by participant, with a random intercept and social information and centered social network size as random slopes, and (2) by item, with a random intercept and social information and centered social network size as random slopes. Within each set, random effects were uncorrelated.

Results showed no significant effect of English all social network on accuracy in English transcriptions ($\chi^2(1)$s < 1.68, p > 0.09; see Table 2.8).

Figure 2.11: Transcription accuracy in English block by English social network for Monolingual and L2-talker social information for Study 1. The x-axis represents English social network, while the y-axis represents the average by word accuracy in transcription

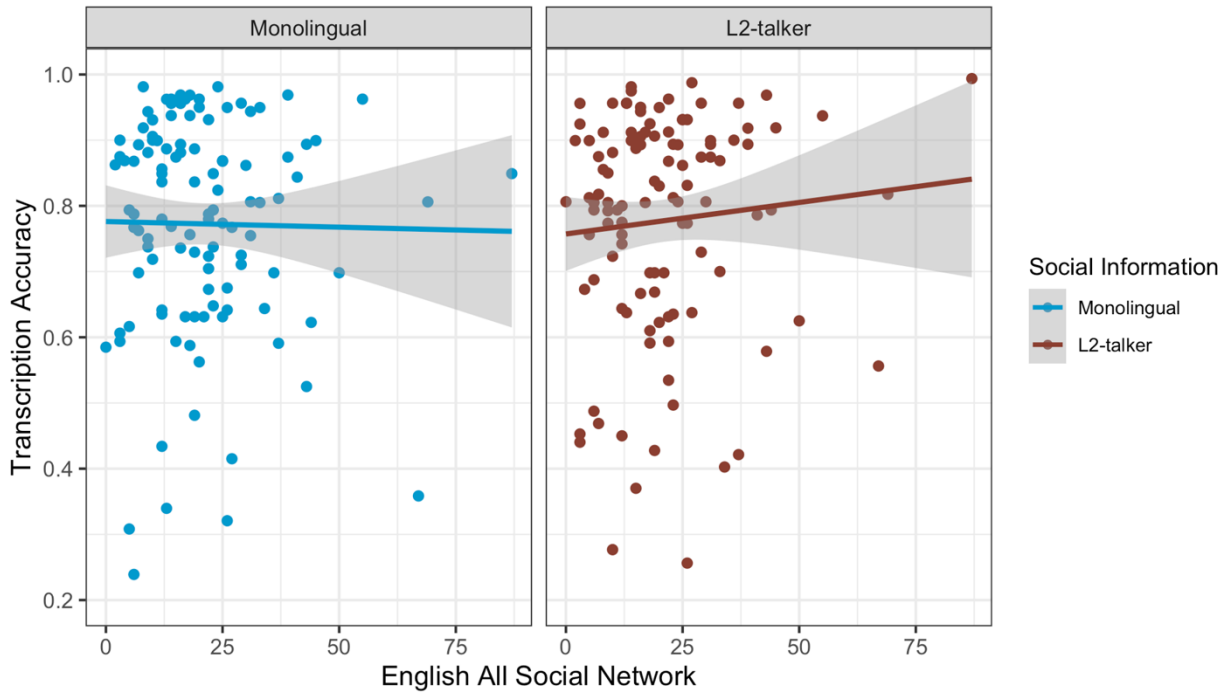


Table 2.8: Results for logistic mixed effects model for accuracy of word transcription in English and English all social network size

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
Monolingual versus L2-talker	0.03	0.09	0.32	0.75
English all social network size	0.004	0.008	0.58	0.56
Monolingual versus L2-talkerX English all social network size	0.01	0.007	1.68	0.09

A logistic mixed-effects model that examined by-word accuracy of the Spanish data depending on social information (monolingual versus L2-talker) and centered social network size (Spanish all). All factors were contrast-coded. There were two sets of uncorrelated random

effects factors: (1) by participant, with a random intercept and social information as a random slope (2) by item, with a random intercept and social information and centered social network size as random slopes. Within each set, random effects were uncorrelated. Results show no significant effect of Spanish all social network on accuracy in Spanish transcriptions ($\chi^2(1)$s < 1.84, p > 0.07; see Table 2.9).

Figure 2.12: Transcription accuracy in Spanish block by Spanish social network for Monolingual and L2-talker social information for Study 1. The x-axis represents Spanish social network, while the y-axis represents the average by word accuracy in transcription

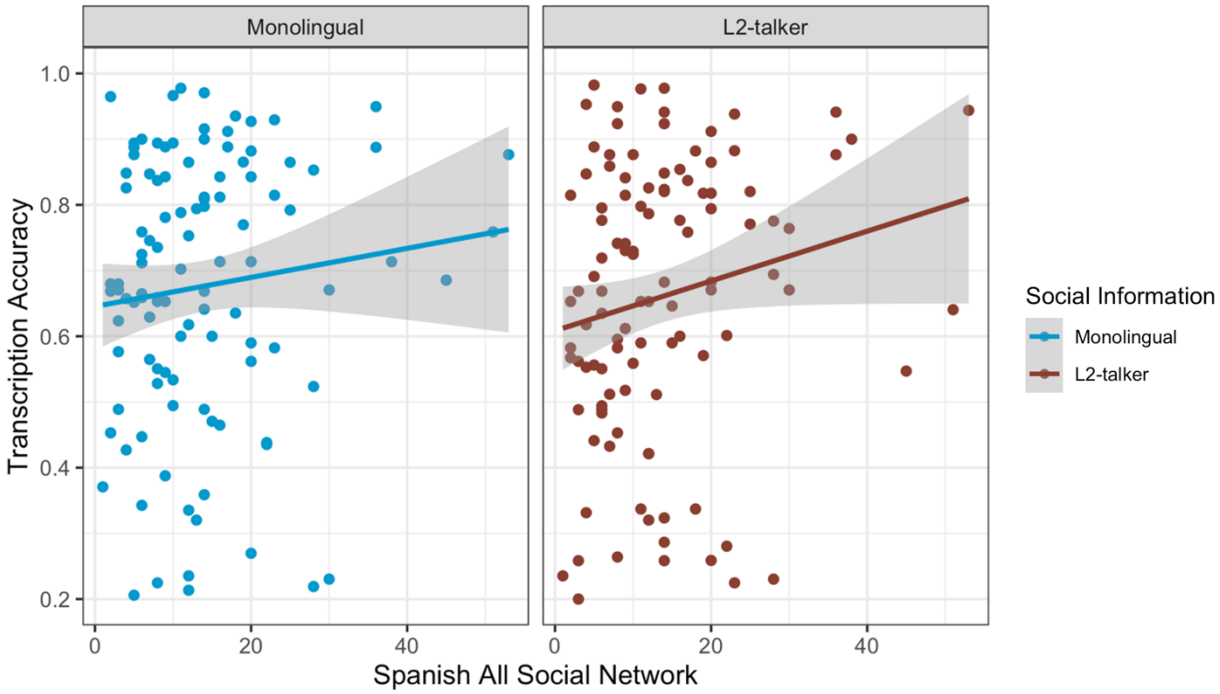


Table 2.9: Results for logistic mixed effects model for accuracy of word transcription in Spanish and Spanish all social network size

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
Monolingual versus L2-talker	-0.07	0.09	-0.75	0.45
Spanish all social network size	0.019	0.01	1.8	0.07
Monolingual versus L2-talker X Spanish all social network size	0.004	0.009	0.4	0.69

Overall, the results of these models suggest that there is no effect of social network size for language nor for social information manipulation.

Likert scale measures of attitudes and accuracy

In order to see if there were individual differences in transcription performance based on the perception of individuals' self-perception in each of their languages, participants responded to questions about their positive and negative perception of their English and Spanish. There were 30 questions in all, which were all responded to on a seven-point Liker scale. 16 were asking questions about positive perceptions (e.g., "I like my accent in English/Spanish") and 14 were about negative perceptions (e.g., "I make a conscious effort to make sure people don't make fun of my accent in English/Spanish"; all questions are in Appendix C as part of the questionnaire). Half in each category were asked about English and the other half about Spanish. The sum of all English positive responses was subtracted from the sum of all Spanish positive responses to get a relative language positivity score. The same was done with all negative responses to calculate a relative language negativity score. For both positive and negative scores, a negative score indicates more positive/negative perceptions for English while a positive score indicates more positive/negative perceptions of Spanish. The study is comparing how participants perform in English versus Spanish, as well showing if there is an effect of language dominance. The language relativity score was created in order to better understand if the variation of feeling more positive or negative towards one language impacts performance in English or Spanish.

Two density plots of participants' relative language positivity scores and relative language negativity scores were made to better understand the variation of it within this

participant group. As seen in figure 2.13, the majority of the distribution for relative language positivity, including the peak, is below 0. Meanwhile, as seen in figure 2.14, the majority of the distribution for relative language negativity, including the peak, is above 0. Given that scores less than zero lean towards stronger feelings for English and scores greater than zero towards Spanish, the difference in these distributions suggests that participants have more positive perceptions of their English and more negative perceptions of their Spanish.

Figure 2.13: Density plot of relative language positivity score, showing the overall distribution of relative language positivity score for participants. Higher scores show more positive perception of Spanish, lower scores show more positive perception of English. The arrows below the x-axis indicate if the sentiment leans more towards English (orange) or Spanish (raspberry)

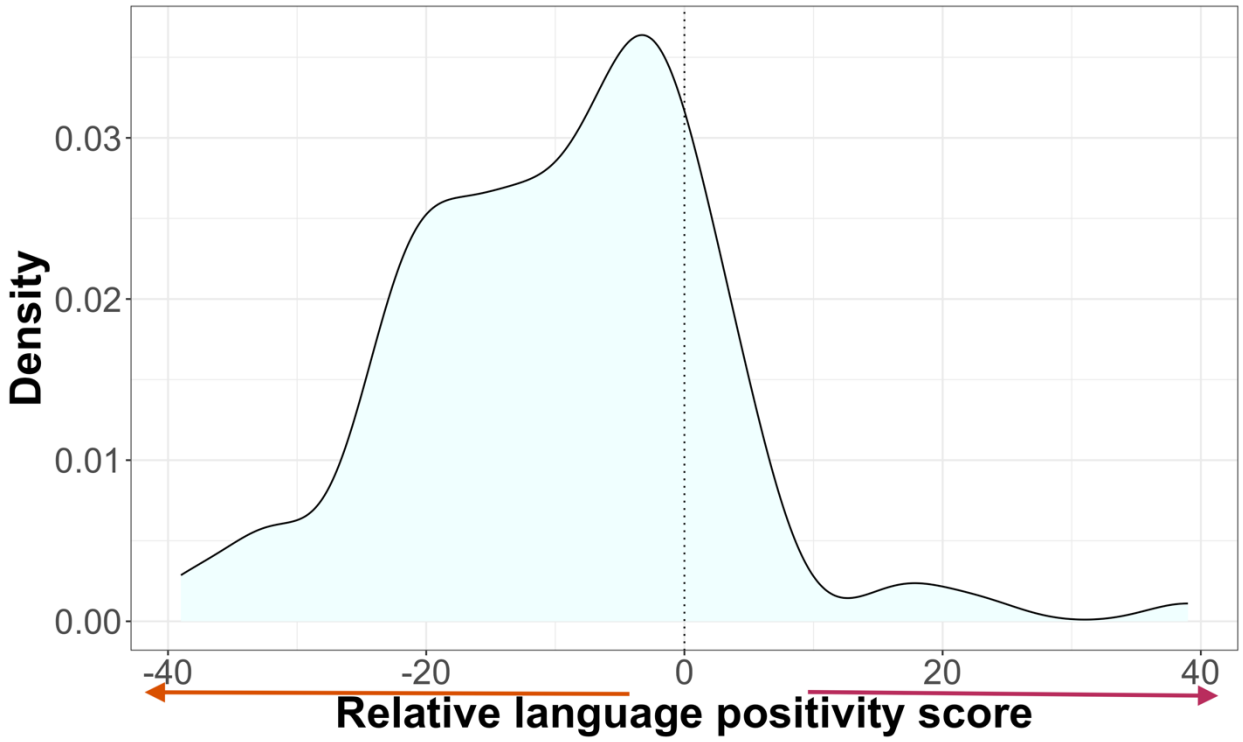
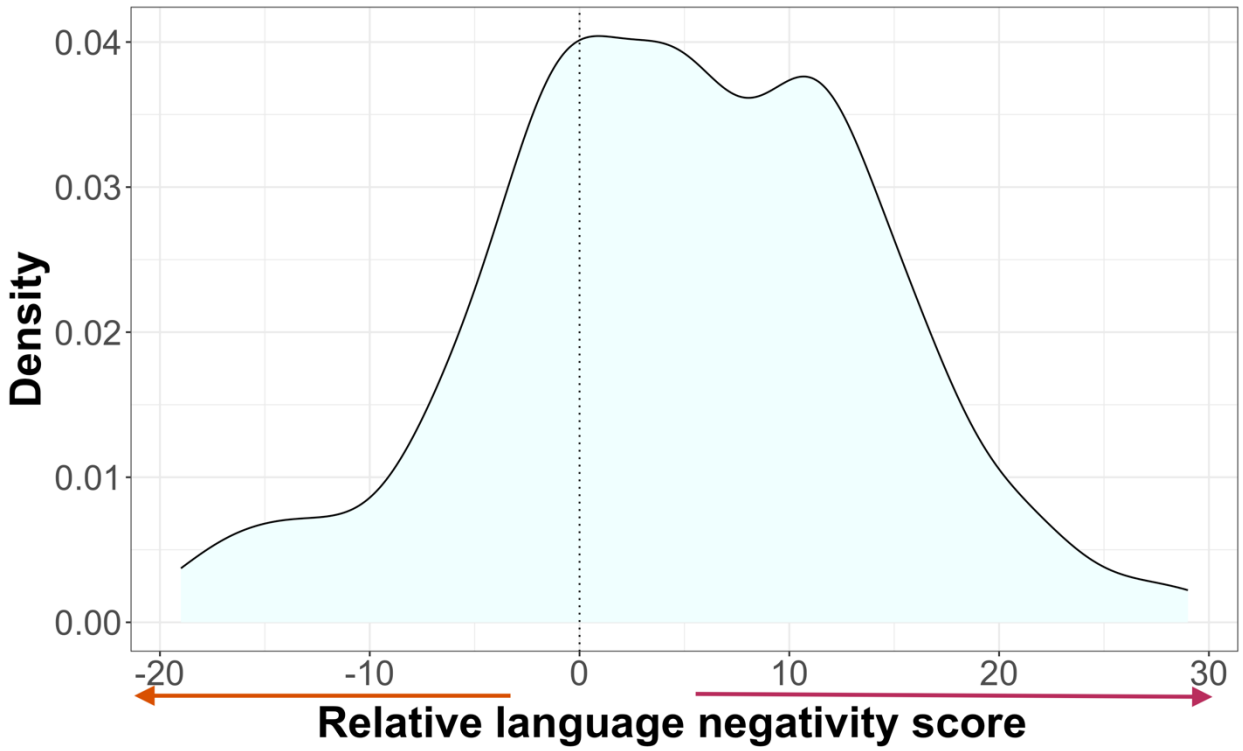


Figure 2.14: Density plot of relative language negativity score, showing the overall distribution of relative language negativity score for participants. Higher scores show more negative perception of Spanish, lower scores show more negative perception of English The arrows below the x-axis indicate if the sentiment leans more towards English (orange) or Spanish (raspberry)



A centered relative language positivity and negativity score was used in a logistic mixed-effects model that examined by-word accuracy depending on language (English versus Spanish), social information (monolingual versus L2-talker), and relative language self-perception (positive and negative score). All categorical factors were contrast-coded. There were two sets of correlated random effects factors: (1) by participant, with a random intercept and language and social information, language, and positive Likert scale as random slopes, and (2) by item, with a random intercept, and language, social information, positive, and negative Likert scale as random slopes. Within each set, random effects were uncorrelated.

Results showed a main effect of language (β = -1.22, *SE* β = 0.39, χ^2 (1)= -3.15, p < 0.01) indicating higher accuracy in English than Spanish blocks. Additionally, there was a main effect of relative language positivity score (β = 0.82, *SE* β = 0.41, χ^2 (1)= 1.99, p < 0.05), indicating that participants with higher relative language positivity score (i.e. more positive perceptions of their Spanish relative to English) perform worse in the task. There was also a main effect of relative language negativity score (β = 0.23, *SE* β = 0.11, χ^2 (1)= 2.11, p < 0.05), indicating that participants with higher relative language negativity score (i.e. more negative perceptions of their Spanish relative to English) perform better in the task.

There was an interaction between language and social manipulation (β = -0.8, *SE* β = 0.29, χ^2 (1)= -3.04, p < 0.01). Follow up regressions conducted on English and Spanish subsets of the data show a (non-significant) trend of higher accuracy in monolingual versus L2-talker guise in Spanish (β = -0.06, *SE* β = 0.09, χ^2 (1)= -0.71, p = 0.48). This is not found in English (β = 0.03, *SE* β = 0.1, χ^2 (1)= 0.31, p = 0.76). There was also an interaction between language and relative language positivity score (β = 0.7, *SE* β = 0.34, χ^2 (1)= 2.03, p < 0.05). Follow up regressions conducted on English and Spanish subsets of the data indicate that, in both languages, a higher relative language positivity score (non-significantly) correlates with lower transcription accuracy. This effect is stronger in English (β = -0.02, *SE* β = 0.009, χ^2 (1)= -1.75, p = 0.08) than Spanish (β = -0.0008, *SE* β = 0.01, χ^2 (1)= -0.08, p = 0.94).

There was also a three-way interaction between language, social manipulation, and relative language negativity score (β = 0.38, *SE* β = 0.09, χ^2 (1)= 4.41, p < 0.001). However, follow up analysis on English versus Spanish, monolingual versus L2-talker, and relative language negativity scores below 0 and above 0 subsets failed to reveal any significant two-way

interactions, making it unclear what factors are driving this interaction. We therefore do not further interpret this effect.

There were no other main effects or interactions found in the model (χ^2s < 1.65, p > 0.1; see Table 2.10).

Figure 2.15: : Transcription accuracy for Study 1 in English and Spanish depending on positive Likert scale score. The x-axis represents the relative language positivity score, while the y-axis represents the average by word accuracy in transcription, blue is for monolingual and brown is for L2-talker social information. The x-axis represents the arrows below the x-axis indicate if the sentiment leans more towards English (orange) or Spanish (raspberry)

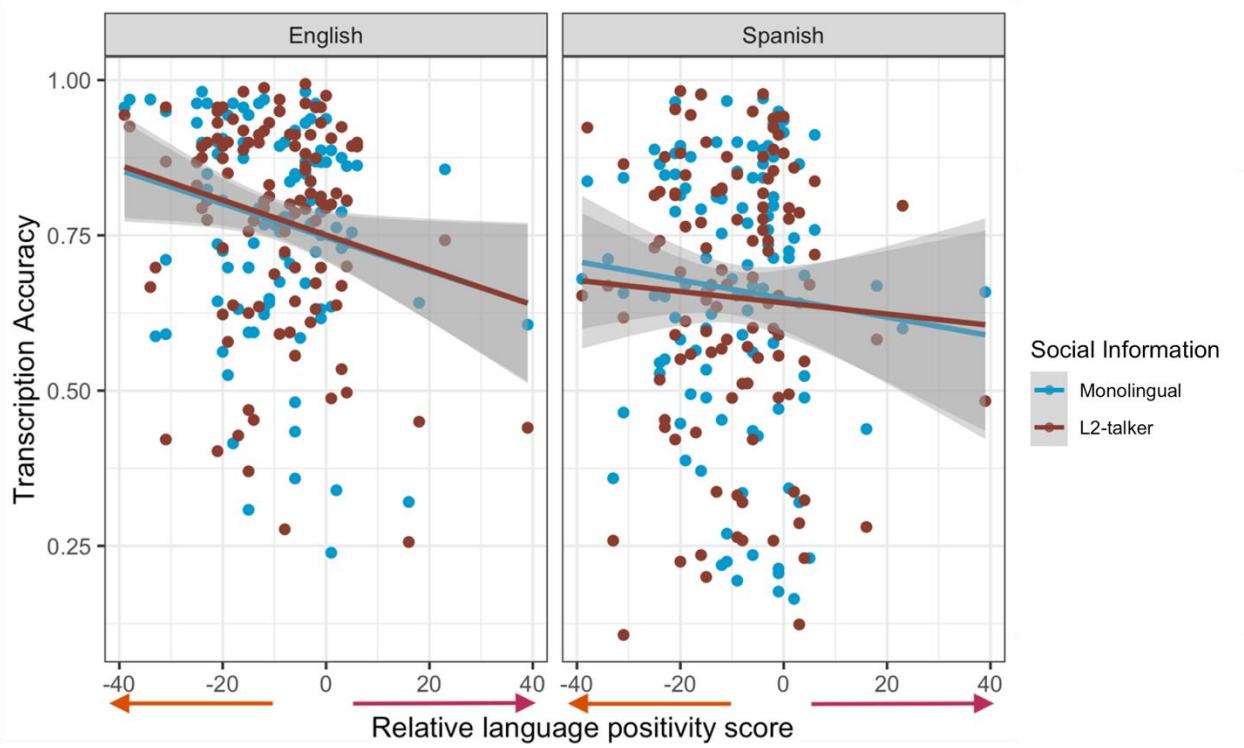


Figure 2.16: Transcription accuracy for Study 1 in English and Spanish depending on negative Likert scale score. The x-axis represents the relative language negativity score, while the y-axis represents the average by word accuracy in transcription, blue is for monolingual while brown is for L2-talker social information. The x-axis represents the negative score, while the y-axis represents the average by-word accuracy in transcription. The arrows below the x-axis indicate if the sentiment leans more towards English (orange) or Spanish (raspberry)

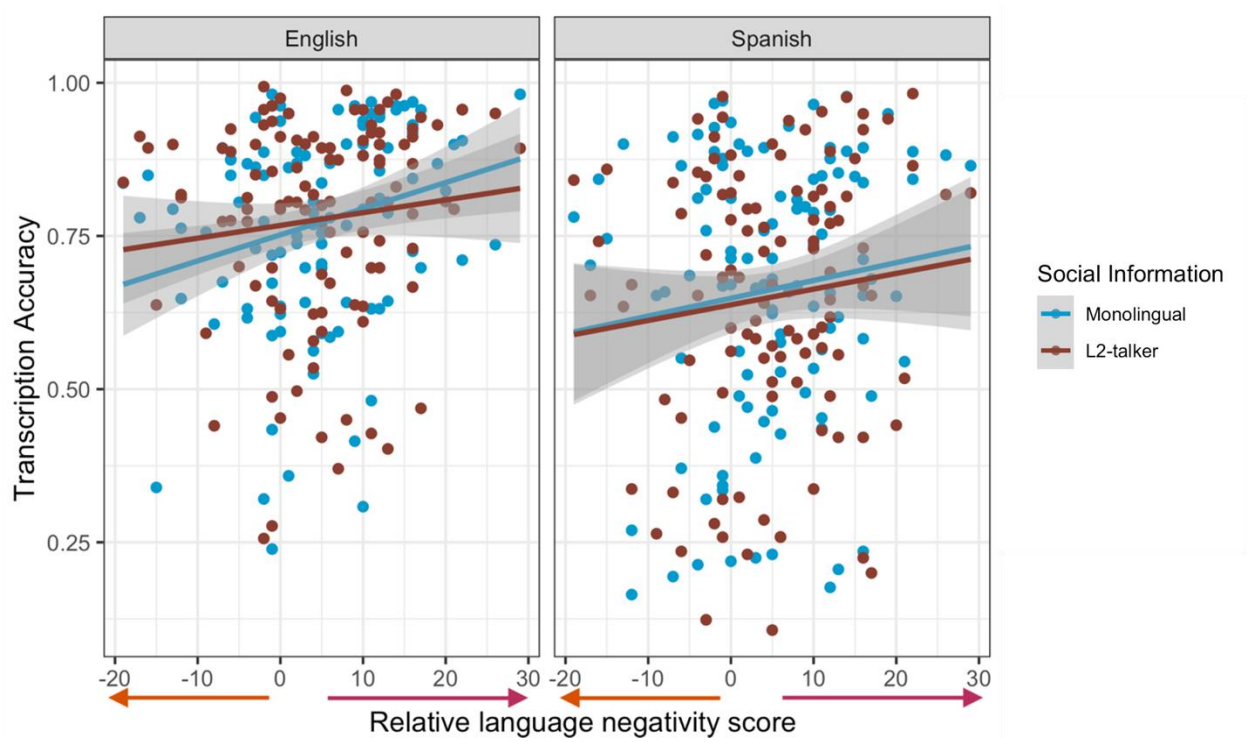


Table 2.10: Results for logistic mixed effects model for accuracy of word transcription and relative language positivity and negativity score for Study 1

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
English versus Spanish	-0.64	0.14	-4.46	< 0.01**
Monolingual versus L2-talker	0.01	0.06	0.17	0.86
Positive Likert scale score	0.82	0.41	1.99	<0.05*
Negative Likert scale score	0.25	0.09	2.57	<0.05*
English versus Spanish X Monolingual versus L2-talker	-0.17	0.07	-2.58	<0.01**
English versus Spanish X Positive Likert scale score	0.68	0.34	2.01	< 0.05*
English versus Spanish X Negative Likert scale score	0.02	0.11	0.21	0.84
Monolingual versus L2-talker X Positive Likert scale score	0.37	0.22	1.69	0.09
Monolingual versus L2-talker X Negative Likert scale score	0.02	0.07	0.27	0.79
English versus Spanish X Monolingual versus L2-talker X Positive Likert scale score	-0.21	0.26	-0.84	0.4
English versus Spanish X Monolingual versus L2-talker X Negative Likert scale score	0.35	0.09	4.02	<0.001***

Overall, there are effects of self-perception of languages for participants. Having higher relative language positivity correlated with lower transcription accuracy, with this effect being stronger in English than Spanish. Meanwhile, having higher relative language negativity correlated with higher accuracy.

Thematic coding and accuracy

For the purposes of Study 1, open ended questions 1, 2, and 4 were further analyzed through a clustering analysis using divisive clustering using the fpc R package (v2.2-10; Henning, 2023). (Note: Question 3, which is about code-switching, was not analyzed for this study since participants did not perceive any code-switching.) This clustering analysis was done to better understand if certain experiences and attitudes captured by the thematic analysis correlate with task performance. Based on whether the question asked about English (i.e.,

question 1), Spanish (i.e., question 2), or both languages (i.e., question 4), transcription accuracy about the language(s) that participants were asked about was compared across clusters. This was done to better understand if the attitudes expressed in the open ended questions affected task performance, or if participants performed similarly regardless of the language attitudes they expressed. Divisive clustering is a hierarchical clustering method that is used to cluster similar data points together. This process starts off by having all data points in one cluster, then separating the data points into the two most dissimilar clusters. From there, the data is further divided into the most dissimilar clusters; here, up to 7 clusters allowed. Then, the optimal number of clusters is determined using two heuristic measures: the elbow (which measures the similarities of points within clusters; clusterings that result in more similar clusters are preferred) and silhouette (which measures how close each point in a cluster is to points in neighboring clusters; clusterings where points in different clusters are far apart should be preferred). Results from both the elbow and silhouette analyses were used to determine the ideal number of clusters. Below the details of each cluster analysis by question.

Open ended question 1

The first open ended question participants answered was "What does English mean to you? What do you think about when you think about English? What does being an English speaker mean to you?" The themes identified in the responses were the following: aesthetic appeal; American; comfortable; default; facilitates communication; global/success/opportunity; pride; racism; struggle/effortful for others; struggle/effortful for themselves; ugly; United Kingdom (UK). Table 2.11 has details on the meaning of each of these themes. Each answer was annotated with one to four of these themes.

Table 2.11: Table explaining the meaning of each thematic code used for open ended question one

Thematic code	**Meaning**
aesthetic appeal	English is a beautiful language
American	English has a tie with the U.S. and/or indicates how American one is
comfortable	The participant feels comfortable speaking English
default	This is the base language used in their community and/or in overall society
facilitates communication	English helps the speaker communicate
global/success/opportunity	English is a global language that facilitates the opportunities one has for jobs, traveling, and/or interacting with people from outside the U.S. It is also a tool for having career and/or academic success
pride	The speaker feels pride in being able to use English
racism	English can be used to instill racism against Mexican-Americans or other immigrants
struggle/effortful for others	English has been hard for the participant's family members or community members to learn and/or use effectively in the larger U.S. society
struggle/effortful for themselves	English was hard for the participant to learn and they second guess how "correctly" they use the language
ugly	English is an ugly language to speak
United Kingdom (UK)	English has a tie with the UK or reminds speakers of the UK

Based on the clustering analysis, four clusters emerged. To gain a sense of what makes participants in the cluster differ, I focused on any themes that at least 50% of participants in each cluster indicated. The first cluster (i.e., global/success/opportunity) had 57 participants; this group indicated that English is a global language that helped them become successful and provided opportunity. The second cluster (i.e., struggle/effortful for others) had 10 participants; this group indicated that English is a language that can be difficult for others to use or learn, English is a global language that helped them become successful and provide opportunity, and (like the first cluster) that English is the default societal language. The third cluster (i.e., default)

had 26 participants; this group indicated that English is the default societal language. The fourth cluster (i.e., comfortable) had 19 individuals that indicated feeling comfortable with English.

In order to see if there was a difference in transcription accuracy in English and social information based on which cluster a participant was in, a logistic mixed-effects model was conducted. The model examined by-word accuracy of the English data depending on social information and cluster (each factor was treatment-coded with cluster four as the reference-level, i.e. cluster four versus cluster one, cluster four versus cluster two, and cluster four versus cluster three). Cluster four (i.e., comfortable) was chosen as the baseline because the majority of participants in the other clusters did not indicate comfortable, when everyone in cluster four did. There were two sets of random effects factors: (1) by participant, with a random intercept and social information as a random slope, and (2) by item, with a random intercept and social information as a random slope. Within each set, random effects were correlated. Results did not show any main effects ($\chi^2(1)$s < 0.08, p > 0.12; see Table 2.10), but did show an interaction between social information and cluster four versus three ($\beta = 0.59$, *SE* $\beta = 0.29$, χ^2 (1)= 2.03, p < 0.05). Follow up regressions conduced on cluster 4 versus cluster 3 subsets of the data showed opposite (non-significant) trends in the two clusters. Cluster 4 shows a trend of higher accuracy when given monolingual social information ($\beta = -0.42$, SE $\beta = 0.28$, χ^2 (1) = −1.49, p = 0.14), while cluster 3 shows the opposite trend ($\beta = 0.11$, SE $\beta = 0.19$, χ^2 (1) = 0.56, p = 0.58). No other interactions were found ($\chi^2(1)$s < 1.71, p > 0.08; see Table 2.12).

Figure 2.17: Clustering of thematic coding for answers for open ended question one. The x-axis represents each thematic coding cluster, while the y-axis represents the coding variable. A color gradient indicates how many participants in a cluster indicated a certain coding variable in their response. Light yellow indicated all participants had that coding variable, while black indicates that none had that coding variable.

Figure 2.18: Transcription accuracy in English for Study 1 with social information included. Blue represents monolingual social information while brown represents L2-talker social information. The x-axis represents the thematic coding cluster for open-ended question 1, while the y-axis represents the average by-word accuracy in transcription (wing show bootstrapped 95% confidence intervals)

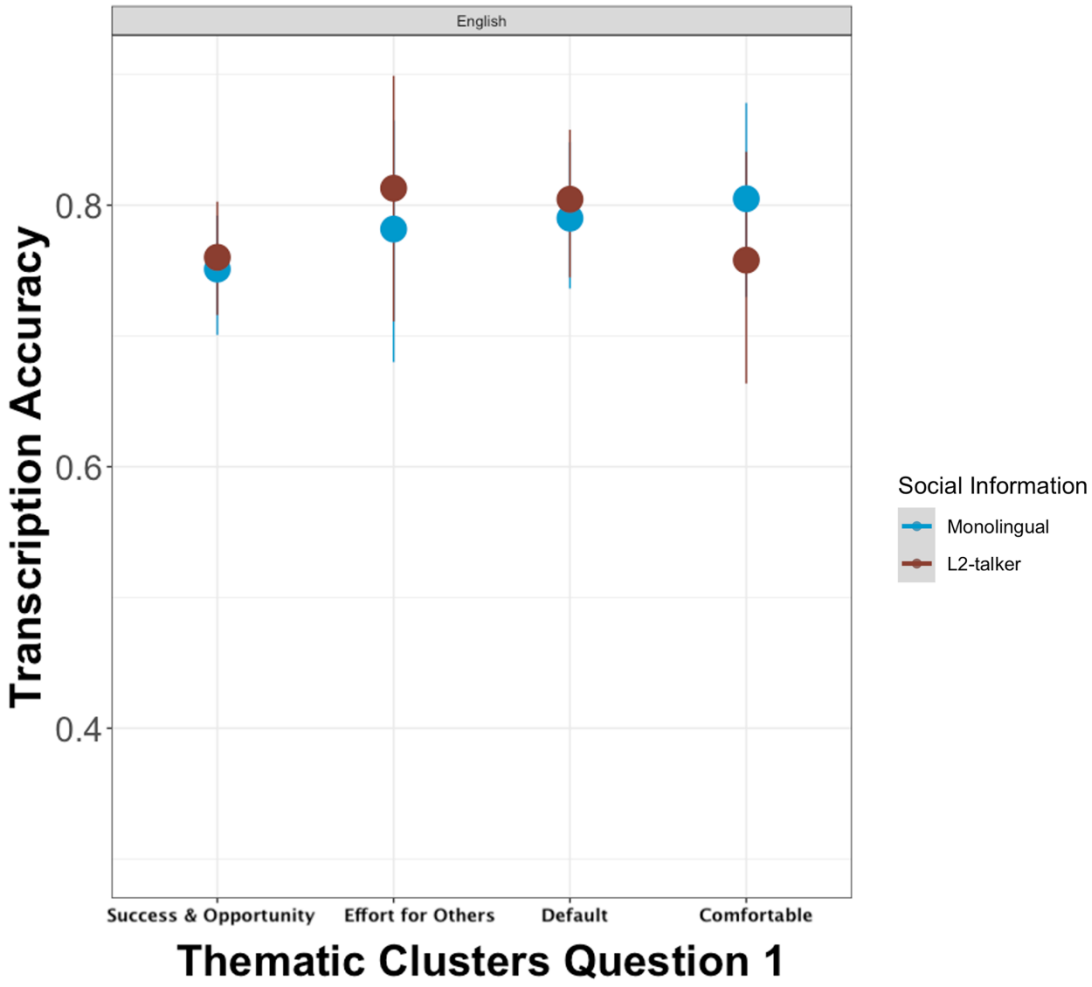


Table 2.12: Results for logistic mixed effects model for accuracy of word transcription and cluster for thematic coding for open-ended question 1 for Study 1

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
Monolingual versus L2-talker	-0.36	0.22	-1.61	0.12
Cluster 4 versus 1	-0.24	0.27	-0.89	0.37
Cluster 4 versus 2	0.03	0.4	0.08	0.94
Cluster 4 versus 3	0.007	0.31	0.02	0.98
Monolingual versus L2-talker X Cluster 4 versus 1	0.35	0.26	1.37	0.17
Monolingual versus L2-talker X Cluster 4 versus 2	0.64	0.38	1.71	0.08
Monolingual versus L2-talker X Cluster 4 versus 3	0.59	0.29	2.03	<0.05*

In order to better understand the interrelations between the two attitude measures taken (i.e. relative language positivity/negativity score and the cluster), the means of the relative language positivity/negativity scores were calculated for each cluster. As shown in Table 2.13, participants in cluster four have a higher relative language negativity score, which (as shown in the preceding analysis) correlates with having higher transcription accuracy when told that a speaker is monolingual.

Table 2.13: Mean relative language positivity/negativity score for each cluster for thematic coding for open-ended question 1 for Study 1

Cluster	**Relative language positivity score**	**Relative language negativity score**
1 – success & opportunity	-9.27	3.27
2 - effortful for others	-10.80	8
3 - default	-7.84	4.61
4 - comfortable	-12	8.11

Overall, the thematic analysis of question one shows that participants' attitudes towards English have an effect on their performance in the English block. Individuals who indicated comfort towards English (i.e., cluster 4) show a trend towards an effect of social information,

with participants having higher accuracy when told a speaker is monolingual. Meanwhile individuals who indicated English being the default societal language (i.e., cluster 3) showed no effect of social information. This difference could have arisen because individuals who are more comfortable with English also have higher relative language negativity scores (i.e., more negative ideas about Spanish). They may have more negative ideas of L2-talker English speakers whose first language is Spanish, an ideology not captured in the relative language negativity score. They may, therefore, have lower accuracy when transcribing talkers who they are told are L2-talker.

Open ended question 2

The second open ended question participants answered was "What does Spanish mean to you? What do you think about when you think about Spanish? What does being a Spanish speaker mean to you?" The themes found in the responses were the following: aesthetic appeal; bridge both cultures; conditional; easy; foreign; global/success/opportunity; heritage/culture; insecure; language loss/important to maintain; Mexico; negative/poor; pride; sentimental/home/family. Table 2.14 has details on the meaning of each of these themes. Each answer was annotated with one to four of these themes.

Table 2.14: Table explaining the meaning of each thematic code used for open ended question two

Thematic code	**Meaning**
aesthetic appeal	Spanish is a beautiful language
bridge both cultures	Spanish is a tool to help bridge between American and Mexican culture
conditional	Spanish is only used in certain settings
easy	The participant feels that Spanish is an easy language to use
foreign	Spanish is referred to as a "foreign" language in a derogatory way
global/success/opportunity	Spanish is a global language that facilitates the opportunities one has for jobs, traveling, and/or interacting with people from outside the U.S. It is also a tool for having career and/or academic success
heritage/culture	Spanish is an important part of the participant's heritage and culture
insecure	The participant feels insecure when using Spanish and/or in the dialect of Spanish they speak
language loss/important to maintain	The participant has lost proficiency in Spanish and/or believes it is important to maintain Spanish proficiency for themselves and transmit it to the younger generation
Mexico	Spanish has a tie to Mexico
negative/poor	Spanish is used by poor people and people who use it are referred to in a negative/derogatory way
pride	The speaker feels pride in being able to use Spanish
sentimental/home/family	Spanish is a language individuals have strong sentimental ties to spoken in the home and by family members

Based on the clustering analysis, four clustering patterns emerged based on themes found in their responses. To gain a sense of what makes participants in the cluster differ, I focused on any themes that at least 50% of participants in each cluster indicated. The first cluster (i.e., culture) has 64 participants that indicated that Spanish was sentimental, spoken in their home, tied to their family and part of their heritage and culture. The second cluster (i.e., global/success/opportunity) has 27 participants that indicated that Spanish was a global language that helped them become successful and provided opportunity. The third cluster (i.e., insecure)

had 13 participants that indicated that Spanish is sentimental, spoken in their home, tied to their family, as well as feeling insecure in their Spanish abilities. The fourth and final cluster (i.e., aesthetic appeal) had eight participants that indicated Spanish having aesthetic appeal, was sentimental, spoken in their home, tied to their family and part of their heritage and culture.

In order to see if there was a difference in transcription accuracy in Spanish and social information based on which cluster a participant was in, a logistic mixed-effects model was conducted. The model examined by-word accuracy of the Spanish data depending on social information and cluster (each factor was treatment-coded with cluster four as the reference-level, i.e.: cluster four versus cluster one, cluster four versus cluster two, and cluster four versus cluster three). Cluster four (i.e., aesthetic appeal) was chosen as the baseline because the participants in the other clusters did not indicate aesthetic appeal, when everyone in cluster four did. There were two sets of random effects factors: (1) by participant, with a random intercept social information as a random slope, and (2) by item, with a random intercept and social information as a random slope. Within each set, random effects were correlated. Results showed a main effect of cluster four versus two ($\beta = -0.75$, SE $\beta = 0.34$, χ^2 (1) = -2.19, $p < 0.05$), indicating that participants in cluster four had significantly higher transcription accuracy than those in cluster two (the cluster with lowest accuracy). There were no other main effects or interactions found in the model ($\chi^2(1)s < 1.64$, $ps > 0.102$; see Table 2.15)

Figure 2.19: Clustering of thematic coding for answers for open ended question two. The x-axis represents each thematic coding cluster, while the y-axis represents the coding variable. A color gradient indicates how many participants in a cluster indicated a certain coding variable in their response. Light yellow indicates all participants had that coding variable, while black indicates that none had that coding variable

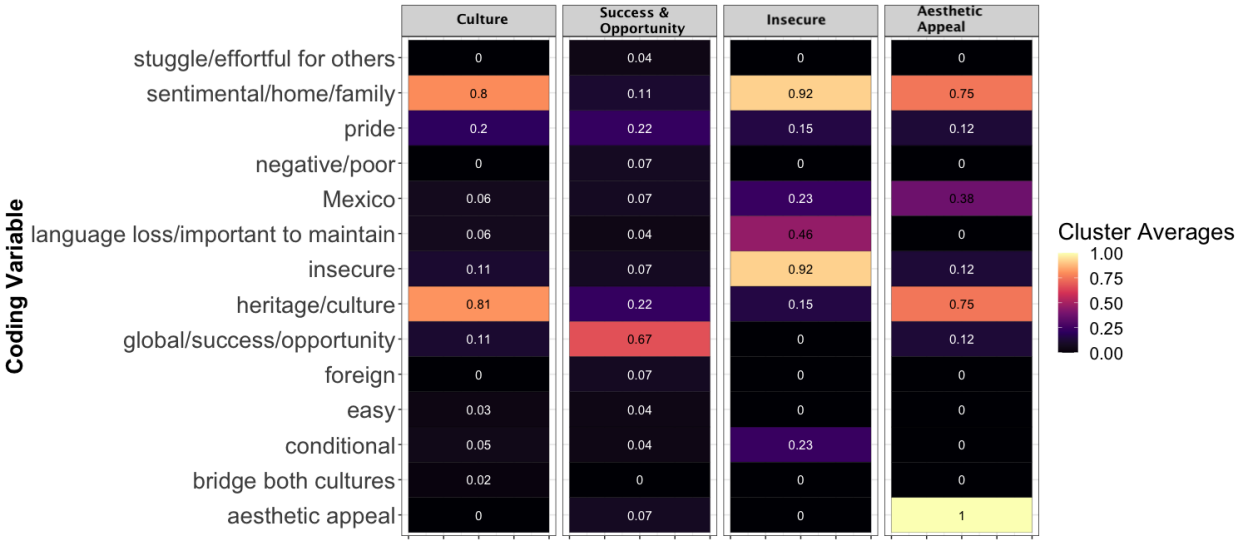


Figure 2.20: Transcription accuracy in Spanish for Study 1. Blue represents monolingual social information while brown represents L2-talker social information. The x-axis represents the thematic coding cluster for open-ended question 2, while the y-axis represents the average by word accuracy in transcription (wings show bootstrapped 95% confidence intervals)

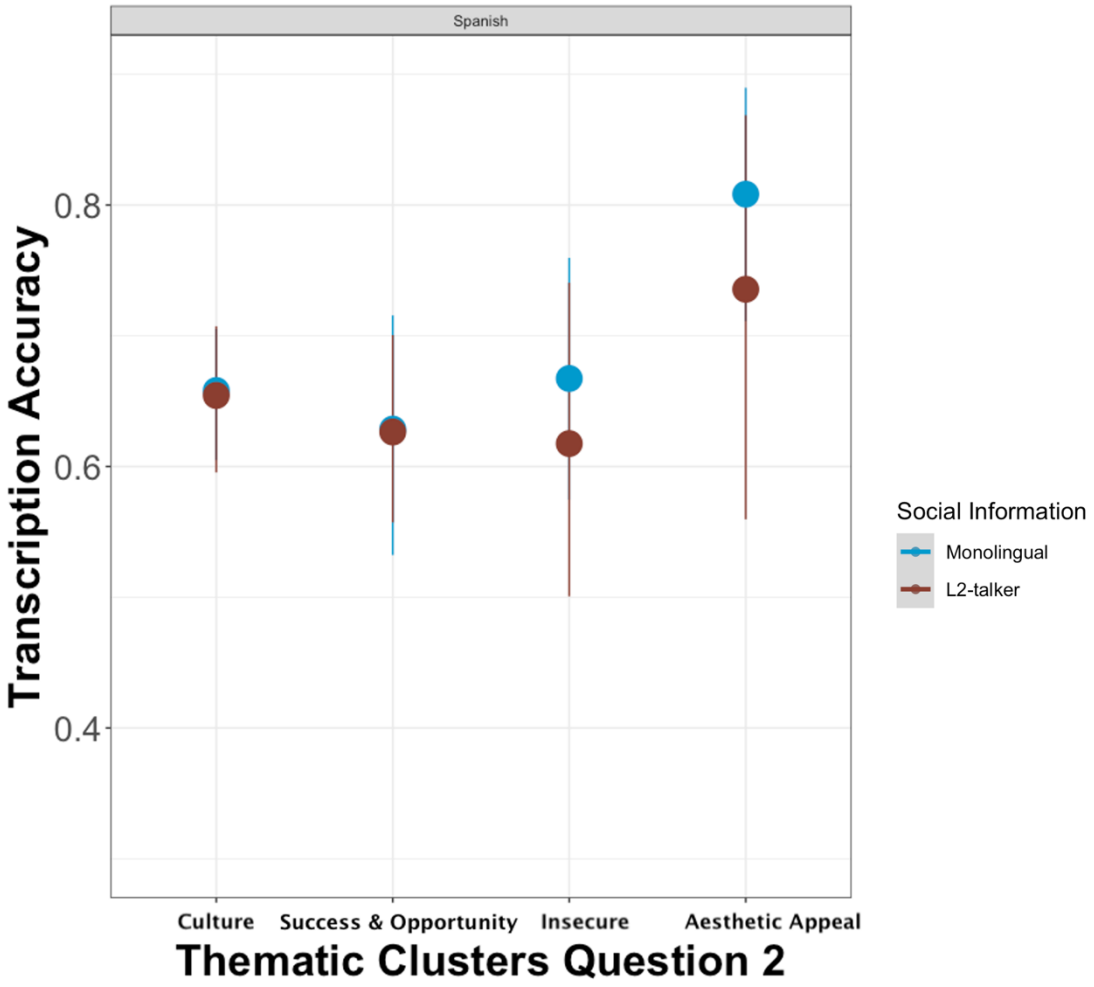


Table 2.15: Results for logistic mixed effects model for accuracy of word transcription and cluster for thematic coding for open-ended question 2 for Study 1

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
Monolingual versus L2-talker	-0.08	0.25	-0.34	0.73
Cluster 4 versus 1	-0.6	0.32	-1.9	0.06
Cluster 4 versus 2	-0.75	0.34	-2.19	<0.05*
Cluster 4 versus 3	-0.55	0.38	-1.44	0.15
Monolingual versus L2-talker X Cluster 4 versus 1	0.11	0.26	0.43	0.67
Monolingual versus L2-talker X Cluster 4 versus 2	0.08	0.28	0.29	0.77
Monolingual versus L2-talker X Cluster 4 versus 3	-0.12	0.31	-0.38	0.7

In order to better understand the interrelations between the two attitude measures taken (i.e. relative language positivity/negativity score and the cluster), the means of the relative language positivity/negativity scores were calculated for each cluster. As shown in Table 2.16, participants in cluster four have a lower relative language positivity score and higher relative language negativity score, which does not correlate with having higher transcription accuracy in Spanish.

Table 2.16: Mean relative language positivity/negativity score for each cluster for thematic coding for open-ended question 2 for Study 1

Cluster	**Relative language positivity score**	**Relative language negativity score**
1 - culture	-10.1	4.76
2 – success & opportunity	-5.48	2.93
3 - insecure	-14.90	7.08
4 - aesthetic appeal	-9.75	8.25

Overall, the thematic analysis of question two shows that participants' attitudes towards Spanish have an effect on their performance in the Spanish block. Individuals who indicate that Spanish has aesthetic appeal perform significantly better than those who indicate Spanish provide success and opportunity. This discrepancy suggests that the cluster analysis is capturing language attitudes and ideologies that the Likert scales did not.

Open ended question 4

The fourth open ended question participants answered was "Do you think that Spanish and/or English are an important part of your culture? Of your identity? Why or why not?" The themes found in the responses were the following: assimilation; both languages are important part of culture; both languages are important part of culture/identity; bridge both cultures;

English is default/societal; English is global/success/opportunity; neither language are an important part of culture/identity; neither language is an important part of identity; only English is important part of culture/identity; only Spanish is important part of culture/identity; preference depends on setting; shame in Spanish ability; Spanish is roots. Each answer was given between one through four codes.

Table 2.17: Table explaining the mean of each thematic code used for open ended question four

Thematic code	**Meaning**
assimilation	Their language usage shows their assimilation to American culture and away from Mexican culture
both languages are important part of culture	The participant thinks both English and Spanish are an important part of their culture
both languages are important part of culture/identity	The participant thinks both English and Spanish are an important part of their culture and identity
bridge both cultures	Their knowledge of both languages is a tool to help bridge between American and Mexican culture
English is default/societal	English is the base language used in their community and/or in overall society
English is global/success/opportunity	English is a global language that facilitates the opportunities one has for jobs, traveling, interacting with people from outside the U.S. It is also a tool for having career and/or academic success
neither language are an important part of culture/identity	The participant does not think language is an important part of their culture and identity
neither language is an important part of identity	The participant does not think language is an important part of their identity
only English is important part of culture/identity	The participant thinks only English is an important part of their culture and identity
only Spanish is important part of culture/identity	The participant thinks only Spanish is an important part of their culture and identity
preference depends on setting	The preference of which language to use depends on the setting
shame in Spanish ability	The participant feels shame in their Spanish proficiency, especially when compared to English
Spanish is roots	Spanish is a language that showcases their cultural roots and heritage

Based on the clustering analysis, four clustering patterns emerged based on the themes found in participants' responses. To gain a sense of what makes participants in the cluster differ, I focused on any themes that at least 50% of participants in each cluster indicated. The first cluster (i.e., both identity) has 86 participants that indicated that Spanish is part of their roots, English is the societal language, as well as both languages being part of their identity. The second cluster (i.e., Spanish only) has 24 participants that indicated that only Spanish is an important part of their culture and identity, as well as Spanish being part of their roots. The third cluster (i.e., neither identity) contained one individual that indicated that neither language was a part of their identity, as well as English being the societal language. The fourth and final cluster (i.e., English only) has one participant that indicated that only English being a part of their identity as well as it being the societal language.

In order to see if there was a difference in transcription accuracy and social information based on which cluster a participant was in, a logistic mixed-effects model was conducted. The model examined by-word accuracy of all the data depending on social information and cluster (only cluster one and two were analyzed; cluster three and four were excluded from analysis for having less than five participants). All factors were contrast-coded. There were two sets of correlated random effects factors: (1) by participant, with a random intercept and language as a random slope and (2) by item, with a random intercept and language as a random slope. Within each set, random effects were correlated. Results showed a main effect of language ($\beta = -0.84$, SE $\beta = 0.14$, χ^2 (1) = -5.79, $p < 0.001$) indicating there was higher transcription accuracy in English than Spanish, replicating an effect found in previous models run with the data in this study. There was an interaction between language and social information manipulation (β = -

0.34, SE β = 0.13, χ^2 (1) = -2.52, p < 0.05). Follow up analysis on English and Spanish subsets of the data show a (non-significant) trend towards higher transcription accuracy when given monolingual versus L2-talker social information (β = -0.2, SE β = 0.12, χ^2 (1) = 0.97, p = 0.33). However, this is not seen in the English subset of the data (β = 0.11, SE β = 0.12, χ^2 (1) = -2.52, p < 0.05). Additionally, there was a three-way interaction between language, social information manipulation, and cluster (β = -0.9, SE β = 0.26, χ^2 (1) = -3.48, p < 0.001). Follow up regressions conducted on cluster one and two subsets of the data found an interaction between language and social information for cluster two (β = -0.75, SE β = 0.24, χ^2 (1) = -3.12, p < 0.01), but not cluster one (β = 0.11, SE β = 0.13, χ^2 (1) = 0.86, p = 0.39). These results suggest that participants in cluster two had higher accuracy in monolingual guises when compared to L2-talkers in the Spanish block, but there was no difference based on social information in either language block in cluster one.

Figure 2.21: Clustering of thematic coding for answers for open ended question four. The x-axis represents each thematic coding cluster, while the y-axis represents the coding variable. A color gradient indicates how many participants in a cluster indicated a certain coding variable in their response. Light yellow indicated all participants had that coding variable, while black indicate that none had that coding variable. Note: Clusters 3 and 4 had only one participant each

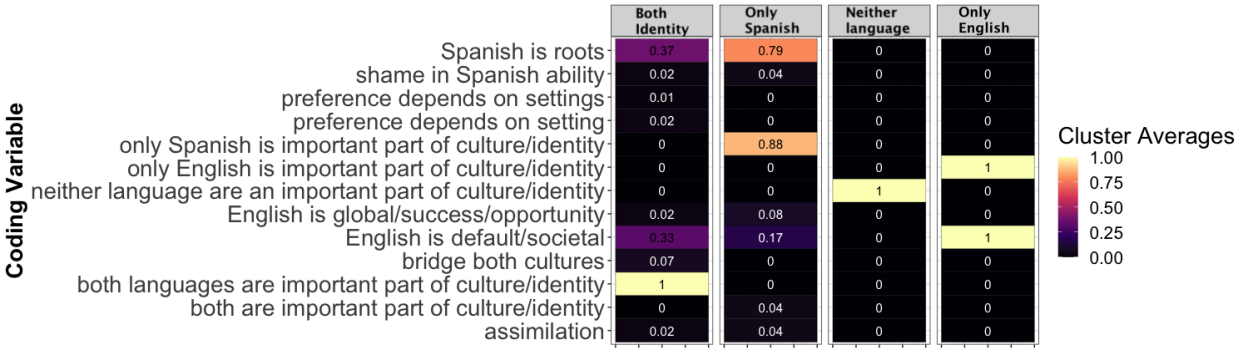


Figure 2.22: Transcription accuracy in English and Spanish for Study 1. To the left is the English results, while to the right is the Spanish results. Blue represents monolingual social information while brown represents L2-talker social information. The x-axis represents the average by word accuracy in transcription (wings show bootstrapped 95% confidence intervals)

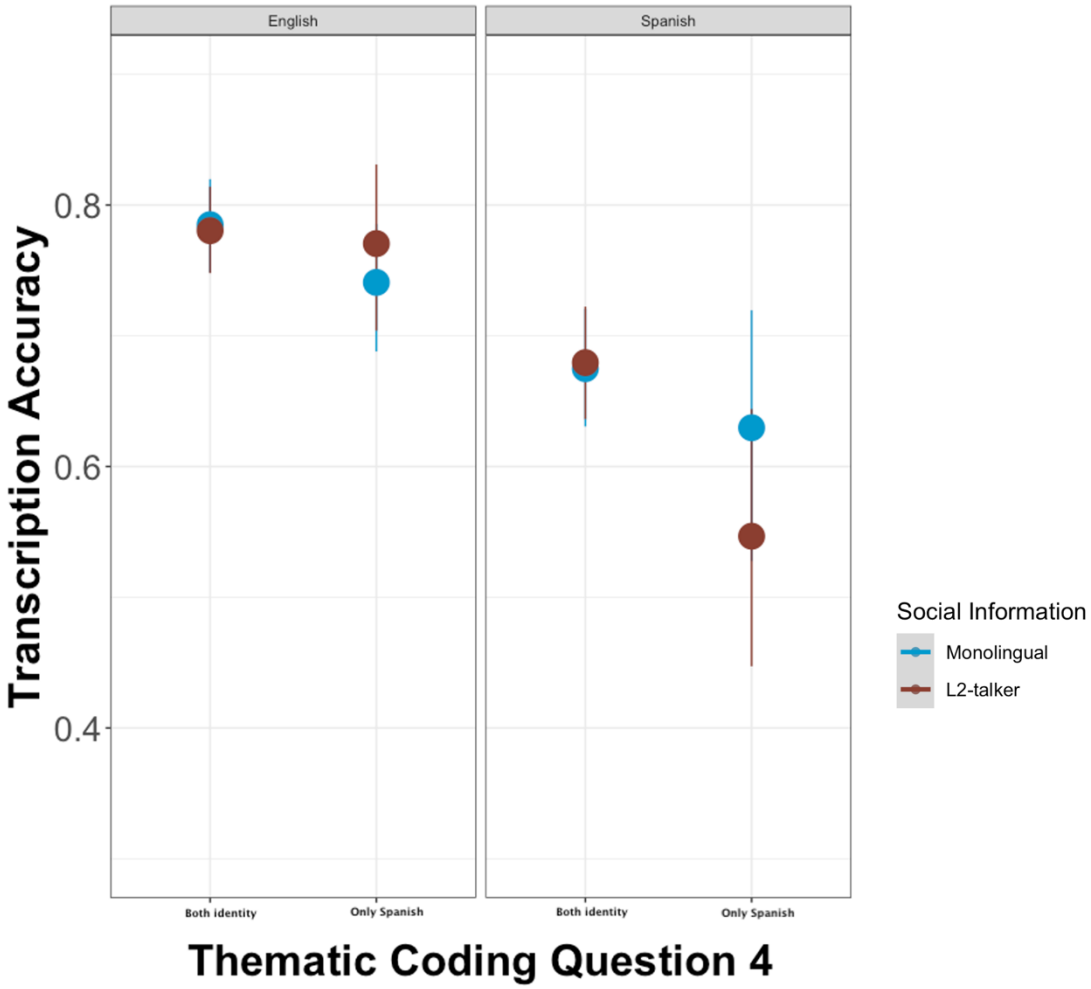


Table 2.18: Results for logistic mixed effects model for accuracy of word transcription and cluster for thematic coding for open-ended question 4 for Study 1

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
English versus Spanish	-0.84	0.14	-5.79	<0.001 ***
Monolingual versus L2-talker	-0.04	0.09	-0.45	0.66
Cluster 1 versus 2	-0.4	0.22	-1.8	0.07
English versus Spanish X Monolingual versus L2-talker	-0.34	0.13	-2.52	<0.05*
English versus Spanish X Cluster 1 versus 2	0.24	0.2	-1.16	0.24
Monolingual versus L2-talker X Cluster 1 versus 2	-0.05	0.17	-0.31	0.76
English versus Spanish X Monolingual versus L2-talker X Cluster 1 versus 2	-0.9	0.26	-3.48	<0.001 ***

In order to better understand the interrelations between the two attitude measures taken (i.e. relative language positivity/negativity score and the cluster), the means of the relative language positivity/negativity scores were calculated for each cluster. The means for each cluster, as shown in Table 2.19, do not show a difference between relative language positivity score, nor for relative language negativity score. This discrepancy suggests that the cluster analysis is capturing language attitudes and ideologies that the Likert scales did not.

Table 2.19: Mean relative language positivity/negativity score for each cluster for thematic coding for open-ended question 4 for Study 1

Cluster	**Relative language positivity score**	**Relative language negativity score**
1 - both identity	-9.23	5.20
2 – Spanish only	-10.60	3.42

Overall, the thematic analysis of question four shows that how participants' language identity affects their performance in the task, with participants who indicate only Spanish as part of their identity showing an effect of social manipulation in the Spanish block, but for

participants who indicate both languages as part of their identity showed no effect of social manipulation.

2.7 Discussion

The current study examined how Mexican-American Spanish heritage bilinguals' experiences and attitudes in English and Spanish affect their sensitivity to perceptual difficulties when speech is associated with more versus less prestigious social information. We found a consistent effect of language, with participants in both talker groups having higher accuracy in their dominant language. This effect varies depending on certain types of experiences (i.e., bilingual index) and attitudes (i.e., relative language positivity score, relative language negativity score, thematic coding). When the data was analyzed without taking individual differences into account, only listeners for talker group 1 (not group 2) showed an interaction between language and social information, with participants having higher accuracy when given monolingual versus L2-talker social information in Spanish. However, the additional information provided by experiences (i.e., bilingual index) and attitudes (i.e., relative language positivity score, relative language negativity score, thematic coding) revealed an interaction of language and social information, as well as interactions between the attitudes (i.e., relative language positivity score, relative language negativity score, thematic coding) and social information. These interactions suggest that the variation heritage listeners have across their language attitudes and experiences affect their speech perception.

Participants in this study had higher accuracy in English than Spanish, replicating language dominance effects found in heritage bilinguals (e.g., Blasingame and Bradlow, 2020). The heritage bilinguals' in this study first language is Spanish and most are sequential bilinguals

(i.e., acquired Spanish before English), therefore they first created their sound system based on Spanish (Flege, 1995). Their acquisition of English in early childhood and eventual dominance in English impacted the structure of their sound system. This suggests that both early input as well as the updating of their sound system throughout their lives has an impact in the perception of both their languages. The increased input of English seems to provide a perceptual benefit when listening to speech in a difficult listening environment. Additionally, variation in language dominance seems to impact perception in Spanish, with participants who are closer to being balanced bilinguals performing significantly better in Spanish than participants who are much more English dominant.

This study showed some effects of the social information manipulation, mostly in Spanish. However, this effect varies depending on the analysis, since the interaction between language and social information appears in some (i.e., talker group one, bilingual index, relative language positivity/negativity score, open ended question 4), but not all statistical models. The inconsistency of this effect replicates findings from other work with Spanish heritage bilinguals (Staggs et al., 2022), which failed to find an effect of social information. Most previous work using social information manipulation that has found effects has used monolingual English listeners (e.g., Vaugh, 2019; Rubin, 1992) and/or a single voice instead of multiple like in this study (e.g., Vaugh, 2019; McGowan, 2015), and that work conducted with heritage bilinguals has not found this effect (Staggs et al., 2022). Our findings suggests that the inconsistent results could be due to failing to account for variation; when differences in language attitudes and experiences were accounted for, social information effects emerged in this study.

Furthermore, it is possible that some listeners did not believe the social information manipulation. For talker group two, a post-test was added where participants were asked to fill out a Likert scale of how native a talker sounded, with 1 being very non-native and 7 being very native. When listeners heard a talker speaking English, the average score for the monolingual social information manipulation was 4.9, while the average score for L2-talker social information was 4.6– a difference of 0.3. In contrast, when hearing the same talkers speak Spanish, the average listener score for the monolingual social information manipulation was 5.8, while the average score for L2-talker social information was 4.4 – a difference of 1.4. However, this difference is also seen when participants are split up following the cluster analysis for open-ended question 4. If believability accounts for the different results, it would be expected that the only Spanish" cluster would show a noticeably larger believability effect. However, the size of the difference is 1.4 across both groups. For listeners who consider both languages part of their identity, when they heard a talker speaking Spanish the average score for monolingual social information was 5.9 and for L2-talker social information was 4.5 – a difference of 1.4. Similarly, for those who consider only Spanish part of their identity, for Spanish the average score for monolingual social information was 6 and for L2-talker social information was 4.6 – a difference of 1.4. The lack of variation in average monolingual versus L2-talker believability suggests that the believably of social information manipulation was not driving this effect.

Relative experience with the two languages may explain why the effect is not found in English. Given that the talkers and listeners were both heritage bilinguals, it's likely that they found the participants probably have higher levels of experience with English and use it more often, meaning that they have more English than Spanish speech input to update their social

categories. Since these participants interact with more talkers in English than Spanish, they have a better sense of between-talker variation in English than Spanish. Therefore, it's likely they can more accurate judge whether a person is a monolingual versus L2-talker in English than Spanish, making them more susceptible to social information manipulation effects in the less frequently encountered language. Because of this, it's possible that the social manipulation effect would be more consistent across languages if the experiment used stimuli from talkers that acquired a language later in life or talkers spoke dialects they are not as familiar (e.g., European Spanish, Australian English) were used. Another possibility would be to increase the difficulty of the task by using semantically anomalous sentences (e.g., The hard heart let the bay); removing semantic information would force participants to focus on the acoustics, allowing the effect to emerge in both languages. It's also possible that the type of social information used (i.e., paragraphs about the speaker) were not strong enough to trigger the effect. Other work has used pictures (e.g., Rubin, 1992), and it's possible that if we had used pictures of stereotypical White and Latino individuals we would have observed the effect more consistently.

We found that heritage bilinguals overall had larger social networks in English than Spanish, replicating previous work that shows a correlation of larger social networks for the dominant language than non-dominant language (Tiv et al., 2020). However, unlike previous work investigating the modulation of social network on speech perception (Lev-Ari, 2017, 2018), there was no effect of social network. One possibility for this result is that there was not enough variation in social network sizes across participants, which would reduce our ability to detect social network effects. It could also be that social network size has a smaller effect on sentence level perception in comparison to perception of smaller stretches of speech. Previous

work has found that having a larger social network can aid in the perception of single words in noise (Lev-Ari, 2018), as well as having more stable phoneme categories that cannot be manipulated (Lev-Ari, 2017). Additionally, it is important to note that previous work focused on monolingual listeners, so there is the possibility that social network effects is harder to detect in bilingual listeners, especially since their social networks are split into two different languages.

A critical result in this work is the effects of attitude on speech perception. Given the cultural tie to Spanish, as well as how Spanish is intertwined with how Latinos are racialized (García Bedolla, 2003; Rosa & Flores, 2016), heritage bilinguals feel they need to speak Spanish and speak it well in order to claim their "Mexicanness". Although heritage bilinguals may feel that they are languageless (Rosa, 2019), or do not feel like they speak "proper" English or Spanish, they are more criticized for speaking Spanish incorrectly. These criticisms are done by fellow Latinos, with derogatory terms such as "pocho", "mocho" or "no sabo kid(s)" being used to denote that, even if the speaker knows Spanish, there are levels of correctness. Typically, earlier generations are the ones that can claim that they speak "proper" Spanish (García Bedolla, 2003). This drive to avoid "improper" Spanish correlates with the analysis of Likert scale assessments of attitudes, with higher relative language negativity score (i.e. more negative attitudes towards Spanish than English) correlating with higher accuracy. Meanwhile, English needs to be spoken well in order to assimilate to the overall American culture as well as have better career opportunities. Use and dominance in English is pushed onto Latinos, which is reflected in bilingual education practices (e.g., Transitional Bilingual Education) that focus on transitioning children from using Spanish to English as quickly as possible (Nieto, 2009; Potowski, 2021). Even when these heritage bilinguals may think they speak a stigmatized variety

of English, like Latino English (Fought, 2003), it is typically a default language (reflected in the participants' responses to open-ended question 1) that, unlike Spanish, they need to function in U.S. society. This correlates with participants having more positive attitudes about their English and more negative attitudes about their Spanish. These varying language attitudes may shape how the languages are being used, which can affect how sound categories are updated, modulating perception of speech. For example, an individual with more negative Spanish attitudes may use Spanish less, causing for their Spanish sound categories to be less robust. Their less robust Spanish categories would lead them to less accurately perceive Spanish, as opposed to their counterpart with more negative English attitudes.

Thematic coding of open ended questions provided additional insight into participant's language attitudes. For this study, three questions were analyzed: one asking about English attitudes, one about Spanish attitudes, and one about which language they consider part of their identity. Most participants indicated English as a default societal language that provided important opportunities, while Spanish is a cultural language that's a part of their roots; both languages are important for their identity and culture, which has been commented on in previous work (García Bedolla, 2003; Rosa, 2019; Urciuoli, 1996). The variation in language attitudes captured by the thematic coding varies from that captured by the Likert scales; in contrast to the Likert data, the attitudes revealed by participants' responses to open-ended questions modulated the effect of social information. Participants who indicated being comfortable in English (question 1, cluster three), indicated Spanish having aesthetic appeal (question two, cluster four), and indicated only Spanish being an important part of their identity (question four, cluster two) had higher accuracy in transcribing talkers they are told are monolingual. Each of these sub-

groups of participants may have higher levels of confidence in their dialect in English for question one and Spanish for questions two and four. They may also be more judgmental and have more negative opinions about L2-talkers, which may lead their biases to affect how they process speech. Among other factors, this effect has been attributed to listeners (inappropriately) relying on prior experiences rather than the acoustic information, and/or listeners devoting less attention to speech when listening to stigmatized accents.

Overall, the analysis of attitudes through Likert scales and thematic coding provides additional evidence that the societal differences between how Spanish and English are used in the Mexican-American community not only shape participants' attitudes, but also the mechanisms used to perceive speech.

2.8 Conclusion

The current study investigated how heritage speakers' language attitudes and experiences affect their auditory perception of different talkers in a speech in noise task. I found that heritage speakers were better at perceiving speech in their dominant language (i.e., English) than their non-dominant language (i.e., Spanish; Blasingame & Bradlow, 2020). Although I did not find an effect of social information manipulation, I found an interaction between language and social information in some, but not all analyses. Additionally, I found that certain types of experiences (as shown by the bilingual index) and attitudes (as shown by relative language positivity/negativity score and thematic coding) modulated the language dominance effect and/or language and social information interaction. These results provide evidence that individual differences within the heritage bilingual population may affect their performance in experimental tasks. It is therefore important for future work to take these individual differences into account in

order to avoid reaching inaccurate conclusions regarding the nature of bilingual language processing.

Chapter 3: The effect of experience and attitudes on the perception of different language settings

3.1: Introduction

Bilinguals have the ability to use their languages in single language contexts (e.g., a Spanish-English bilingual using English) or in mixed language contexts (e.g., a Spanish-English bilingual code-switching; Meuter & Allport, 1999). There is evidence that bilingual listeners have both languages activated at all times, but they are more likely to have both of their languages activated with bilingual talkers than with monolingual talkers, which allows for easier accommodation of language mixing (Kaan et al., 2020). Unfavorable listening conditions not only impact speech within a single language, but also the perception of speech in contexts where multiple languages are used (Kaan et al., 2020; Marian & Spivey, 2003). In particular, code-switched speech (where multiple languages are used within a single utterance) is difficult to perceive, both when reading (Adler et al., 2019; Altarriba et al., 1996) or auditorily in noise (Garcia et al., 2018). However, it's possible that listeners' individual variation with the amount of code-switching used (e.g., every day to not at all), the different types of code-switching they habitually use (Green and Wei, 2014), and their attitudes towards the use of code-switching (e.g., positive or negative) could affect their ability to perceive their languages, especially in more difficult contexts (Garcia et al., 2018).

An important type of variation in bilingual experience with code-switching relates to community-specific practices for code-switching (Bullock et al., 2017; Woolard, 2007; Zentella, 1997). Code-switches can be broadly categorized (Muysken, 2000) as alternations (i.e., stretches of words of one language alternate within a conversational turn), insertions (i.e., words or

constituents from one language are inserted into an utterance), or congruent lexicalization (i.e., shared language structure is realized with words/morphemes of different languages). Different communities may favor one switching type (e.g., stable bilingual communities that typically separate their languages may prefer alternations; Green and Wei, 2014). These variations impact the control mechanisms that they use to process representations in each of their languages (Beatty-Martínez & Dussias, 2017; Green & Wei, 2014). Similar to many bilinguals, most heritage speakers code-switch. They use different types of code-switches depending on factors like proficiency levels, attitudes, and identity, (Toribio, 2011; Zentella, 1997). Yet, there are negative attitudes associated with code-switching (Poplack, 1980; Toribio, 2002; although factors like language learning history and practices can positively impact attitudes: Dewaele and Wei, 2014). The variation among Spanish heritage speakers' use and exposure to code-switching, their identification with it, and seeing it as a negative practice could affect their perception of code-switching.

Previous work has not looked at how heritage bilinguals perceive both their languages in different contexts, as well as how their perception may be modulated by their language experiences and attitudes. The current study aims to address this gap by investigating Mexican-American Spanish heritage bilinguals' perception of sentences in noise in single (i.e., English or Spanish only) versus code-switched sentences. Transcription accuracy of sentences in English, Spanish, and code-switched was analyzed, as well as their language experiences (via language proficiency and social network measures) and their language attitudes (via Likert scales and opened ended questions). Based on previous work, we predict that participants will be more accurate in perceiving single language sentences than code-switched sentences (Garcia et al.,

2018), and we expect this effect will be modulated by variation in code-switching attitudes and experiences.

The remainder of this chapter is structured as follows. We begin by reviewing previous work examining the effect of language context and language experience and attitudes on heritage bilinguals' speech perception. This motivates the design and methods of our current study. The results show a language dominance effect as well as a language context effect. Additionally, we observe a modulation of effects based on language experience and attitudes, providing insight into heritage bilinguals' language processing. We conclude by discussing what aspects of bilingual speech perception this contributes to and what theories need to be revised and extended to account for these findings, including areas for future work.

3.2: Background

Code-switching

Bilinguals have accesses to two languages, which means that there are certain language practices available to them that monolinguals are unable to use. A language practice that bilinguals are able to partake in is code-switching, which is when an individual uses both languages (e.g., Spanish and English) in a conversation or utterance. Code-switching is not a random alternation between two languages, but rather it is a systematic switch between the two languages that follows both languages' syntactic structures. There is variation in how a code-switch is manifested, and different types of code-switching have been identified by researchers at various linguistic levels. Syntactically, code-switching can be intrasentential or intersentential. Intrasentential code-switching is when the switch is within the same sentence. An example of

this code-switch would be "Mary went to *la tienda a comprar pan*[3]," since the switch between two constituents within the same sentence. Intersentential code-switching is across sentences within the same conversation. An example of an intersentential code-switch would be "Mary went to the store to buy bread. *Después fue al banco a depositar un cheque*[4],"since the switch happened between two different sentences (Poplack, 1980; Zentella, 1997).

Code-switching, especially intrasentential code-switches, requires a substantial knowledge of both languages in order to produce grammatical code-switches in conversations with little effort. Yet, bilinguals who have severely asymmetrical language proficiency may appear to code-switch, but in reality are exhibiting *language borrowing*. These speakers tend to use their dominant language as a crutch when speaking their non-dominant language. This means that if they are a Spanish dominant bilingual speaking English, they will insert Spanish words or phrases when they do not know how to say the English translation equivalent. Although highly proficient bilinguals will do this from time to time, this is the main kind of "code-switch" type of language practice that bilinguals who have a lower proficiency in one of their languages can partake in (Woolard, 2007; Zentella, 1997). This shows how language dominance can affect the ability to code-switch.

Another factor that can affect code-switching is community code-switching practices. Code-switching practices differ by community and language, and can be found in bilingual communities around the world (Bullock et al., 2017). Three types of code-switching practices have been identified: alternations, insertions, and congruent lexicalization. Different communities may favor one switching type (Green & Wei, 2014). For example, stable bilingual

[3] Full English translation – Mary went to the store to buy bread.
[4] Full English translation – Then she went to the bank to deposit a check.

communities where bilingualism is the norm may typically separate their languages, preferring alternations. Communities where the bilingual members may be stigmatize, which may lead to language loss of the minority language, may prefer insertions. Additionally, bilinguals who habitually code-switch more easily process code-switches as well as can more accurately identify ungrammaticality than their non-habitual code-switch counterparts (Beatty-Martínez & Dussias, 2017), as well as bilinguals with higher Spanish proficiency (Potowski & Bolyanatz, 2012). These variations may impact the control mechanisms that they use to process their languages, with participants with more experience having an easier time perceiving code-switches, especially in unfavorable (i.e., noisy) environments.

Code-switching in Spanish-speaking communities in the U.S.: Varying experiences, varying attitudes

For Latino communities in the United States, code-switching differs depending on the varieties of English and Spanish being spoken. There are also different codes (i.e., different forms, in one or both languages) that will be used depending on the interlocutor. Zentella (1997) showcases examples of how speakers' codes vary depending on who their interlocutor. The Puerto-Rican girls Zentella observed in *el bloque* ("the block") were aware that in order for an interaction to be felicitous, they had to use languages their interlocutors knew. This means that they would speak Spanish to Spanish monolinguals, English to English monolinguals, and had the capability of code-switching with Spanish-English bilinguals. If they did not know which of their registers to use, they were able to quickly switch on the spot if they made a mistake. For example, when they went to a *bodega* ("corner store") to buy candy and they initially spoke to the cashier in English. When he did not respond, they knew that they had to switch to Spanish.

Their code-switching habits also depended on their language use within their social network. This can be seen in how the five girls in Zentella (1997) differ in the way they code-switching. The older girls differed from the younger girls in the code-switching strategies they used, with younger ones using code-switching when being an active interlocutor. The older girls used language borrowing more so than code-switching. There was a difference with the amount of Spanish or English spoken, with the girls who spoke more English using language borrowing instead of code-switching. The importance of social network and language use can also be seen in how their language practices and ideologies varied significantly from when they were friends in childhood to years later when they were no longer friends in adulthood. Some of them became more English dominant in order to better assimilate with the American linguistic norms, and had limited Spanish use. This limited use of Spanish resulted to them rarely code-switching. One of them avoided code-switching in adulthood in order to avoid speaking a stigmatized variety of Spanish and English. Another one of them became Spanish dominant and would regularly code-switch with bilingual interlocutors. This is evidence of how bilinguals differ in their code-switching habits depending on their social networks, and how becoming a part of a different social circle will affect, not only the way they code switch, but their attitudes towards code-switching.

Code-switching practices and attitudes also interact in complex ways with Latino identity. The racialization of both Spanish and English within the Latino community in the United States has led to the creation of a language ideology referred to as “languagelessness”, or feeling of not having a language, since this is a community that speaks stigmatized dialects of both of their languages (Rosa, 2019; Urciuoli, 1996). They are seen as not speaking a legitimate

variety of either language, since both the English varieties they speak have "too much" Spanish influence, and the Spanish varieties they speak have "too much" English influence. A way for Latino bilinguals to combat their ideology of "languagelessness" is through code-switching, since it can be a way to have a language practice that is a unique marker to this community. In spite of this, it is still perceived negatively by Latinos. This links back to the linguistic ideology of "languagelessness" and speakers' beliefs that they speak a deficient version of both of their languages. The mixing of languages is regularly perceived as the speaker lacking proficiency in Spanish and English because of folk theories of code-switching indicating that a Latino's languages are more deficient when code-switching (Urciuoli, 1996). These negative perceptions of code-switching are reflected in the pejorative terms used to describe code-switching like *Tex-Mex* and *Spanglish.* The use of these terms perpetuate misconceptions about code-switchers' social, intellectual, and linguistic abilities (Toribio, 2002).

Toribio (2002) discovered a paradox in Latino's use of code-switching. She found that bilinguals will code-switch to signal their Latino identity, even if they perceive code-switching to be a negative language practice. Yet, there is variation in a speaker's relationship with code-switching. Many speakers do not regularly code-switch, and there is variation with a speaker's comfort level with code-switching. All four of Toribio's participants varied in their perception and usage of code-switching. Even though all participants were from the same Mexican-American community, their usage of code-switching differed tremendously, and was correlated with their attitudes towards code-switching's role in establishing their identity. Individuals who believed that code-switching was integral in indexing their Latinidad were more accepting of people using it and were more proficient in code-switching. They were able to identify

ungrammatical code-switches and produce grammatical code-switches with ease. On the other hand, individuals who did not believe that code-switching was an important factor for them to be able to index Latino identity had a harder time identifying ungrammatical code-switches and being able to produce grammatical code-switch.

This showcases the variability in attitudes towards code-switching can affect the perception of grammaticality of them, and this could carry over to how there could be differences in the language control mechanism based on community practices (Green & Wei, 2014). It is possible that there are ties between the effect of community practices and attitudes, which could affect the processing of code-switched sentences.

3.3: Current Study

The current study aims to better understand how heritage speakers' experiences with their languages in different contexts and attitudes towards code-switching affect their auditory perception of code-switching in a speech in noise task. Based on prior work, we expect that heritage speakers should be better at perceiving speech in single language blocks than mixed blocks (Garcia et al., 2018). Within the single language block, we expect for them to be better at perceiving their dominant language (i.e., English) than their non-dominant language (i.e., Spanish; Blasingame & Bradlow, 2020). Extending previous work, we will examine both experience and attitudes in order to better understand their influence on speech perception, since experience and attitudes are not identical and both can influence speech perception. For example, we expect that participants with more code-switching experience will be better at perceiving speech in the mixed block than participants that have less experience with code-switching, and for participants with more positive attitudes about code-switching to be better at perceiving code-

switching than those with more negative attitudes. However, it is unclear how exactly these two factors will affect perception.

3.4: Methods

Power Analysis

Based on the Monte Carlo power analysis run (detailed in Chapter 2), 50 participants were needed. In order to ensure that each list had the same amount of participants, 54 participants were needed for this study.

Talkers

A subset of the six of the talkers used in Study 1 were used in Study 2. The six talkers recorded the stimuli in English, Spanish, and code-switched sentences, with the English and Spanish sentences being used for both Study 1 and this study. Their voices were used for the English, Spanish, and code-switched blocks between listeners. Each listener hears all six voices, but the language context they are presented in (i.e., English, Spanish, or code-switched) varies across participants.

Listeners

Based on the power analysis and having an equal number of participants exposed to each list, 54 Spanish-English heritage speakers were recruited as listeners for this study. In order to be eligible to participate, listeners needed to be native Mexican Spanish speakers who are English dominant that received their schooling in the U.S. A total of 63 English-dominant Mexican-American Spanish-English heritage bilingual listeners were recruited through social media and university listservs. Eight participants were excluded for being Spanish dominant and one because of technical difficulties. Their average age of acquisition for Spanish was 0 years old

(range 0-4) and for English was 3.7 years old (range 0-12). They all completed their education in English, and were all English-dominant according to the results of the MINT Sprint (Garcia & Gollan, 2022).

Stimuli

A list of sentences taken from the ALLSTAR corpus (Hearing in noise test sentences; Bradlow, n.d.) were used as the stimuli. There are a total of 180 sentences, one third in English (e.g., "A boy fell from the window."), one third in Spanish (e.g., "El niño hace ruido en su cuarto."), and one third code-switched (e.g., "They heard un ruido extraño").

The code-switched sentences were created by the author taking a list of 60 English and Spanish sentences HINT sentences from the ALLSTAR corpus (Bradlow, n.d.) not used for the English and Spanish blocks. Sentences originally in English started in English and were switched into Spanish for the second half of the sentence (e.g., "They heard a strange noise" became "They heard un ruido extraño."). The same was done for sentences originally in Spanish (e.g., "El niño entró por la ventana." became "El niño entró through the window."). Code-switching within each sentence was based on naturalness and the presence of changes that unambiguously identified the language being switched into (e.g. sentences with "in" or "en" at the switch site were excluded because "en" could be perceived as "in" and vice versa).

To aid acoustic analyses, the sentences were forced aligned using the Montreal Forced Aligner (McAuliffe et al., 2017). As in Study 1, Praat (Boersma and Weenik, 2021) was used to then edit the audio files. Praat scripts were implemented to chop the audio files so they had no silences before or after the speech, then to equalize them to 70dB, and then resampled to 44,100 hertz. 500 ms of silence was added at the beginning and end of each sentence. Then speech

shaped noise based on the long term average speech spectrum of the stimuli was created and mixed into the sentences at 0SNR with the noise fading in during the first 250 ms of the sentence.

Lists

There were nine lists in total. Half of the sentences in each list are read by one speaker, and the other half by the other (e.g., T1 reads English 1-30 and T2 reads English 31-60), and this is counterbalanced across lists. Each block always has a male and a female talker. Across blocks, the talker pairing are counterbalanced.

Questionnaires

Participants completed the same questionnaires used in Study 1: a social network questionnaire, a language background and attitudes questionnaire, and a language proficiency test. Details about the questionnaires are in Chapter 2 under the "Questionnaires" subsection.

Procedure

Participants completed three experimental blocks, one in English, one in Spanish, and one with English and Spanish code-switched sentences. Instructions for each block were in the language of the block, and they were tested on the same day. Language order was set across participants; they completed the English block first, then Spanish, and finally code-switched. Participants completed a speech in noise task in which they have to type the sentence they heard. Afterwards, they completed the MINT Sprint, the social network questionnaire, and the language background and attitudes questionnaire.

Data Analysis

Performance was assessed using scoring by-word transcription accuracy. The transcriptions were all converted to lowercase, and all accent markers were removed. Then Autoscore (Borrie et al., 2019) was used to score accuracy. Afterwards, a script was run to count accuracy by word. By word accuracy is what was used to measure performance.

3.5: Results

Main model Study 2

A logistic mixed-effects model was run that examined by-word accuracy time depending on language (English versus Spanish) and language context (English and Spanish versus conde-switch). All factors were contrast-coded. There were two sets of correlated random effects factors: (1) by participant, with a random intercept and language and language contrast as a random slope, and (2) by item, with a random intercept, and language and language contrast as a random slope. Within each set, random effects were correlated. Model comparisons (likelihood ratio tests) were used to test the significance of fixed effects.

Results showed that English sentences were more accurately transcribed than Spanish sentences (β = -0.42, *SE* β= 0.19, χ^2 (1)= -2.22, $p < 0.05$). Single language context sentences (i.e., English only and Spanish only) were more accurately transcribed than code-switched sentences (β = 0.006, *SE* β= 0.03, χ^2 (1)= 0.10, $p < 0.01$). The results of the model suggests that code-switched sentences were more difficult to process than the single language sentences, but there is still a language dominance effect in the single language sentences.

Figure 3.1: Transcription accuracy in English, code-switched, and Spanish for Study 2. The x-axis represents language context, while the y-axis represents the average by word accuracy in transcription. (wings show bootstrapped 95% confidence intervals)

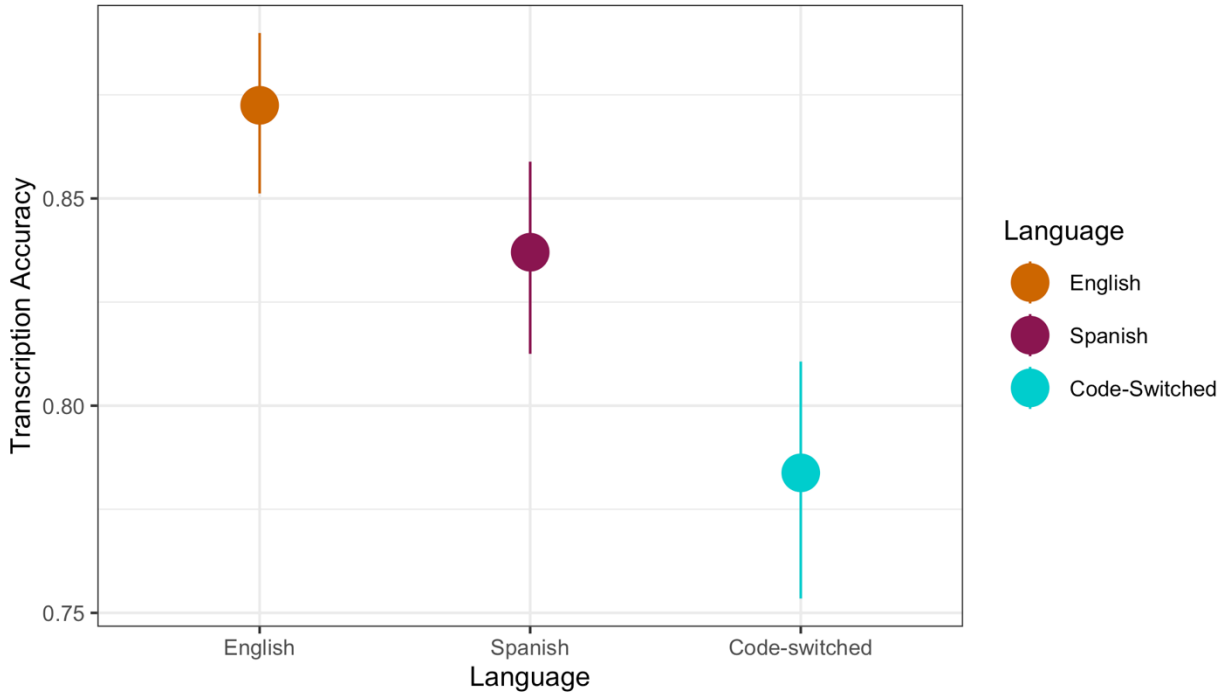


Table 3.1: Results for logistic mixed effects model for accuracy of word transcription

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
English versus Spanish	-0.42	0.19	-2.22	< 0.05*
Single versus code-switched	0.41	0.15	2.72	< 0.01**

Because of previous work showing that there is an asymmetry in code-switching usage and perception based on language dominance (e.g., Bosma & Blom, 2019), a logistic mixed-effects model that examined by-word accuracy was conducted of the code-switched data depending on the language the sentence starts with (i.e., English versus Spanish). All factors were contrast-coded. There were two sets of uncorrelated random effects factors: (1) by participant, with a random intercept and start language as a random slope, and (2) by item, with a

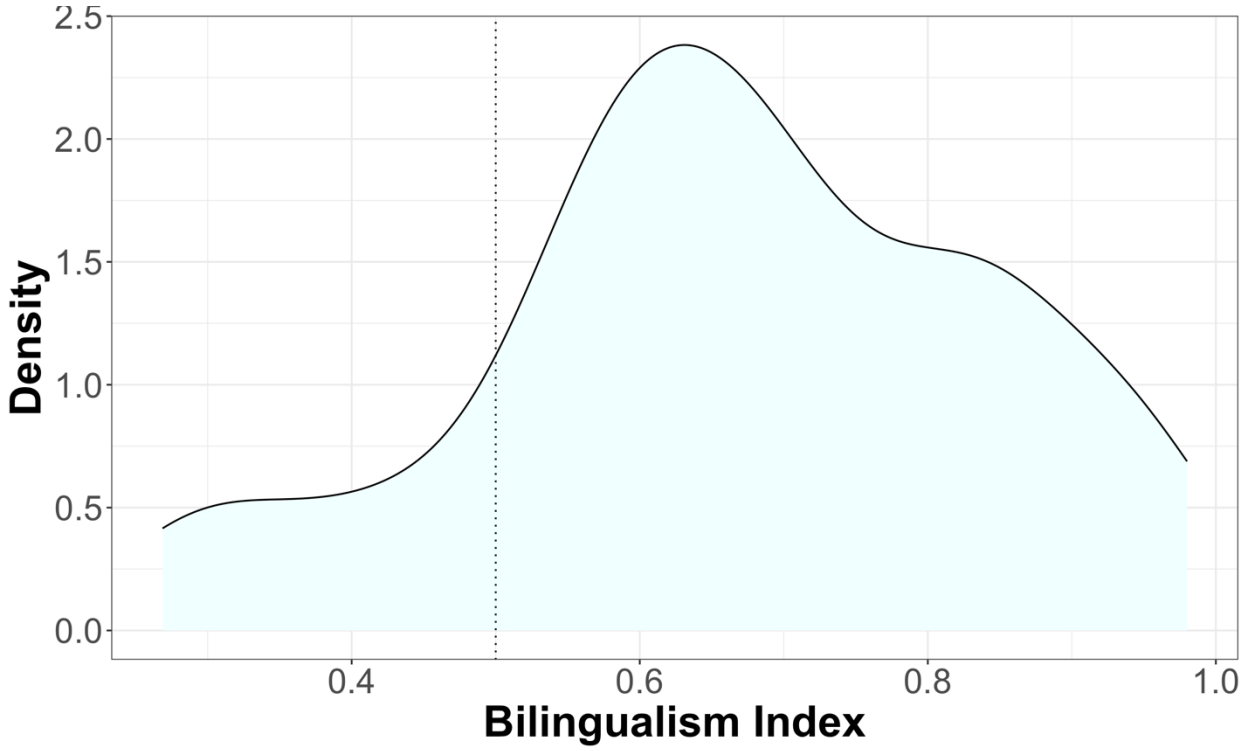
random intercept and start language as a random slope. Within each set, random effects were correlated. Results showed no significant effect of the start language of the sentence ($\beta = 0.09$, SE $\beta = 0.17$, χ^2 (1) = 0.52, $p > 0.05$), suggesting that there is no difference in transcription accuracy based on what language the code-switched sentence begins.

Bilingualism index and accuracy

In order to see if there were individual differences in performance in the task based on language proficiency, a bilingualism index score was calculated for each participant. Details as to why and how this was done can be found in the "Bilingualism index and accuracy" section in chapter 2.

A density plot of bilingualism index was made to better understand the variation of it within this participant group. As seen in figure 3.2, the distribution has a peak at around 0.6 and a second much smaller peak at around 0.8. This tells us that most participants have a Spanish lexical size that is at least 60% the size of their English lexical size, indicating that participants are English dominant, but still have high proficiency in Spanish.

Figure 3.2: Density plot of bilingualism index, showing the overall distribution of bilingualism index for participants



A logistic mixed-effects model that examined by-word accuracy depending on language (English versus Spanish), language context (English and Spanish versus conde-switch), and language proficiency (bilingual index). All factors were contrast-coded. There were two sets of correlated random effects factors: (1) by participant, with a random intercept and language and language context as random slopes, and (2) by item, with a random intercept, and language and language context as random slopes. Within each set, random effects were uncorrelated.

Results showed a main effect of language (β = -0.42, *SE* β= 0.19, χ^2 (1)= -2.22, $p < 0.05$) and language context (β = 0.41, *SE* β= 0.15, χ^2 (1)= 2.72, $p < 0.01$), but no other main effects or

interactions found in the model (χ^2 (1)s< 1.34, p > 0.18; see Table 3.2). This suggests that there is no strong effect of language proficiency on transcription accuracy.

Figure 3.3: Transcription accuracy in English, Spanish, and code-switched for Study 2. The x-axis represents language proficiency, while the y-axis represents the average by word accuracy in transcription.

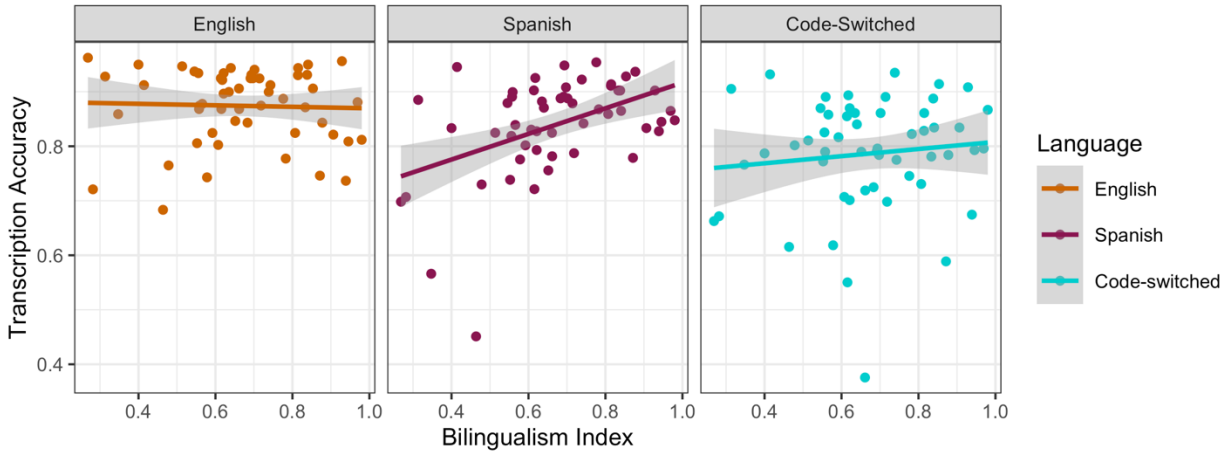


Table 3.2: Results for logistic mixed effects model for accuracy of word transcription and bilingualism index for Study 2

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
English versus Spanish	-0.42	0.19	-2.22	< 0.05*
Single versus code-switched	0.41	0.15	2.72	< 0.01**
Bilingualism index	0.02	0.01	1.34	0.18
English versus Spanish X Bilingualism Index	-0.003	0.01	-0.24	0.81
Single versus code-switched X Bilingualism Index	-0.01	0.01	-0.89	0.37

Social network and accuracy

In order to see if there were individual differences in performance in the task based on the social network size of the target language, the data was split into English, Spanish, and code-switched subsets. Then, for each participant in each language, two measures of social network

size were calculated: the number of people they spoke to in that language, including people that they speak both languages with (English all or Spanish all); people they only spoke English or Spanish to, excluding those they speak both languages with (English only and Spanish only), and people they spoke both languages with (both).

Three density plots of participants' English all, Spanish all, and both languages social network was made to better understand the variation of it within this participant group. As seen in figure 3.4, the English social network density plot peaks at around 30 individuals in the social network. As seen for figure 3.5, for the Spanish social network density plot peaks at around 20 individuals in the social network. Finally, for the both languages social network density plot (i.e., Figure 3.6) peaks at around five individuals in the social network, and then has a much smaller peak at around 35 individuals. Overall, the results of these plots show these participants have larger social networks in English than Spanish, as well as that their social networks with other bilingual individuals are the smallest. This suggest that these participants tend to interact with more monolinguals than bilinguals.

Figure 3.4: Density plot of English all social network, showing the overall distribution of Spanish social network for participants

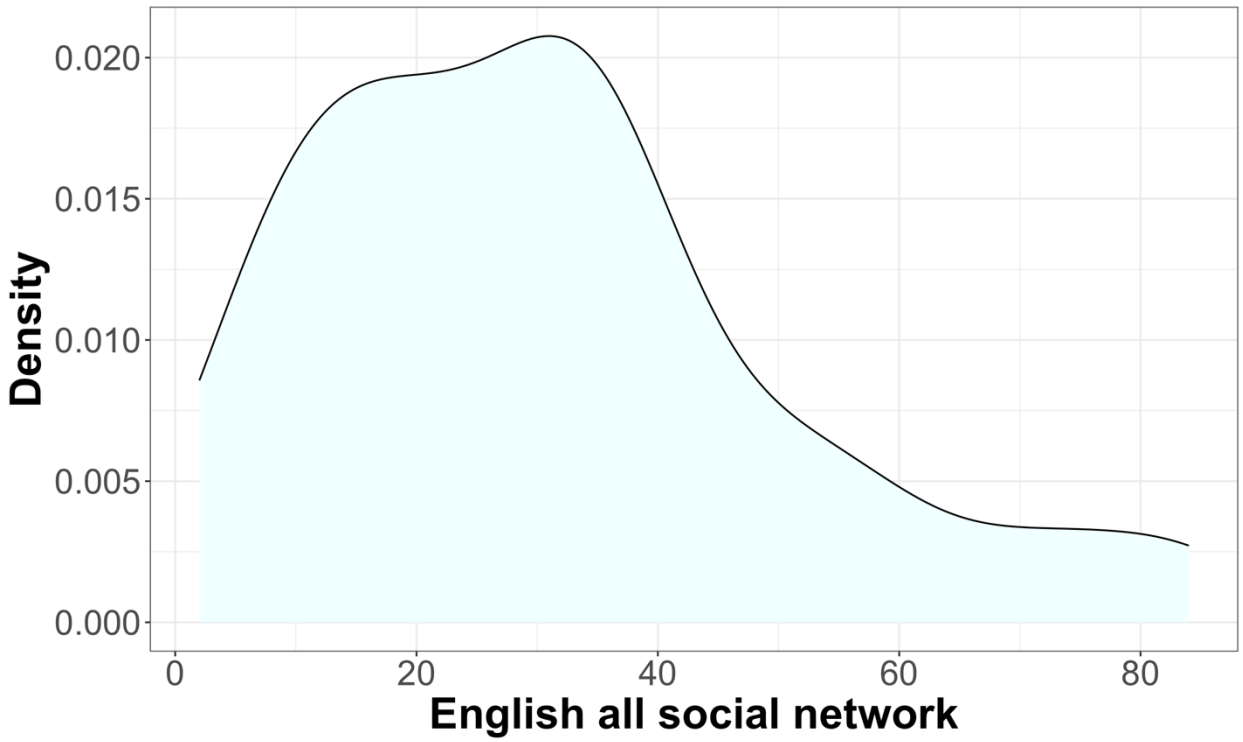


Figure 3.5: Density plot of Spanish all social network, showing the overall distribution of Spanish social network for participants

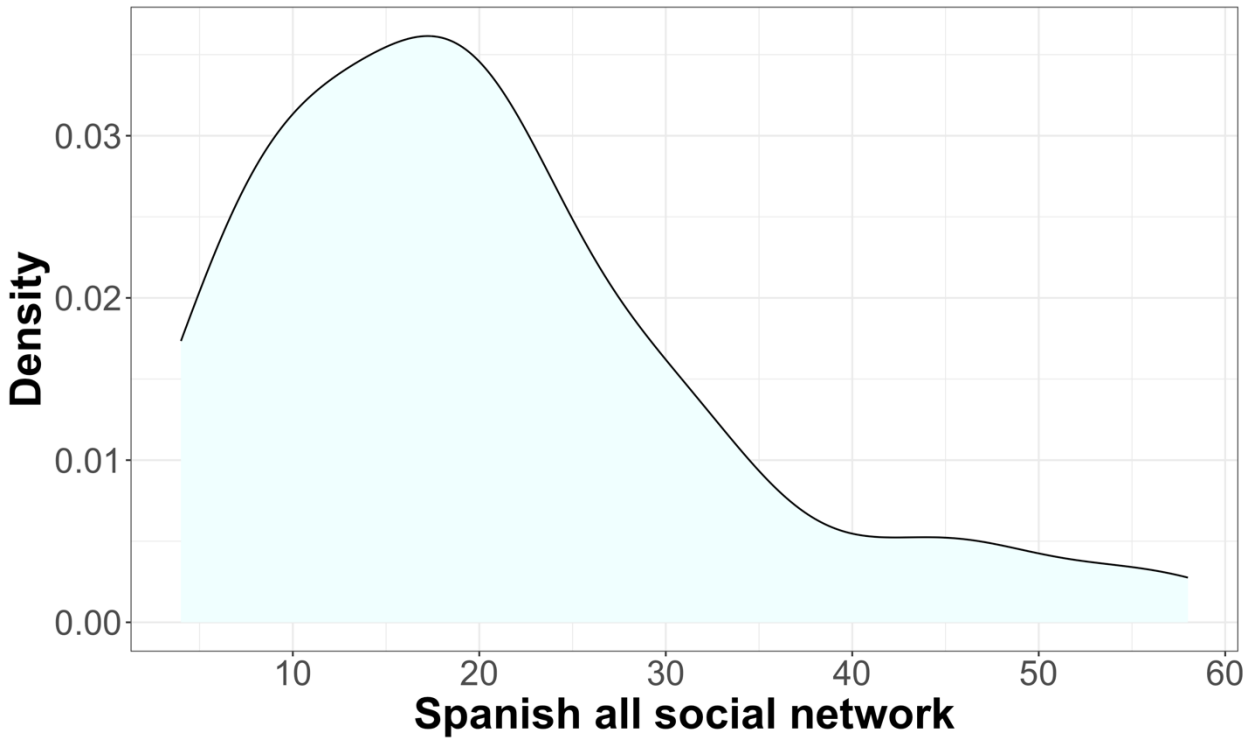
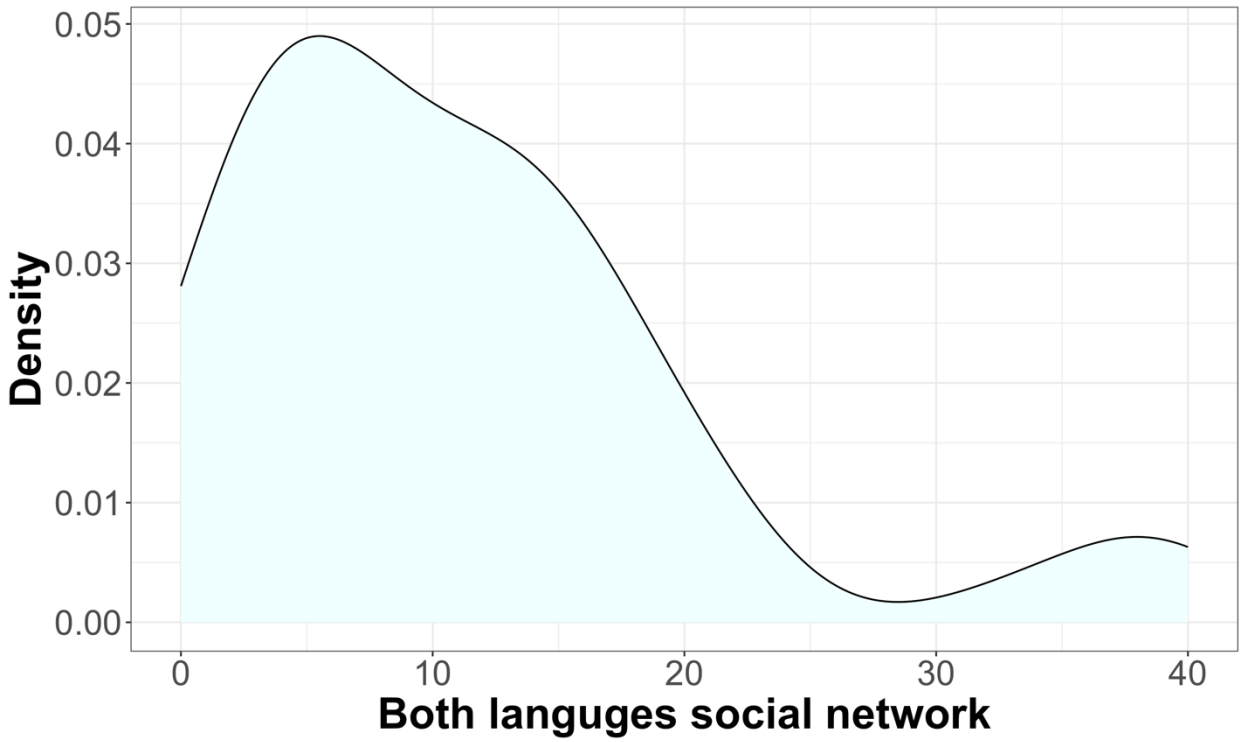


Figure 3.6: Density plot of Both languages social network, showing the overall distribution of Spanish social network for participants



Below is a series of logistic mixed-effects models that examined the effects of English all, Spanish all, and both. Analysis of English only with both, Spanish only with both can be found in Appendix E.

A logistic mixed-effects model examined by-word accuracy of the English data depending on social network size (English all). All factors were contrast-coded. There were two sets of uncorrelated random effects factors: (1) by participant, with a random intercept, and (2) by item, with a random intercept and social network as a random slope. Within each set, random effects were uncorrelated. Model comparisons (likelihood ratio tests) were used to test the significance of fixed effects.

Results did not show a main effect of social network (β = 0.006, *SE* β= 0.005, χ^2 (1)= 1.04, p > 0.05), suggesting that there is no effect of English social network size on performance in the English block.

Figure 3.7: Transcription accuracy in English block by English social network for Study 2. The x-axis represents English all social network, while the y-axis represents the average by word accuracy in transcription.

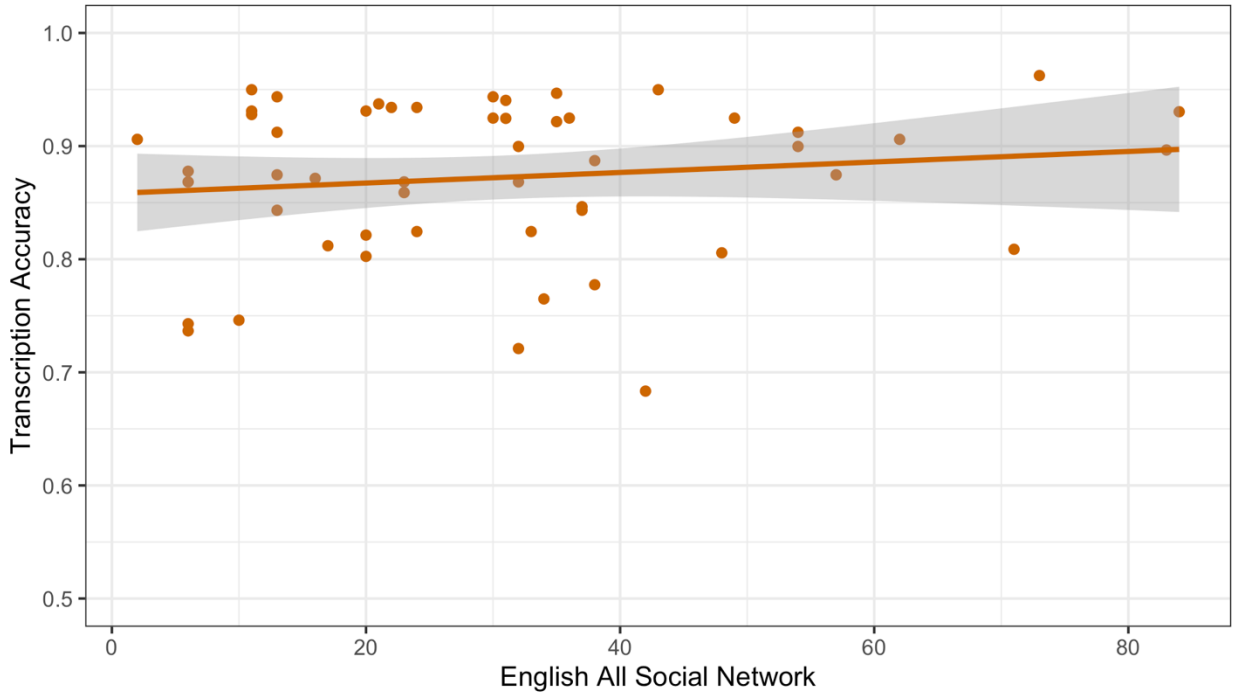


Table 3.3: Results for logistic mixed effects model for accuracy of word transcription in English and English all social network size

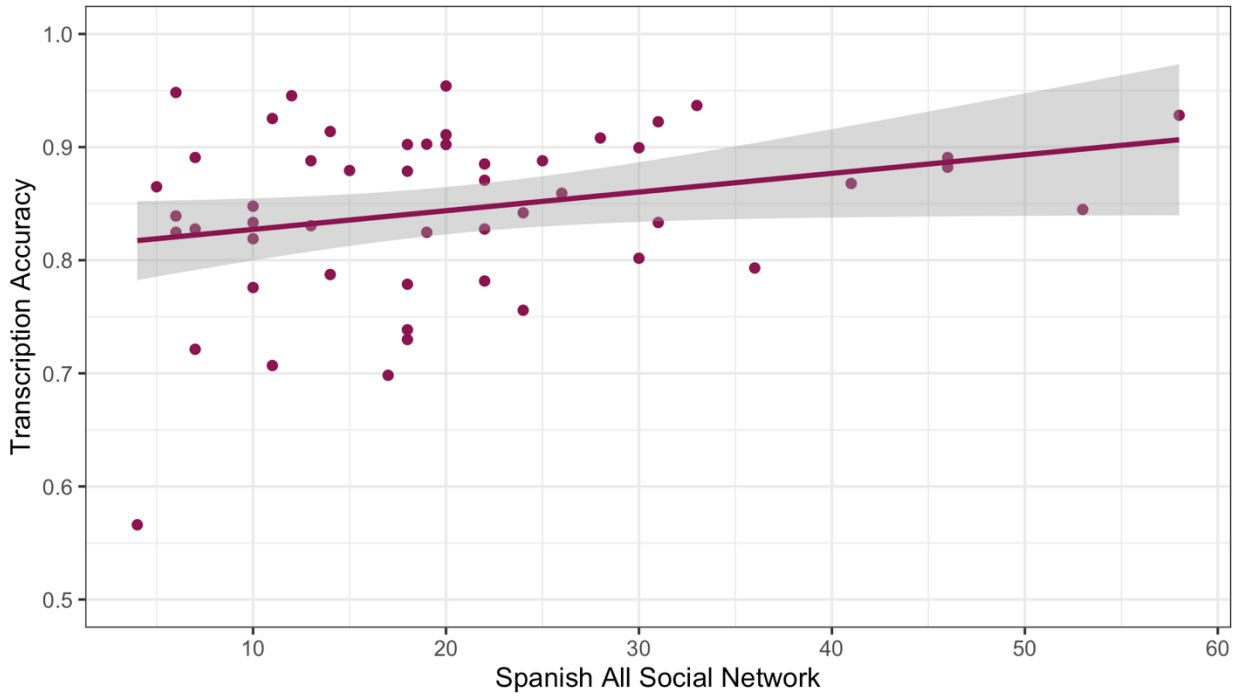
Fixed effects	**β**	***SE* β**	**χ^2**	**p**
English all social network size	0.005	0.005	1.04	0.3

A logistic mixed-effects model that examined by-word accuracy of the Spanish data depending on social network size (Spanish all). All factors were contrast-coded. There were two

sets of uncorrelated random effects factors: (1) by participant, with a random intercept, and (2) by item, with a random intercept and social network as a random slope. Within each set, random effects were uncorrelated. Model comparisons (likelihood ratio tests) were used to test the significance of fixed effects.

Results showed a main effect of social network[5] ($\beta = 0.02$, *SE* $\beta = 0.006$, χ^2 (1)= 2.88, $p < 0.01$), suggesting that individuals with a larger Spanish social network perform better in the Spanish block.

Figure 3.8: Transcription accuracy in Spanish block by Spanish social network for Study 2. The x-axis represents Spanish all social network, while the y-axis represents the average by word accuracy in transcription.



[5] In order to ensure that the outlier with a very small social network and low accuracy was not driving the effect, a model was run with that participant excluded. The model output was similar ($\beta = 0.02$, *SE* $\beta = 0.007$, χ^2 (1)= 2.66, $p < 0.01$).

Table 3.4: Results for logistic mixed effects model for accuracy of word transcription in Spanish and Spanish all social network size

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
Spanish all social network size	0.02	0.006	2.88	< 0.01**

A logistic mixed-effects model that examined by-word accuracy of the code-switched data depending on social network size (both). All factors were contrast-coded. There were two sets of uncorrelated random effects factors: (1) by participant, with a random intercept, and (2) by item, with a random intercept and social network as a random slope. Within each set, random effects were uncorrelated.

Results did not show a main effect of social network ($\beta = 0.006$, *SE* $\beta = 0.005$, χ^2 (1)= 1.17, $p < 0.05$), suggesting that the social network size of individuals participants speak both languages with does not affect the performance of the code-switched block.

Figure 3.9: Transcription accuracy in code-switched block by both social network for Study 2. The x-axis represents both languages social network, while the y-axis represents the average by word accuracy in transcription.

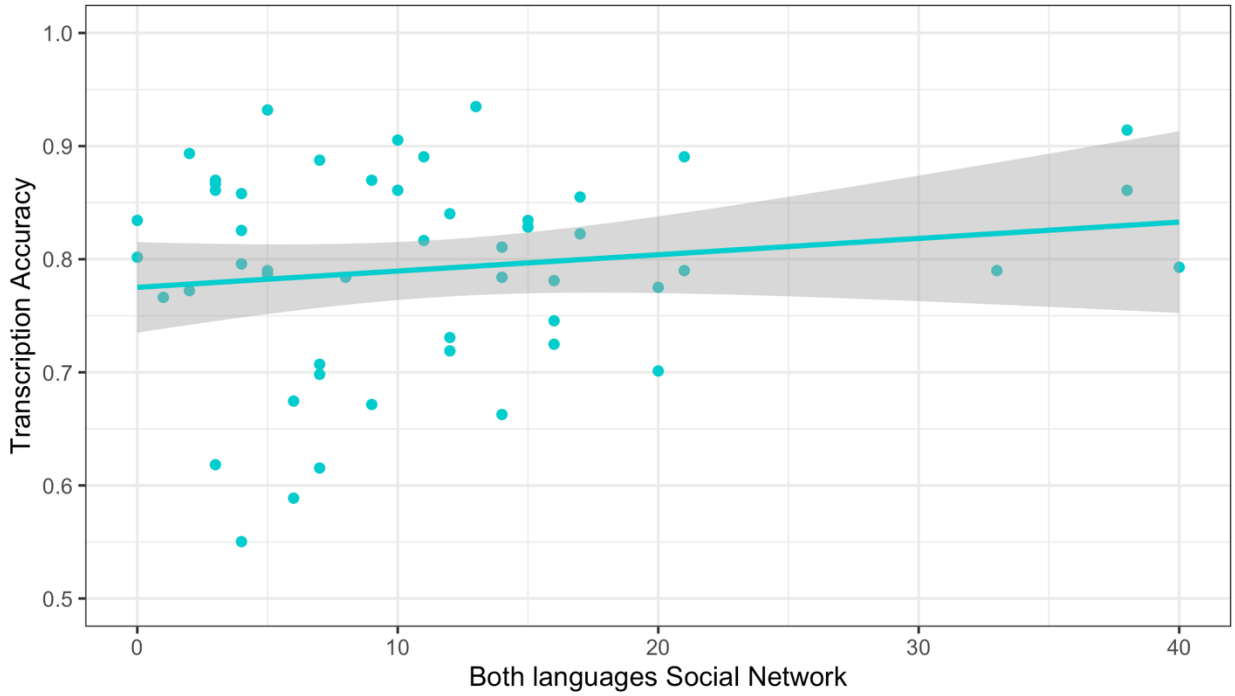


Table 3.5: Results for logistic mixed effects model for accuracy of word transcription in Spanish and Spanish all social network size

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
Both social network size	0.015	0.009	1.8	0.07

Overall, the results of these models suggest that there is an effect of Spanish social network in Spanish transcription, with larger Spanish social network size correlating with higher Spanish transcription accuracy. There were no other effects of social network size.

Likert scale measures of attitudes and accuracy

In order to see if there were individual differences in transcription performance, language attitudes asking questions about positive and negative perceptions of participants' English and Spanish were asked. There were 30 questions in all, which were all responded to on seven-point

Likert scales 16 were asking questions about positive perceptions (e.g., “I like my accent in English/Spanish”) and 14 were about negative perceptions (e.g., “I make a conscious effort to make sure people don't make fun of my accent in English/Spanish”; all questions are in Appendix C). Half in each category were asked about English and the other half about Spanish. From there, the sum of all English positive responses was subtracted from the sum of all Spanish positive responses to get a relative language positivity score. The same was done with all negative responses to calculate a relative language negativity score. For both positive and negative scores, a lower score indicates more positive/negative perceptions for English while a higher score indicates more positive/negative perceptions of Spanish.

Two density plots of participants’ relative language positivity scores and relative language negativity scores were made to better understand the variation of it within this participant group. As seen in figure 3.10, the majority of the distribution for relative language positivity, including the peak, is below 0. Meanwhile, as seen in figure 3.11, the majority of the distribution for relative language negativity, including the peak, is above 0. Given that scores less than zero lean towards stronger feelings for English and scores greater than zero towards Spanish, the difference in these distributions suggests that participants have more positive perceptions of their English and more negative perceptions of their Spanish.

Figure 3.10: Density plot of relative language positivity score, showing the overall distribution of relative language positivity score for participants. Vertical dotted line shows 0, denoting an unbiased positivity score. The arrows below the x-axis indicate if the sentiment leans more towards English (in orange) or Spanish (in raspberry)

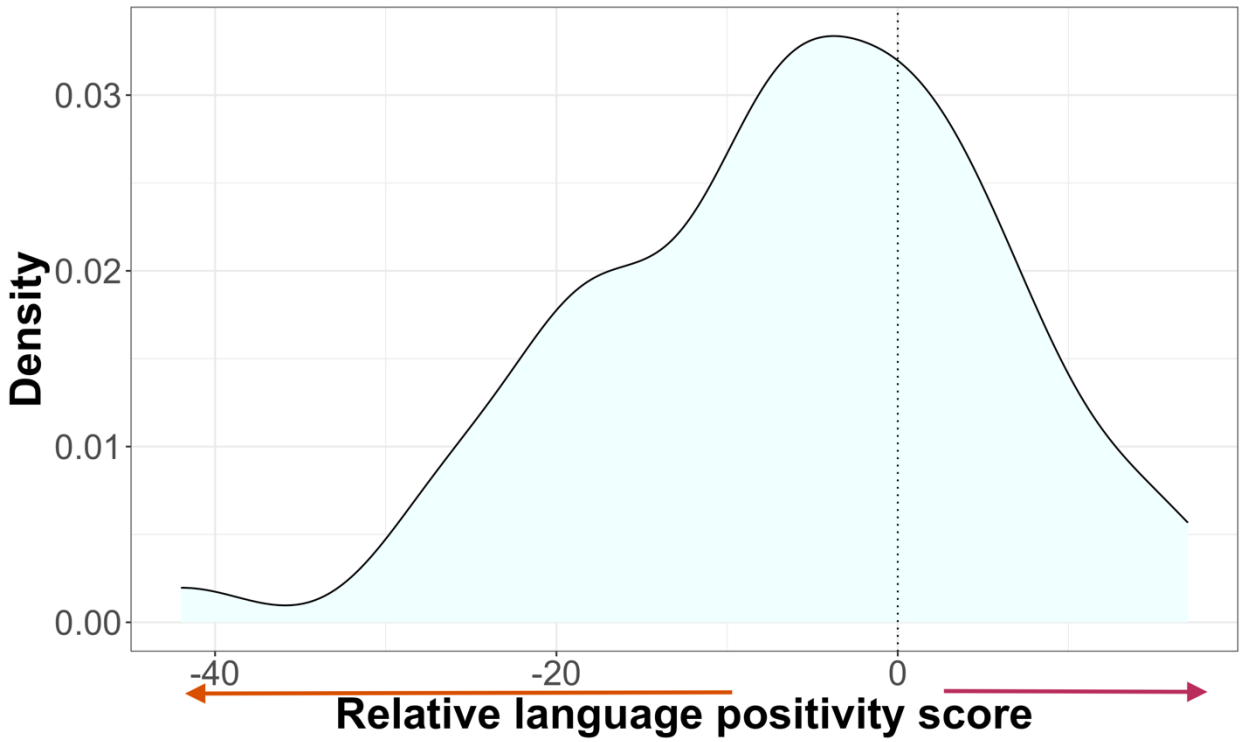
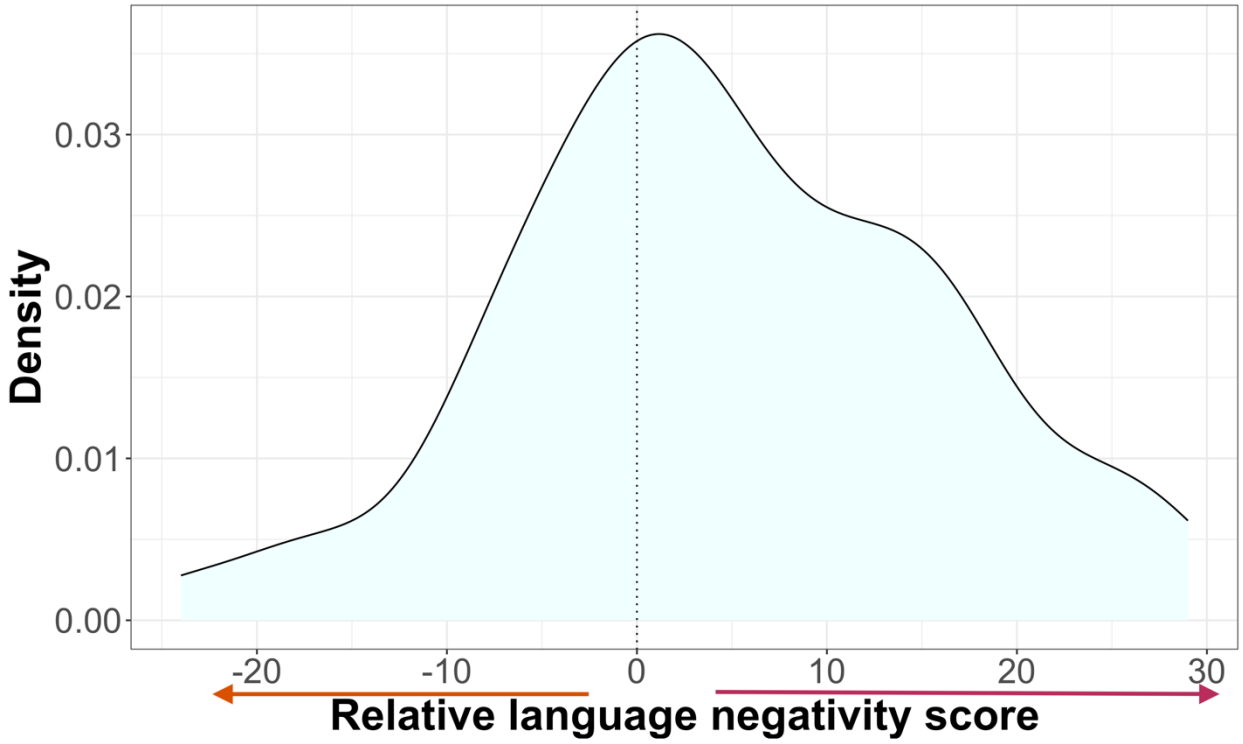


Figure 3.11: Density plot of relative language positivity score, showing the overall distribution of relative language negativity score for participants. Vertical dotted line shows 0, denoting an unbiased negativity score. The arrows below the x-axis indicate if the sentiment leans more towards English (in orange) or Spanish (in raspberry)



This score was centered and then used in a logistic mixed-effects model that examined by-word accuracy depending on language (English versus Spanish), language context (English and Spanish versus code-switched), and Likert scale score (relative language positivity score and relative language negativity score). All factors were contrast-coded. There were two sets of uncorrelated random effects factors: (1) by participant, with a random intercept and language, language context, relative language negativity score as random slopes, and (2) by item, with a random intercept, and language, language context, relative language positivity score, and relative language negativity score as random slopes. Within each set, random effects were uncorrelated.

Results showed a main effect of language (β = -0.39, *SE* β = 0.16, χ^2 (1)= -2.37, p < 0.05), indicating that participants had higher accuracy in English than Spanish blocks. There was also a main effect of language context (β = 0.46, *SE* β = 0.15, χ^2 (1)= 3.12, p < 0.01), indicating that participants had higher accuracy in single language blocks than the code-switched block. Additionally, there was a main effect of relative language positivity score (β = -0.82, *SE* β = 0.33, χ^2 (1)= -2.49, p < 0.05), indicating that participants with higher positive scores (i.e. more positive perceptions of their Spanish relative to English) perform worse in the task. This effect seems to be driven by the English and code-switched blocks, although the interaction just missed significance (β = 0.02, *SE* β = 0.009, χ^2(1)= 1.89, p = 0.06). Additionally, it is important to note that, numerically, there is an effect of relative language negativity score in Spanish (β = -0.02, *SE* β = 0.01, χ^2(1)= -1.79, p = 0.07), with participants with higher scores had lower accuracy in the Spanish block.

There were no other main effects or interactions found in the model (χ^2(1)s < 1.7, p > 0.09; see Table 3.6).

Figure 3.12: Transcription accuracy for Study 2 in English, Spanish, and Code-Switched blocks depending on relative language positivity score. The x-axis represents the positive score, while the y-axis represents the average by word accuracy in transcription. The arrows below the x-axis indicate if the sentiment leans more towards English (in orange) or Spanish (in raspberry)

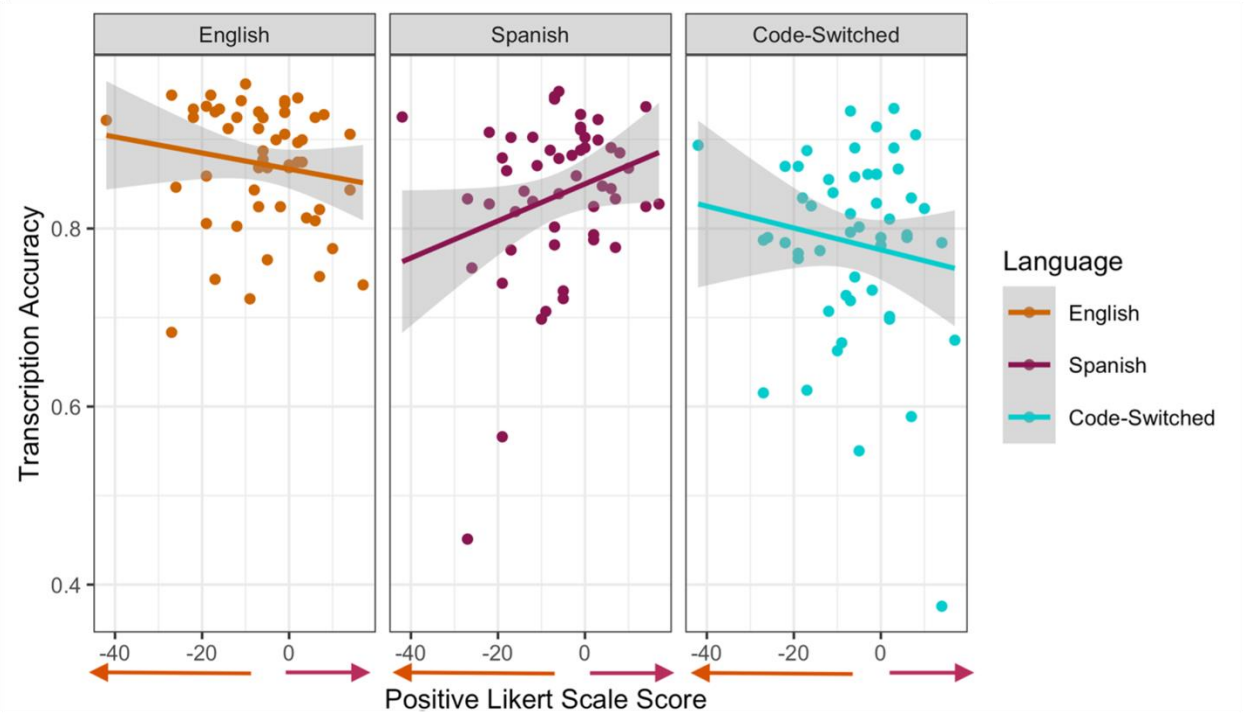


Figure 3.13: Transcription accuracy for Study 2 in English, Spanish, and Code-Switched blocks depending on relative language negativity score. The x-axis represents the negative score, while the y-axis represents the average by word accuracy in transcription. The arrows below the x-axis indicate if the sentiment leans more towards English (in orange) or towards Spanish (in raspberry).

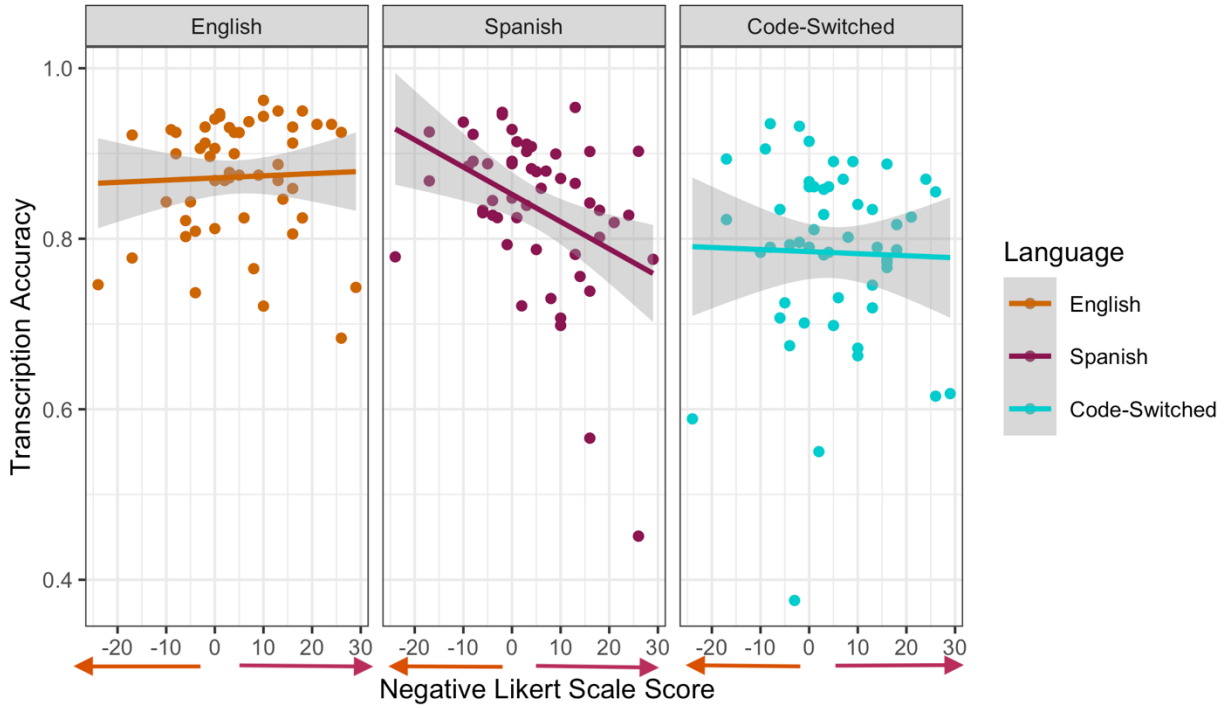


Table 3.6: Results for logistic mixed effects model for accuracy of word transcription and Likert Scale score for Study 2

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
English versus Spanish	-0.39	0.16	-2.37	< 0.05*
Single versus Code-Switched	0.46	0.15	3.17	<0.01**
Positive Likert scale score	-0.02	0.008	-2.28	<0.05*
Negative Likert scale score	-0.01	0.01	-1.4	0.16
English versus Spanish X Positive Likert scale score	0.02	0.009	1.89	0.06
English versus Spanish X Negative Likert scale score	-0.02	0.01	-1.79	0.07
Single versus Code-Switched X Positive Likert scale score	0.02	0.009	1.7	0.09
Single versus Code-Switched X Negative Likert scale score	-0.01	0.009	-1.46	0.14

Overall, there was an effect of relative positive self-perception of language in transcription accuracy, with more positive perceptions of their Spanish relative to their English correlating with lower transcription accuracy. There were no effects of relative negative self-perception of language.

Thematic coding and accuracy

For the purposes of Study 2, open ended questions 1, 2, 3, and 4 were further analyzed through a divisive clustering analysis to better understand if certain experiences and attitudes analyzed through the themes corelate with task performance. The details about how the divisive clustering was conducted can be found in Chapter 2. Below the details of each cluster analysis by question.

Open ended question 1

The first open ended question participants answered was "What does English mean to you? What do you think about when you think about English? What does being an English speaker mean to you?" The themes found in the responses were the following: aesthetic appeal; American; comfortable; default; facilitates communication; global/success/opportunity; pride; racism; struggle/effortful for others; struggle/effortful for themselves; ugly; United Kingdom (UK). Table 3.7 has details on the meaning of each of these themes. Each answer was annotated with one to four of these themes.

Table 3.7: Table explaining the mean of each thematic code used for open ended question one

Thematic code	**Meaning**
aesthetic appeal	English is a beautiful language
American	English has a tie with the U.S. and/or indicates how American one is
comfortable	The participant feels comfortable speaking English
default	This is the base language used in their community and/or in overall society
facilitates communication	English helps the speaker communicate
global/success/opportunity	English is a global language that facilitates the opportunities one has for jobs, traveling, and/or interacting with people from outside the U.S. It is also a tool for having career and/or academic success
pride	The speaker feels pride in being able to use English
racism	English can be used to instill racism against Mexican-Americans or other immigrants
struggle/effortful for others	English has been hard for the participant's family members or community members to learn and/or use effectively in the larger U.S. society
struggle/effortful for themselves	English was hard for the participant to learn and they second guess how "correctly" they use the language
ugly	English is an ugly language to speak
United Kingdom (UK)	English has a tie with the UK or reminds speakers of the UK

Based on the clustering analysis, three clustering patterns emerged based on the themes found in participants' responses. The first cluster (i.e., struggle/effortful for others) has participants 16 that indicated that English was a global language that helped them become successful and provide opportunity, as well as a language that is difficult for others (i.e., immigrant family members) to learn and use in a prestigious way. The second cluster (i.e., default and global/success/opportunity) has 24 participants that indicate that English was a global language that helps them become successful and provide opportunity, as well as the default language in their environment. The third and last cluster (i.e., comfortable) has 14 participants

that indicated English as the default language in their environment, as well as feeling very comfortable in using English.

In order to see if there was a difference in transcription accuracy in English based on which cluster a participant was in, a logistic mixed-effects model was conducted. The model examined by-word accuracy of the English data depending cluster (cluster one versus cluster two and cluster one versus cluster three; each factor was treatment-coded with cluster two as the reference-level). Cluster three (i.e. comfortable), was chosen as the baseline because nobody in that cluster indicated global/success/opportunity, when everyone in the other two clusters did. There were two sets of correlated random effects factors: (1) by participant, with a random intercept and (2) by item, with a random intercept. Results did not show a main effect of cluster one versus two ($\beta = 0.19$, SE $\beta = 0.21$, χ^2 (1) = 0.92, $p < 0.05$) nor of cluster one versus three ($\beta = 0.29$, SE $\beta = 0.24$, χ^2 (1) = 1.22, $p < 0.05$). This indicates that there is no overall difference in performance based on what cluster a participant is in.

Figure 3.14: Clustering of thematic coding for answers for open ended question one. The x-axis represents each thematic coding cluster, while the y-axis represents the coding variable. A color gradient indicates how many participants in a cluster indicated a certain coding variable in their response. Light yellow indicated all participants had that coding variable, while black indicates that none had that coding variable.

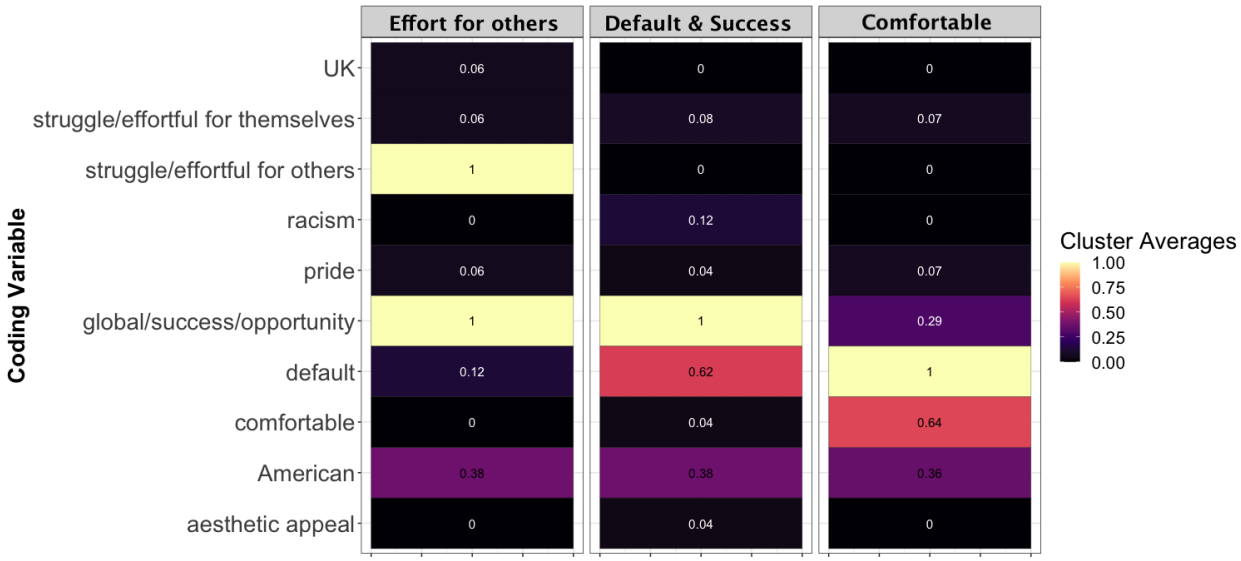
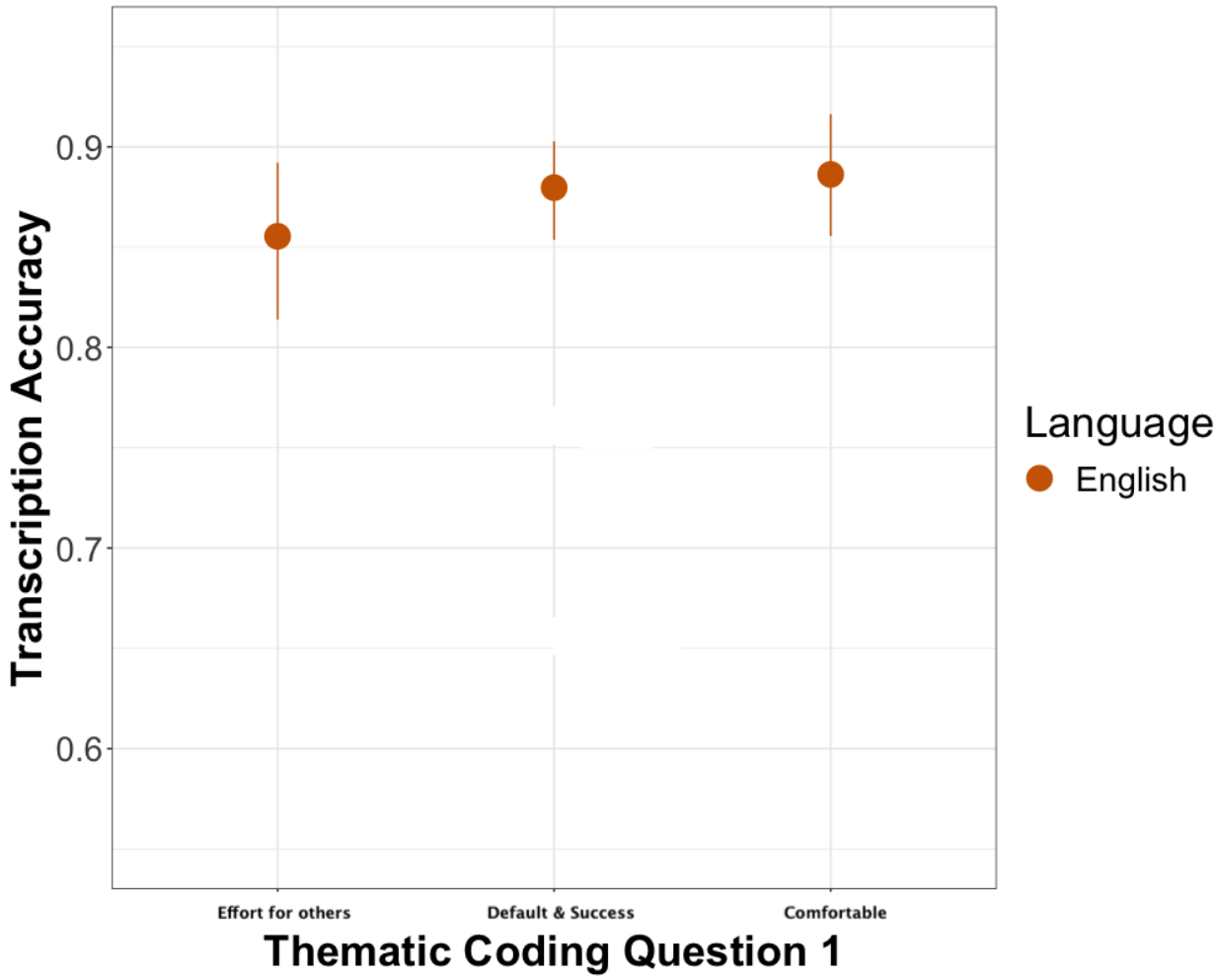


Figure 3.15: Transcription accuracy in English for Study 2. The x-axis represents the thematic coding cluster for open-ended question 1 (attitudes toward English), while the y-axis represents the average by word accuracy in transcription. (wings show bootstrapped 95% confidence intervals)



In order to better understand the interrelations between the two attitude measures taken (i.e. relative language positivity/negativity score and the cluster), the means of the relative language positivity/negativity scores were calculated for each cluster. As shown in Table 3.8, participants, regardless of clusters, have lower relative positivity score and higher relative language negativity score, which indicates that participants have more positive feelings towards their English and more negative feelings towards their Spanish.

Table 3.8: Mean relative language positivity/negativity score for each cluster for thematic coding for open-ended question 1 for Study 2

Cluster	**Relative language positivity score**	**Relative language negativity score**
1- Effort for others	-5.39	5.93
2- Default & success	-5.68	2.53
3 - Comfortable	-8.34	6.5

Overall, the thematic analysis of question one shows that participants' attitudes towards English does not have an effect on their performance in the English block. Although there is variation in participants' attitudes based on the clusters they are in, all participants seem to have more positive attitudes towards English than Spanish.

Open ended question 2

The second open ended question participants answered was "What does Spanish mean to you? What do you think about when you think about Spanish? What does being a Spanish speaker mean to you?" The themes found in the responses were the following: aesthetic appeal; bridge both cultures; conditional; easy; foreign; global/success/opportunity; heritage/culture; insecure; language loss/important to maintain; Mexico; negative/poor; pride; sentimental/home/family. Each answer was given between one through four codes.

Table 3.9: Table explaining the mean of each thematic code used for open ended question two

Thematic code	**Meaning**
aesthetic appeal	Spanish is a beautiful language
bridge both cultures	Spanish is a tool to help bridge between American and Mexican culture
conditional	Spanish is only used in certain settings
easy	The participant feels that Spanish is an easy language to use
foreign	Spanish is referred to as a "foreign" language in a derogatory way
global/success/opportunity	Spanish is a global language that facilitates the opportunities one has for jobs, traveling, and/or interacting with people from outside the U.S. It is also a tool for having career and/or academic success
heritage/culture	Spanish is an important part of the participant's heritage and culture
insecure	The participant feels insecure when using Spanish and/or in the dialect of Spanish they speak
language loss/important to maintain	The participant has lost proficiency in Spanish and/or believes it is important to maintain Spanish proficiency for themselves and transmit it to the younger generation
Mexico	Spanish has a tie to Mexico
negative/poor	Spanish is used by poor people and people who use it are referred to in a negative/derogatory way
pride	The speaker feels pride in being able to use Spanish
sentimental/home/family	Spanish is a language individuals have strong sentimental ties to spoken in the home and by family members

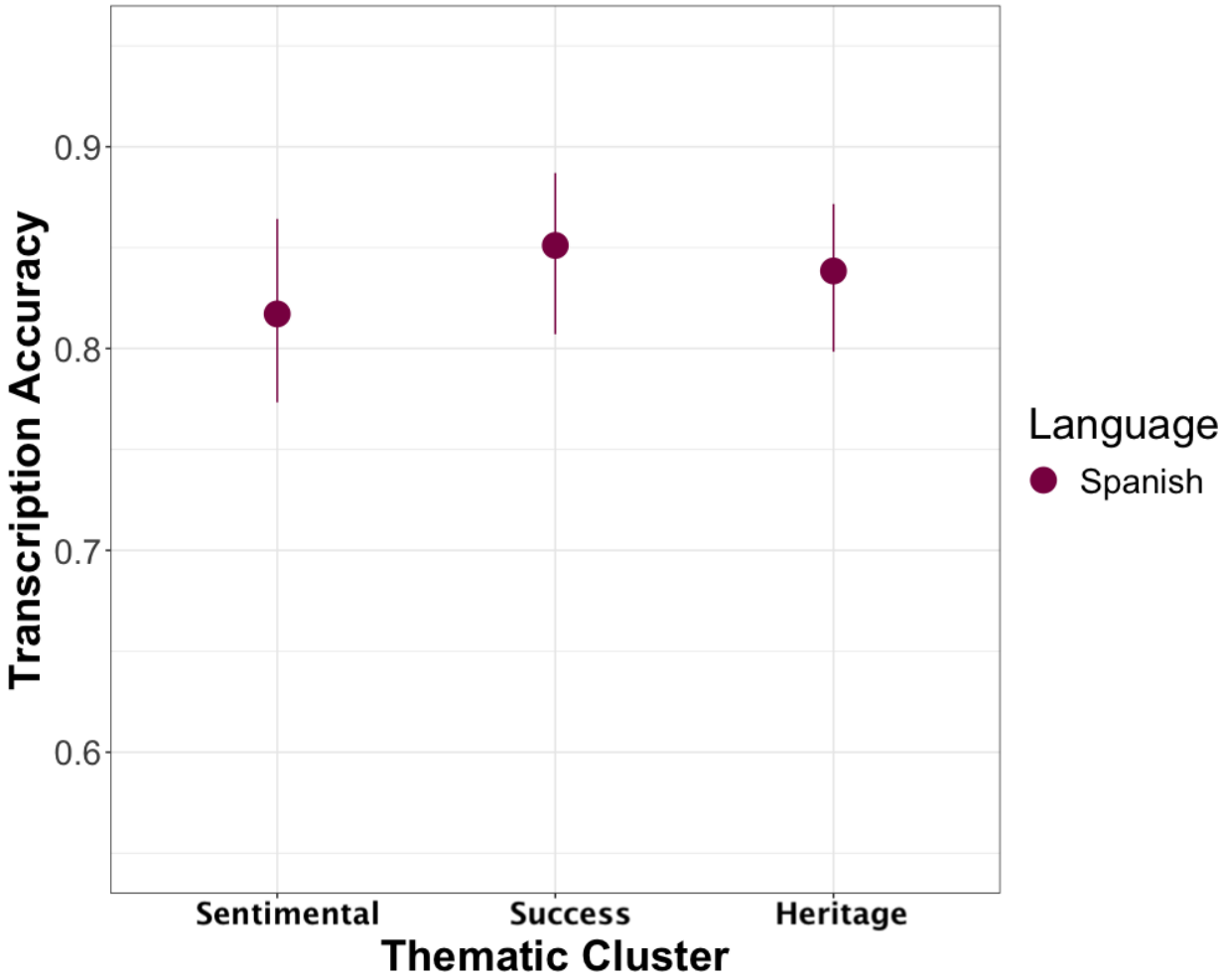
Based on the clustering analysis, four clustering patterns emerged based on the themes found in participants' responses. The first cluster (i.e. sentimental) has 8 participants that indicated that Spanish was a global language that helped them become successful and provided career opportunity, a language with a lot of sentimental value, spoken in their home and with their family, and feeling pride in speaking the language. The second cluster (i.e. success) has 9 participants that indicate that Spanish was a global language that helped them become successful and provide opportunity, part of their heritage and culture, and feeling pride in speaking the language. The third cluster (i.e. heritage) has 32 participants that indicated Spanish as

sentimental, spoken in their home and with their family as well as part of their heritage and culture. The fourth and final cluster (i.e. foreign) has 5 participants that indicated Spanish having aesthetic appeal, being a foreign language, a global language that helped them become successful and provide opportunity, and feeling pride in speaking the language.

In order to see if there was a difference in transcription accuracy in Spanish based on which cluster a participant was in, a logistic mixed-effects model was conducted. The model examined by-word accuracy of the Spanish data depending cluster (cluster two versus cluster one, cluster two versus cluster three; each factor was treatment-coded with cluster one as the reference-level; cluster four was excluded for having five participants). Cluster two (i.e. success), was chosen as the baseline because it was the cluster that had the lowest usage of sentimental and emotional codes. There were two sets of correlated random effects factors: (1) by participant, with a random intercept, and (2) by item, with a random intercept. Results did not show a main effect of cluster one versus two ($\beta = 0.16$, SE $\beta = 0.28$, χ^2 (1) = 0.57, $p < 0.05$), nor of cluster one versus three ($\beta = 0.12$, SE $\beta = 0.22$, χ^2 (1) = 0.52, $p < 0.05$). This indicates that there is no overall difference in performance based on what cluster a participant is in.

Figure 3.16: Clustering of thematic coding for answers for open ended question two (attitudes toward Spanish). The x-axis represents each thematic coding cluster, while the y-axis represents the coding variable. A color gradient indicates how many participants in a cluster indicated a certain coding variable in their response. Light yellow indicated all participants had that coding variable, while black indicates that none had that coding variable.

Figure 3.17: Transcription accuracy in Spanish for Study 2. The x-axis represents the thematic coding cluster for open-ended question 2, while the y-axis represents the average by word accuracy in transcription. (wings show bootstrapped 95% confidence intervals)



In order to better understand the interrelations between the two attitude measures taken (i.e. relative language positivity/negativity score and the cluster), the means of the relative language positivity/negativity scores were calculated for each cluster. As shown in Table 3.10, participants in cluster one (i.e. sentimental) and three (i.e. heritage) have a lower relative language positivity scores and higher relative language negativity score, which indicates that participants have more positive feelings towards their English and more negative feelings

towards their Spanish. However, participants in cluster two (i.e. success) show the opposite for their relative language scores, indicating that participants have more negative feelings towards their English and more positive feelings towards their Spanish. This is also the cluster that has global/success/opportunity as its main thematic code, while cluster one and three have codes that indicate a more sentimental outlook towards Spanish (i.e., sentimental/home/family and heritage/culture).

Table 3.10: Mean relative language positivity/negativity score for each cluster for thematic coding for open-ended question 2 for Study 2

Cluster	**Relative language positivity score**	**Relative language negativity score**
1 - sentimental	-9.38	10.1
2 - success	0.34	-3.28
3 - heritage	-8.83	6.44

Overall, the thematic analysis of question two shows that participants' attitudes towards Spanish does not have an effect on their performance in the Spanish block. However, there does seem to be a difference in relative language positivity and negativity scores based on cluster, which also correlates with differences in the main themes in the clusters for this question.

Open ended question 3

The third open ended question participants answered was "Do you consider code-switching to be an important part of your identity? Why or why not?" The themes found in the responses were the following: ease of use/habit; facilitates communication; fun; intelligent; intimacy; leads to language loss; not part of identity; part of identity; preference depends on setting; pride; shame/less intelligent; shows mixed identity; somewhat part of identity; used to it. Each answer was given between one through four codes.

Table 3.11: Table explaining the mean of each thematic code used for open ended question three

Thematic code	**Meaning**
ease of use/habit	The use of code-switching is habitual and it's easy to use to communicate
facilitates communication	Code-switching makes communication easier, like when a word cannot be retrieved
fun	Code-switching is fun to use
intelligent	The use of code-switching indicates that the speaker is highly intelligent
intimacy	Code-switching is used to indicate intimacy between interlocutors
leads to language loss	The use of code-switching leads to the loss of Spanish proficiency
not part of identity	The participant does not considers code-switching a part of their identity
part of identity	The participant considers code-switching a part of their identity
preference depends on setting	The use of code-switching depends on who the participant is interacting with and the formality of the setting
pride	The participant feels pride in being able to code-switch
shame/less intelligent	The use of code-switching is shameful and indicates lower intelligence
shows mixed identity	Code-switching reflects how the individual part of the Mexican-American community
somewhat part of identity	Code-switching is somewhat, but not fully part of the participant's identity
used to it	Participant is used to hearing or interacting with interlocutors using English

Based on the clustering analysis, two clustering patterns emerged based on the themes found in participants' responses. The first cluster (i.e., part of identity) has 32 participants that indicated that code-switching was part of their identity, that it helped show their mixed Mexican and American identity, and that it helps facilitate communication. The second cluster (i.e., not part of identity) has 21 participants that indicated that code-switching was not part of their identity, and that using it is shameful and an indicator of being less intelligent.

In order to see if there was a difference in transcription accuracy based on which cluster a participant was in, a logistic mixed-effects model was conducted. The model examined by-word

accuracy of all the data depending on language (English versus Spanish), language context (English and Spanish versus code-switch), and cluster (one versus 2). All factors, including cluster, were contrast-coded. There were two sets of correlated random effects factors: (1) by participant, with a random intercept and language and language context as random slopes, and (2) by item, with a random intercept and language and language context as random slopes. Results showed a main effect of single versus code-switch language blocks ($\beta = 0.42$, SE $\beta = 0.15$, χ^2 (1) = 2.8, $p < 0.01$), indicating that participants have higher accuracy in single language blocks than the code-switched block. There was also a main effect of cluster one versus two ($\beta = -0.35$, SE $\beta = 0.15$, χ^2 (1) = -2.36, $p < 0.05$), indicating that participants in cluster one had higher accuracy than those in cluster two. Finally, there was an interaction between English versus Spanish and cluster ($\beta = 0.4$, SE $\beta = 0.19$, χ^2 (1) = 2.14, $p < 0.05$), indicating that participants in cluster one had higher accuracy in the English block than participants in cluster two. There were no other significant effects ($|\chi^2(1)|s < 1.09$, $ps > 0.06$; see Table 3.12).

Figure 3.18: Clustering of thematic coding for answers for open ended question three (attitudes toward code-switching). The x-axis represents each thematic coding cluster, while the y-axis represents the coding variable. A color gradient indicates how many participants in a cluster indicated a certain coding variable in their response. Light yellow indicated all participants had that coding variable, while black indicates that none had that coding variable.

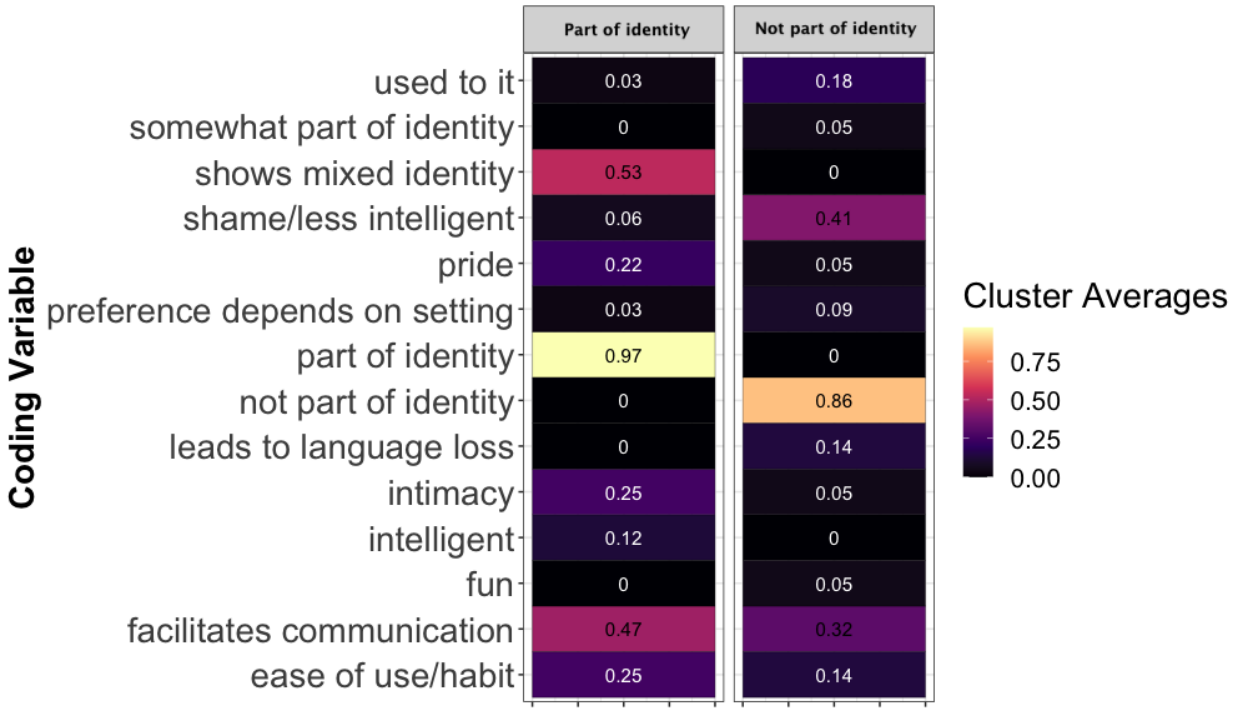


Figure 3.19: Transcription accuracy in Code-switched block for Study 2. The x-axis represents the thematic coding cluster for open-ended question 3, while the y-axis represents the average by word accuracy in transcription. (wings show bootstrapped 95% confidence

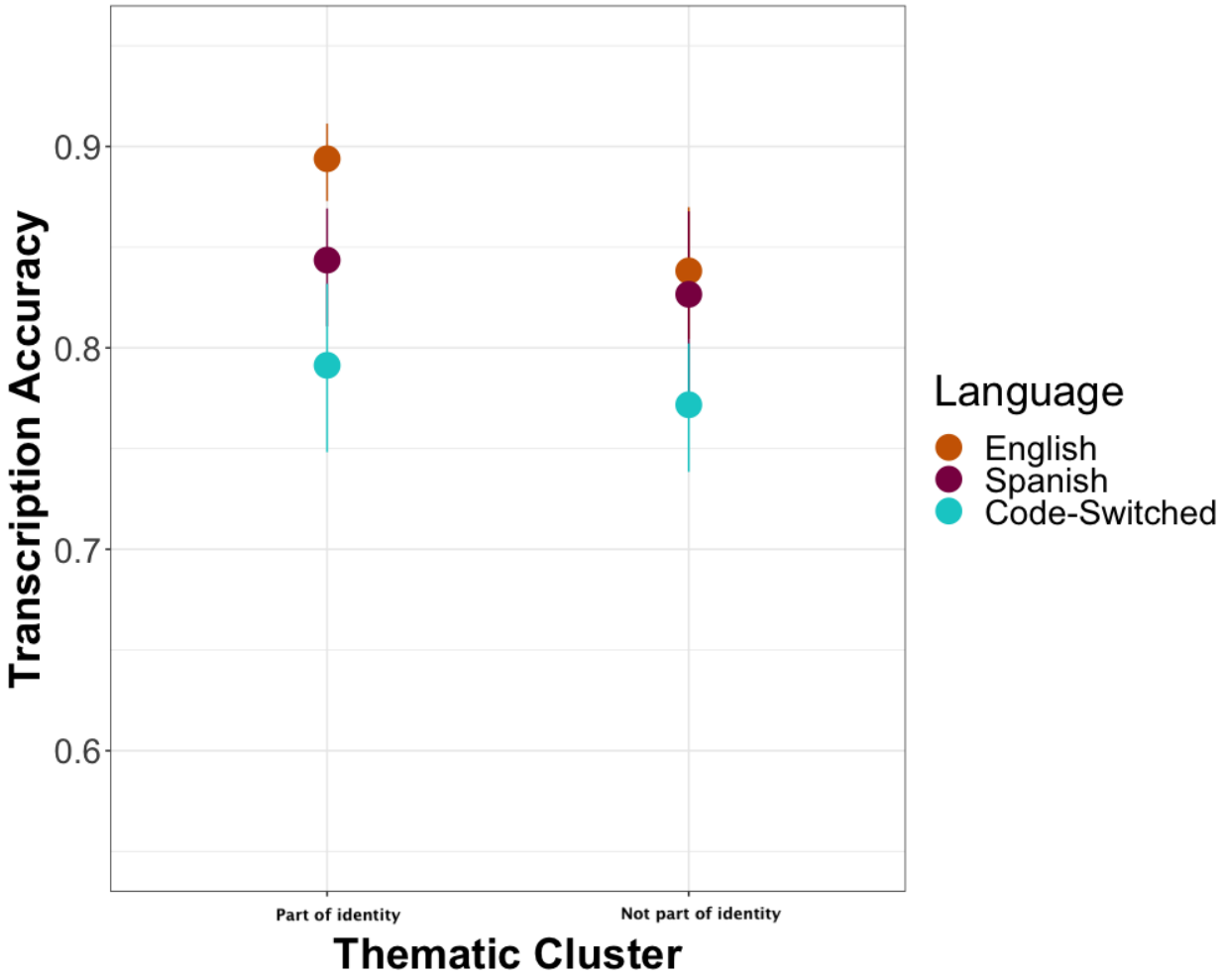


Table 3.12: Results for logistic mixed effects model for accuracy of word transcription and cluster for open ended question 3 for Study 2

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
English versus Spanish	-0.36	0.19	-1.9	0.06
Single versus Code-Switched	0.42	0.15	2.8	<0.01**
Cluster 1 versus cluster 2	-0.35	0.15	-2.36	<0.05*
English versus Spanish X Cluster 1 versus cluster 2	0.4	0.19	2.14	<0.05*
Single versus Code-Switched X Cluster 1 versus cluster 2	0.09	0.18	0.52	0.6

In order to better understand the interrelations between the two attitude measures taken (i.e. relative language positivity/negativity score and the cluster), the means of the relative language positivity/negativity scores were calculated for each cluster. As shown in Table 3.13, participants in cluster one (i.e., part of identity) have a lower relative positivity scores and higher relative language negativity score, indicating that participants have more positive feelings towards their English and more negative feelings towards their Spanish. However, participants in cluster 2 (i.e., not part of identity) have higher relative positivity scores and lower relative negativity scores, indicating that they have more negative feelings towards their English and positive feelings towards their Spanish.

Table 3.13: Mean relative language positivity/negativity score for each cluster for thematic coding for open-ended question 3 for Study 2

Cluster	**Relative language positivity score**	**Relative language negativity score**
1 - Part of identity	-9.38	10.1
2 - Not part of identity	0.34	-3.28

Overall, the thematic analysis of question three shows that participants' attitudes towards code-switching have an effect on their performance in the task. Individuals in cluster one overall had higher transcription accuracy than those in cluster two. Individuals in cluster one also had an effect of language (i.e., higher accuracy in English than Spanish) while those in cluster two did not (i.e., no difference in accuracy in English and Spanish).

Open ended question 4

The fourth open ended question participants answered was "Do you think that Spanish and/or English are an important part of your culture? Of your identity? Why or why not?" The

themes found in the responses were the following: assimilation; both languages are important part of culture; both languages are important part of culture/identity; bridge both cultures; English is default/societal; English is global/success/opportunity; neither language are an important part of culture/identity; neither language is an important part of identity; only English is important part of culture/identity; only Spanish is important part of culture/identity; preference depends on setting; shame in Spanish ability; Spanish is roots. Each answer was given between one through four codes.

Table 3.14: Table explaining the mean of each thematic code used for open ended question four

Thematic code	**Meaning**
assimilation	Their language usage shows their assimilation to American culture and away from Mexican culture
both languages are important part of culture	The participant thinks both English and Spanish are an important part of their culture
both languages are important part of culture/identity	The participant thinks both English and Spanish are an important part of their culture and identity
bridge both cultures	Their knowledge of both languages is a tool to help bridge between American and Mexican culture
English is default/societal	English is the base language used in their community and/or in overall society
English is global/success/opportunity	English is a global language that facilitates the opportunities one has for jobs, traveling, interacting with people from outside the U.S. It is also a tool for having career and/or academic success
neither language are an important part of culture/identity	The participant does not think language is an important part of their culture and identity
neither language is an important part of identity	The participant does not think language is an important part of their identity
only English is important part of culture/identity	The participant thinks only English is an important part of their culture and identity
only Spanish is important part of culture/identity	The participant thinks only Spanish is an important part of their culture and identity
preference depends on setting	The preference of which language to use depends on the setting
shame in Spanish ability	The participant feels shame in their Spanish proficiency, especially when compared to English
Spanish is roots	Spanish is a language that showcases their cultural roots and heritage

Based on the clustering analysis, five clustering patterns emerged based on the themes found in participants' responses. The first cluster (i.e., both identity and English success) has two participants that indicated that both languages are part of their identity, English is a global language that helped them become monetarily successful and provided career opportunity, Spanish is part of their roots, and that they have had to use language to assimilate to U.S. culture.

The second cluster (i.e., both identity) has 31 participants that indicated both languages being a part of their identity. The third cluster (i.e., only Spanish identity) has 7 participants that indicated only Spanish being a part of their identity, as well as Spanish being part of their roots and heritage. The fourth cluster (i.e., English default) has 13 participants that indicated both languages being a part of their identity, English is the default language in society, and Spanish is part of their roots and heritage. The fifth and last cluster (i.e., neither identity) has one participant that indicate that both languages are an important part of culture, but neither language is part of their identity.

In order to see if there was a difference in transcription accuracy based on which cluster a participant was in, a logistic mixed-effects model of the full data set of Experiment 2 was conducted. The model examined by-word accuracy of the data depending on language (English versus Spanish), language context (English and Spanish versus code-switch), and cluster (cluster three versus cluster two and cluster three versus cluster four; clusters one and five were excluded for having five or less participants; each factor was treatment-coded with cluster three as the reference-level). Cluster three (only Spanish identity) was chosen as the reference level because it was the one that had Spanish as part of identity, while the other two clusters indicate both languages are part of identity. There were two sets of correlated random effects factors: (1) by participant, with a random intercept and language and language context as random slopes as random slopes, and (2) by item, with a random intercept and language and language context as random slopes as random slopes. Within each set, random effects were correlated. Results showed no significant effects ($\chi^2(1)$s < 0.89, $p > 0.39$; see Table 3.15). This indicates that there is no difference in performance based on what cluster a participant is in.

Figure 3.20: Clustering of thematic coding for answers for open ended question four (attitudes towards both languages). The x-axis represents each thematic coding cluster, while the y-axis represents the coding variable. A color gradient indicates how many participants in a cluster indicated a certain coding variable in their response. Light yellow indicated all participants had that coding variable, while black indicates that none had that coding variable.

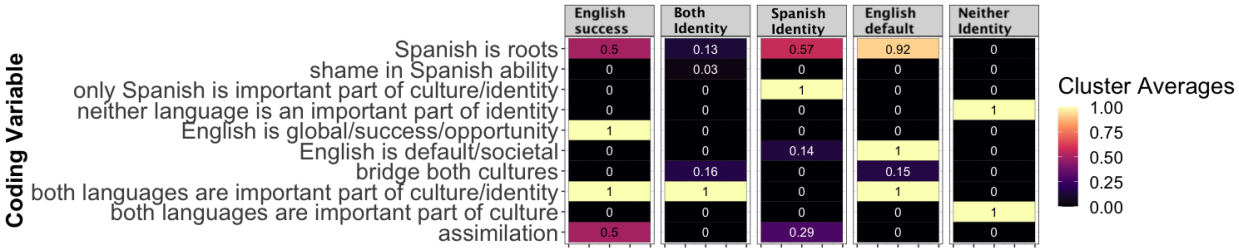


Figure 3.21: Transcription accuracy in English, Spanish, and Code-switched blocks for Study 2. The x-axis represents the thematic coding cluster for open-ended question 4, while the y-axis represents the average by word accuracy in transcription. (wings show bootstrapped 95% confidence intervals)

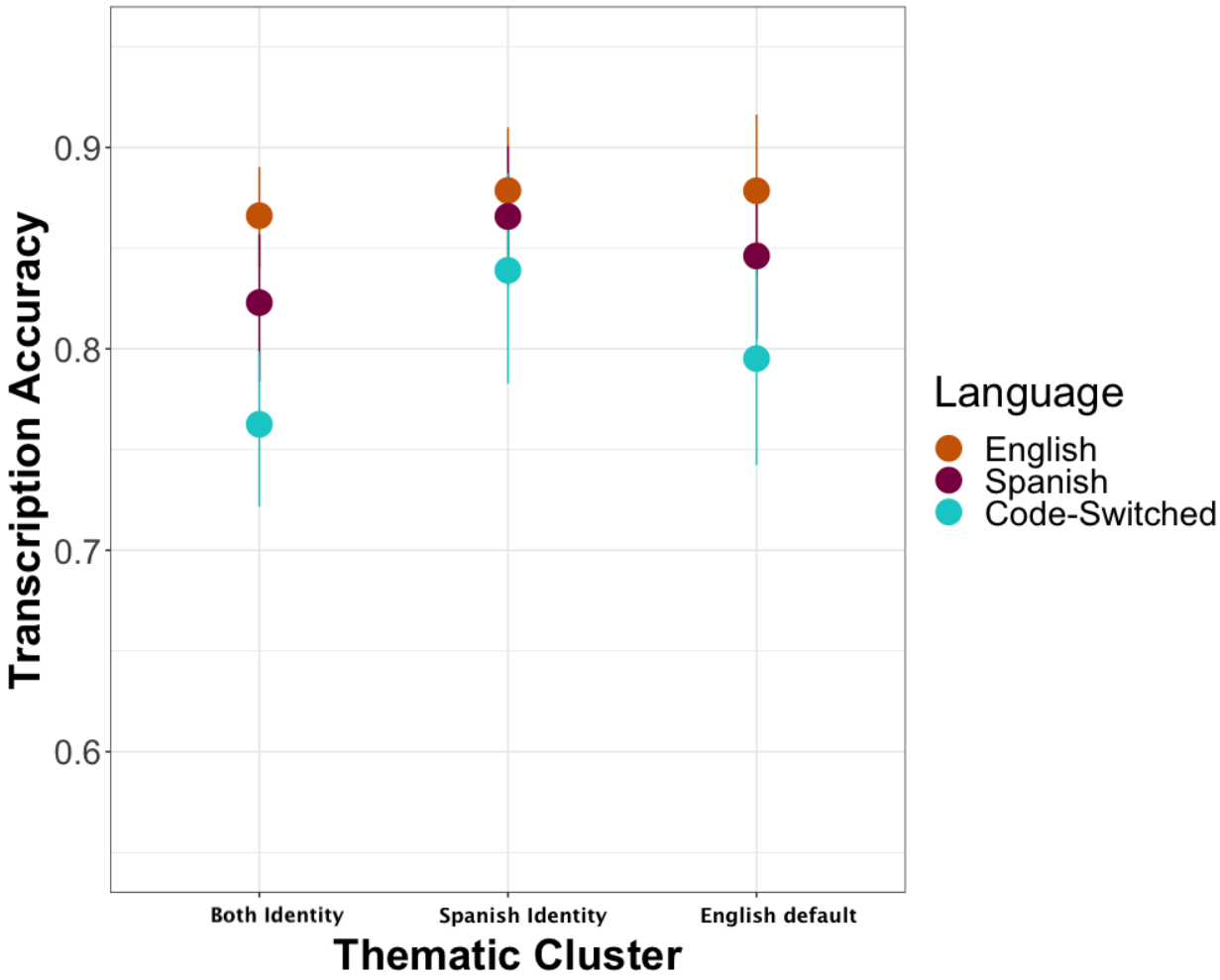


Table 3.15: Results for logistic mixed effects model for accuracy of word transcription and cluster for open ended question 4 for Study 2

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
English versus Spanish	-0.22	0.3	-0.72	0.47
Single versus Code-Switched	0.23	0.26	0.89	0.38
Cluster 3 versus cluster 2	-0.29	0.22	-1.31	0.19
Cluster 3 versus cluster 4	-0.11	0.25	-0.46	0.65
English versus Spanish X Cluster 3 versus cluster 2	-0.23	0.29	-0.79	0.43
English versus Spanish X Cluster 3 versus cluster 4	-0.23	0.32	-0.72	0.47
Single versus Code-Switched X Cluster 3 versus cluster 2	0.22	0.26	0.84	0.40
Single versus Code-Switched X Cluster 3 versus cluster 4	0.17	0.29	0.58	0.57

In order to better understand the interrelations between the two attitude measures taken (i.e. relative language positivity/negativity score and the cluster), the means of the relative language positivity/negativity scores were calculated for each cluster. As shown in Table 3.16, participants, regardless of clusters, have lower relative positivity score and higher relative language negativity score, which indicates that participants have more positive feelings towards their English and more negative feelings towards their Spanish.

Table 3.16: Mean relative language positivity/negativity score for each cluster for thematic coding for open-ended question 4 for Study 2

Cluster	**Relative language positivity score**	**Relative language negativity score**
2 – both identity	-8.2	5.87
3 – Spanish identity	-2.35	4.98
4 – English default	-5.15	2.69

Overall, the thematic analysis of question four shows that participants' attitudes their languages does not have an effect on their performance in the task. There were no significant effects of cluster nor was there much variation in the language positivity or negativity scores.

3.7 Discussion

The current study examined how Mexican-American Spanish heritage bilingual's experiences and attitudes with English, Spanish, and code-switching affect their sensitivity to perceptual difficulties when speech is in different language contexts. We found effects of language dominance and language context, as well as certain types of experiences (as shown by social network size) and attitudes (as shown by positive self-perception perception attitudes) modulating the effect of language dominance or of language context. Additionally, we found that experience indexed by social network modulated the language dominance effect in the non-dominant language, as well as relative positive self-perception perception attitudes modulating language accuracy in the non-dominant language.

This study replicated language dominance effects found in previous work (Blasingame & Bradlow, 2020), as well as in chapter 2 of this work, with bilinguals having higher transcription accuracy in English blocks than Spanish blocks. Language proficiency measured through the bilingualism index did not significantly modulate the effect of language dominance. Whether or not participants were more English dominant or closer to balanced bilinguals, they had higher accuracy in the English block than the Spanish block. However, social network size seemed to have an effect on performance in the non-dominant language. Participants with larger Spanish social networks had higher accuracy in the Spanish block. To understand this result, we can turn to previous work on the effect of social network size in monolingual participants. This work has

suggested that participants with larger social networks have more robust speech sound categories that are less susceptible to the influence of recent experience relative to individuals with smaller social networks (Lev-Ari, 2017). This effect could be extended to this work by suggesting that, in more degraded listening environments like speech in noise, participants with larger social networks in Spanish have more robust Spanish phonetic categories which allows them to more accurately perceive speech when compared to participants with smaller social networks. It is possible that this effect is not seen in English because they have overall more robust categories in their dominant language, and the listening environment needs to be more degraded to see this effect. Additionally, it is possible that there needs to be a certain amount of range and variability in social network size in order for an effect to be detected. However, English social networks are on average were larger than Spanish, as well as had a larger range (i.e., 5-80 in English versus 4-60 in Spanish). This suggests that a larger social network in the non-dominant language creates a boost in perception for that language, but a certain range across the participants is needed in order for this effect to be detected. It is possible that much larger social networks than the participants had here are needed to see a boost the perception of sentences in the dominant language. Replicating this study with a heritage bilingual population with a larger range of English social networks could untangle this possibility.

This study also found language context effects, in which participants had higher accuracy when transcribing English or Spanish-only sentences in comparison to when they transcribed code-switched sentences. Less effortful use of languages in single versus code-switched contexts has been found in speech production studies (measured through reaction times, e.g., Meuter & Allport, 1999), as well as in single-word transcriptions (Garcia et al., 2018). Our results follow

these previous findings, indicating that the language control mechanisms bilinguals use to inhibit and/or activate languages perform similarly across speech perception and production.

The results from the relative language positivity and negativity scores from Likert scales provided insight on their attitudes. Overall, participants seemed to have more positive attitudes about their English and more negative attitudes about their Spanish, which is seen by the variation in the distribution of positivity and negativity scores in figures 3.10 and 3.11. Our findings show that higher relative language positivity scores (i.e., indicating more positive Spanish attitudes) correlate to lower transcription accuracy. However, we did not find effects of negative self-perception perception attitudes. One reason for this is that the distribution for relative language negativity score is not as skewed when compared to the one for language positivity, which is heavily skewed towards English. It is possible that a skewed distribution, which would cause a bigger differences between participants with more English or more Spanish scores, is needed in order for a relative language score to modulate task performance. The modulation of relative language positivity score as well as the variation in distributions provides additional evidence that differences across language attitudes can modulate performance in experimental tasks. However, a certain threshold of variation across the population needs to appear in order to detect differences in the experimental task.

The thematic coding provided further evidence that participants have different language attitudes, and showcases the heterogeneity of the Mexican-American Spanish heritage bilingual community in the United States. For all questions answered, a range of two to five clusters emerged, showing how participants varied on their attitudes and identification of their languages and language usage. There was variation in transcription accuracy for question 3, which analyzed

the question about code-switching and identity. Individuals who considered code-switching part of their identity had higher transcription accuracy than those who did not consider it part of their identity. Additionally, the ones who considered code-switching part of their identity had higher transcription accuracy in English in comparison to Spanish, while participants who did not consider code-switching part of their identity performed similarly in English and Spanish. Yet participants in both groups performed similarly in Spanish, indicating that participants who consider code-switching part of their identity had a boost in English performance. This difference also correlates with bilingualism index scores. Participants who consider code-switching part of their identity have lower bilingualism index scores (i.e., further from being balanced bilinguals; mean 0.64) than those who do not consider it part of their identity (mean 0.72). This suggests that participants who do not consider code-switching part of their identity may do so because they have higher Spanish proficiency levels. Given that they also lean towards Spanish in their relative language positivity scores (0.34 versus -9.38 for group 1), this suggests that the participants who do not consider code-switching part of their identity have stronger ties to Spanish, and, potentially, to Mexico and Mexican culture. This correlates with previous findings (Rosa, 2019; Urciuoli, 1996) that code-switching is used to create a mixed identity between Mexican and American culture. Therefore, individuals who align with Mexican culture more so than a mixed culture do not have a need for code-switching. For the other questions, there was no effect of cluster and performance in the experimental task. A potential explanation for this is that there were not enough participants in this study to observe significant differences for clustering analyses that yielded more than two clusters. Therefore, the main takeaway from this analysis is that there is heterogeneity in participants' attitudes, thoughts, and

experiences with their languages, but more participants are needed in studies to statistically detect how language attitude differences can affect task performance if participants are categorized in more than two clusters.

3.8 Conclusion

The current study investigated how heritage speakers' experiences with their languages in different contexts and attitudes towards code-switching affect their auditory perception of code-switching in a speech in noise task. We found that heritage speakers were better at perceiving speech in single language blocks than code-switched blocks (Garcia et al., 2018), as well as better at perceiving their dominant language (i.e., English) than their non-dominant language (i.e., Spanish; Blasingame & Bradlow, 2020). Additionally, we found that certain types of experiences (as shown by the social network) and attitudes (as shown by the thematic coding cluster analysis of open ended question 3) modulated the effect of language dominance or of language context, providing evidence that individual differences within the heritage bilingual population may affect their performance in experimental tasks.

Chapter 4: Conclusion

This dissertation examined the consequences that language attitudes and experiences have on heritage bilinguals' language processing. This was done through two speech perception studies. Study 1 examined the effect of attitudes and experiences on the perception of prestigious (i.e., monolingual) and stigmatized (i.e., L2-talker) talkers in both English and Spanish. The results of this study showed that heritage bilinguals were better at perceiving English than Spanish, however, the effect of social manipulation was found in only one of two talker groups. In order to better understand the modulation of language attitudes and experiences on language processing, bilingualism index, social network, relative language positivity and negativity scores, and the thematic coding of open ended attitudes questions were analyzed. The results showed that bilingualism index, relative language positivity score, and certain types of attitudes revealed in open ended questions modulated accuracy in English and Spanish. Additionally, analyses with these individual differences showed a robust social information effect in Spanish (i.e., higher accuracy when told a talker is monolingual). This shows how investigating experiences and attitudes can provide insight into the effect of social manipulations.

Study 2 examined the effect of language attitudes and experiences on the perception of English-only, Spanish-only, and code-switched sentences. Results showed that heritage speakers were more accurate in their perception of English-only and Spanish-only sentences than code-switched sentences, as well as better at perceiving English than Spanish, replicating the results of Study 1. As in Study 1, to better understand the modulation of language attitudes and experience, bilingualism index, social network, relative language positivity and negativity scores, and open ended attitudes questions were analyzed. Having a larger Spanish social network size, as well as

more relative language positivity towards English, correlated with higher accuracy in the Spanish block. Additionally, the inclusion of code-switching as part of a participant's identity affected their overall accuracy. Participants who considered code-switching as a part of their identity had higher accuracy in English than Spanish than those who did not consider code-switching a part of their identity.

4.1 The heterogeneity of the Mexican-American bilingual community

Overall, the results of these studies show that the variability across Mexican-American Spanish heritage bilinguals has consequences in their performance of experimental speech perception tasks. For example, the effect of social information manipulation in Study 1 varied depending on certain attitudes. For the main statistical model for Study 1, there was an effect of social information manipulation for talker group one, but not for talker group two nor the model merging both talker groups. Yet, once bilingualism index and relative language positivity and negativity scores are added into the statistical model, there is an effect of social information manipulation. This suggests that, in order to detect this effect, additional variability needed to be included into the model. This highlights how important it is for future research to focus on taking language attitudes and experience into account when investigating social effects.

However, as seen across Study 1 and 2, the distribution and therefore the observed impact of individual differences varies across studies. For example, in Study 1, participants tended to have lower bilingualism index values relative to participants in Study 2. The difference in distribution affected our ability to detect the effect of bilingualism index across studies, with participants with higher bilingualism index having higher Spanish accuracy in Study 1, while it had no effect in Study 2. There are also differences in how participants responded to the open

ended questions, which impacted the formation of the clusters. For example, for open ended question one, there were a total of four clusters for Study 1, and a total of three clusters for Study 2. Although there were some similarities across some clusters (e.g., both had a "comfortable" cluster), the details of each cluster was different (e.g., 100% of participants indicated comfortable and 37% indicated default for Study 1, while 100% indicated default and 84% indicated comfortable for Study 2). For participants in the "comfort" cluster in Study 1, there is an effect of social manipulation, while there's no effect for those in Study 2. The distribution and effects of individual differences could be explained by differences in the sample size of each study (i.e., 112 for Study 1 and 54 for Study 2) – maybe this is simply due to random variation. Yet, the differences in the distribution of language experiences and attitudes for both these studies suggests that variation is not randomly and equally distributed across this population. By looking at descriptive properties (e.g., age, level of education, etc.) there are differences which could contribute to the distribution of variation across the Mexican-American heritage bilingual population. For instance participants from Study 1 were recruited using Prolific (www.prolific.co), while participants from Study 2 were recruited using social media recruitment and through university listservs. Both of these methods are used to recruit participants in many social science experiments, yet, the work here highlights how each of these recruitment methods collects participants from different subsets of the population. For example, participants from Study 2 had higher Spanish proficiency than those in Study 1, and the importance of this difference is shown in the difference of English versus Spanish transcription, with there being larger differences in accuracy for Study 1 than for Study 2.

As seen in these studies, there are weak effects of language experiences and attitudes, which, with the amount of variation across samples, can make it difficult to find evidence of the effects. It can also be difficult to figure out how to find the sufficient variability to find some of these small effects. It is possible that the use of different recruitment methods could be enough. However, there are many other differences across this population (e.g., political affiliation, level of education, dialect of Mexican Spanish spoken, etc.) that could affect language attitudes and experiences; it's not clear if simply using different recruiting channels (e.g., Prolific vs. social media) would be sufficient to provide enough variability. This highlights the challenges of capturing the true diversity of the Mexican-American Spanish heritage bilingual population. Future studies should think of how to best sample heritage bilingual populations. In order to truly capture the diversity of a population, it is important to think of multiple ways to recruit participants.

4.2 Capturing attitudes

Two methods were used to capture participants language attitudes: Likert scales and open ended questions. Each of these methods helped capture attitudes from a different angle. The Likert scales were used to observe the difference in participants' positive and negative attitudes towards both their languages. Their responses were used to calculate a relative language positivity or negativity score, which showed if an individual had more positive or negative self-perception of their own English or Spanish. Open ended questions were used to better understand participants' attitudes in whichever way they chose to interpret the question. All questions asked them to reflect on their relationship with their languages, however, many participants responses mentioned themselves in a societal context or described other people's experiences in

juxtaposition to their own. This was important information to collect since it shows participants' relationships with their languages outside of themselves and in a broader societal context, complimenting data from the Likert scales show participants' relationships with their languages within themselves.

In several cases, results from the two methods converged. For example, for open ended question one, Study 1, there were four clusters: success and opportunity, effortful for others, default, and comfortable. The expectations was for those who indicated comfortable and success and opportunity to have more English leaning language positivity scores, which they did. Another example can be seen for open ended question one, Study 2, which had three clusters: effortful for others, default and success, and comfortable. The expectations was for those who indicated comfortable to have more English leaning language positivity scores, which they did. They also had the most Spanish leaning relative language negativity scores, which was also expected.

Yet, the meaning of Likert scales and open ended questions did not always converge, which can be seen in open ended question four, Study 1. For this question, there were two clusters: both languages are part of identity and Spanish is part of identity. The expectation would be that participants who only consider Spanish as part of their identity would have more English leaning relative language negativity scores and more Spanish leaning relative language positivity scores. However, there was no real difference in relative language positivity or negativity scores based by cluster. Another example of this can be seen in open ended question 2, Study 1. For this question, there was a significant difference in performance between two clusters: success and opportunity and aesthetic appeal. Those who indicated that Spanish had

aesthetic appeal had higher performance in Spanish than those who said Spanish provided success and opportunity. Yet, those who indicate aesthetic appeal had more English leaning relative language positivity score and more Spanish leaning relative language negativity score, when the opposite was expected. This discrepancy suggests that the open ended questions are capturing different language attitudes and ideologies that the Likert scales. Therefore, it is important multiple methods are used, so that the richness of these language attitude can be better captured. Based on the results of this work, future studies should incorporate the use of multiple methods to capture language attitudes, since each method captures different aspects of an individuals' attitudes.

4.3 Limitations

One of the limitations of this project is that transcription accuracy was the only dependent measure used. Additional measures of transcription performance (e.g., speed, errors) could provide a more nuanced picture of performance in this task. More broadly, in the context of aiming to specifically study speech perception, transcription may also serve to over-emphasize orthographic factors. Although many models of spoken word recognition assume speech is processed without influence from orthography, there is evidence that orthography can affect performance in speech perception tasks (Olson, 1996). There is also evidence that illiteracy and type of writing system can affect the perception of phonemes (Morais et al., 1986). The heritage bilinguals who participated in this task heavily varied in their proficiency as well as education levels of Spanish, which could impact the performance in the task. In order to have a more holistic understanding of the effect of experiences and attitudes in heritage bilinguals, future

work should use alternate speech perception methodologies that limit the use of orthography (e.g., EEG, button pressing), as well as speech production tasks (e.g., picture naming, map task).

Another limitation of the project is the limited scope of the experience and attitudes measures. Social network was the only experience measure used here, but other measures commonly used to capture heritage bilinguals' experiences are questionnaires (e.g., Language Experience and Proficiency Questionnaire, Marian et al. 2007; Bilingual Language Profile, Birdsong et al., 2012). Unlike the social network questionnaire used in this project, other questionnaires ask questions about which culture an individual identifies with, as well as which language an individual prefers to use in different scenarios (e.g., when reading, when talking to a fluent bilingual; Marian et al. 2007; Birdsong et al., 2012). These questionnaires could be used to better understand heritage bilinguals' language experiences. Additionally, total size of social network was the main measure used, when other work has measured social network density, strength of ties, and the connections between other people within the participants' social network (e.g., Tiv et al. 2020), which can provide additional insights into participant's language experiences. Additionally, using single summary value for positive or negative Likert scale items can erase the fine grained variation of participants' response across individual questions. These scores were created in order to be able to compare participants attitudes between English and Spanish. While this provided the information needed for our current analysis, other methods might reveal more information. Rather than focusing on a single score, the contribution from English and Spanish items could be separately incorporated into the model. Alternate methods of analyzing Likert scales could also be used (e.g., factor analysis that allows for more than one dimension to characterize positive or negative questions) and/or different types of attitude

measures could be incorporated into the survey (e.g., semantic differential scales, or Likert scales with antonyms at each end point). The use of thematic coding and cluster analysis categorized people into different groups. Although the annotators tried their best to be as unbiased as possible, it is possible that their experiences as heritage bilinguals colored their thematic coding of open ended responses. The use of more annotators, including annotators who are not heritage bilinguals, could add to the reliability of themes, as well as showcase how an annotators background can affect their coding.

4.4 Broader implications and future work

Future work should investigate different language experiences and attitudes not captured in this work. For example, this study did not take inter-generational differences based on immigrant status (i.e., first, second, and third generation) into account, but there is evidence that language experiences vary based on this. First generation speakers tend to be either monolingual Spanish speakers or Spanish dominant bilinguals. Second generation speakers range from being balanced bilinguals to being English dominant bilinguals. By the third generation, speakers may or may not be bilingual. If they are bilingual, they are English dominant. Usually the heritage language is no longer transmitted to the fourth generation, and it has been lost (Rivera-Mills, 2012). The variation in language dominance and usage across generations could affect language processing, and should be investigated.

This work focused on the Mexican-American community in order to control for dialectal differences, as well as language experiences and attitudes that may arise for dialectal differences. For example, Puerto Rican Spanish has different phonological processes from Mexican Spanish such as the aspiration or deletion of /s/, the spirantization of /r/ to [χ], and the lateralization of /r/

to [l], among others (Ortiz López, 2023). Therefore, it is possible that individuals that speak Mexican Spanish may have a harder time understanding Puerto Rican Spanish. There is also evidence that not only the use of Spanish, but the dialect of Spanish spoken by Latinos in the United States affects the racialization of Latinos within their community (DeGenosva & Ramos-Zayas, 2003). Therefore, a study looking at the perception of heritage bilingual talkers who speak a different dialect of Spanish than the listeners (e.g., a Mexican-American heritage bilingual talker and a Puerto Rican-American heritage bilingual listener) could provide insight on how experience with different dialects (e.g., Clopper & Pisoni, 2007), as well as attitudes towards different dialects within the pan-ethnic Latino community affects heritage bilinguals' language processing.

Replicating this work with other Latino communities could provide more evidence towards the effect of language experiences and attitudes, as well as provide a better understanding of how the variation in attitudes across different communities affects language processing. For example, Latinos of Puerto Rican descent are the second largest Latino community in the United States, making up 9.5% of the Latino population (Noe-Bustamante, 2019). As a U.S. territory, the history of Puerto Ricans immigrating to the U.S. is different from Mexicans, which could influence language attitudes and ideologies. Additionally, investigating Latinos of mixed ethnic descent (e.g., MexiRicans, or individuals with one Mexican and one Puerto Rican parent; e.g., Potowski & Matts, 2008) and their variation in Spanish dialect and experiences and attitudes towards different dialects could provide insights into how being exposed to multiple dialects could affect their speech processing.

4.5 Conclusion

This project examined the consequences that language attitudes and experiences have on heritage bilinguals' language processing. This was done through two speech perception studies which tested how experience and attitudes affect the perception of prestigious and stigmatized (i.e., monolingual versus L2-talker) talkers (Study 1) and of stigmatized ways of talking (i.e., code-switching; Study 2). Results showed speech perception variability depending on participants' language experience and attitudes, but which experiences or attitudes modulated speech perception varied depending on the study. This provides evidence for the importance of taking the heterogeneity of language experiences and attitudes into account when investigating heritage bilinguals' language processing.

References

Adler, R. M., Valdés Kroff, J. R., & Novick, J. M. (2020). Does integrating a code-switch during comprehension engage cognitive control?. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *46*(4), 741.

Altarriba, J., Kroll, J., Sholl, A., & Rayner, K. (1996). The influence of lexical and conceptual constraints on reading mixed-language sentences: Evidence from eye-fixation and naming times. *Memory & Cognition, 24*, 477-492.

Babel, M., & Russell, J. (2015). Expectations and speech intelligibility. *The Journal of the Acoustical Society of America*, *137*(5), 2823-2833.

Badiola, L., Delgado, R., Sande, A., & Stefanich, S. (2018). Code-switching attitudes and their effects on acceptability judgment tasks. *Linguistic Approaches to Bilingualism*, *8*(1), 5-24.

Bak, T. H. (2016). Cooking pasta in La Paz: Bilingualism, bias and the replication crisis. *Linguistic Approaches to Bilingualism*, *6*(5), 699-717.

Bates, B., Kliegl, R., Vasishth, S., and Baayen, H. (2015). *Parsimonious Mixed Models*. arXiv preprint available at https://arxiv.org/pdf/1506.04967.pdf

Beatty-Martínez, A. L., & Dussias, P. E. (2017). Bilingual experience shapes language processing: Evidence from codeswitching. *Journal of Memory and Language*, *95*, 173-189.

Birdsong, D., Gertken, L. M., & Amengual, M. (2012). Bilingual language profile: An easy-to-use instrument to assess bilingualism. *COERLL, University of Texas at Austin*.

Blasingame, M., & Bradlow, A. R. (2020). Early versus Extended Exposure in Speech Perception Learning: Evidence from Switched-Dominance Bilinguals. *Languages*, *5*(4), 39.

Boersma, P. & Weenink, D. (2021). Praat: doing phonetics by computer [Computer program]. Version 6.1.48. http://www.praat.org/

Borrie, S.A., Barrett, T.S., & Yoho, S.E. (2019). Autoscore: An open-source automated tool for scoring listener perception of speech. *Journal of Acoustical Society of America, 145*, 392-399. doi:10.1121/1.5087276

Bosch, L., & Sebastián-Gallés, N. (2003). Simultaneous bilingualism and the perception of a language-specific vowel contrast in the first year of life. *Language and speech*, *46*(2-3), 217-243.

Bosma, E., & Blom, E. (2019). A code-switching asymmetry in bilingual children: Code-switching from Dutch to Frisian requires more cognitive control than code-switching from Frisian to Dutch. *International Journal of Bilingualism*, *23*(6), 1431-1447.

Bradlow, A. R. (n.d.) ALLSSTAR: Archive of L1 and L2 Scripted and Spontaneous Transcripts And Recordings. Retrieved from https://oscaar3.ling.northwestern.edu/ALLSSTARcentral/#!/recordings.

Bradlow, A. R., & Bent, T. (2008). Perceptual adaptation to non-native speech. *Cognition*, *106*(2), 707-729.

Bullock, B. E., Hinrichs, L., & Toribio, A. J. (2017). World Englishes, Code-Switching, and Convergence. In M. Filppula, J. Klemola, & D. Sharma (Eds.), *The Oxford Handbook of World Englishes* (pp. 211-231). New York, NY: Oxford University Press.

Castelló, X., Eguíluz, V. M., San Miguel, M., Loureiro-Porto, L., Toivonen, R., Saramäki, J., & Kaski, K. (2008). Modelling language competition: bilingualism and complex social networks. In *The evolution of language* (pp. 59-66).

Chevrot, J., Drager, K., & Foulkes, P. (2018). Editors' introduction and review: Sociolinguistic variation and cognitive science. *Topics in Cognitive Science, 10*(4), 679-695.

Clopper, C. G., & Pisoni, D. B. (2007). Free classification of regional dialects of American English. *Journal of phonetics*, *35*(3), 421-438.

Clopper, C. G., & Pisoni, D. B. (2004). Effects of talker variability on perceptual learning of dialects. *Language and Speech*, *47*(3), 207-238.

de Jong, N. & Wempe, T. (2008). Praat script speech rate. *Retrieved* February, 15, 2021.

DeGenosva, N., & Ramos-Zayas, A. (2003). *Latino crossings: Mexicans, Puerto Ricans, and the politics of race and citizenship.* New York: Routledge.

Dewaele, J.M., & Wei, L. (2014). Attitudes towards code-switching among adult mono- and multilingual language users, *Journal of Multilingual and Multicultural Development*, *35*(3), 235-251.

Farr, M. (2006). *Rancheros in Chicagoacán: Language and identity in transnational community.* Austin, TX: University of Texas Press.

Flege, J. (1995). Second Language Speech Learning Theory, Findings, and Problems. In *Speech perception and Linguistic Experience: Issues in Cross-Language Research* (Winifred Strange). York Press.

Flege, J. E., MacKay, I. R., & Meador, D. (1999). Native Italian speakers' perception and production of English vowels. *The Journal of the Acoustical Society of America*, *106*(5), 2973-2987.

Fought, C. (2010). Language as a representation of Mexican American identity. *English Today, 26*(3), 44-48.

Fought, C. (2002). *Chicano English in context.* Springer.

García, P. B., Leibold, L., Buss, E., Calandruccio, L., & Rodriguez, B. (2018). Code-switching in highly proficient Spanish/English bilingual adults: Impact on masked word recognition. *Journal of Speech, Language, and Hearing Research*, *61*(9), 2353-2363.

Garcia, D. & Gollan, T. H. (2022). The MINT Sprint: Exploring a fast administration procedure with an expanded Multilingual Naming Test. *Journal of the International Neuropsychological Society.*

García Bedolla, L. (2003). The identity paradox: Latino language, politics and selective dissociation. *Latino Studies, 1*(2), 264-283.

Gollan, T. H., Weissberger, G. H., Runnqvist, E., Montoya, R. I., & Cera, C. M. (2012). Self-ratings of spoken language dominance: A Multilingual Naming Test (MINT) and preliminary norms for young and aging Spanish-English bilinguals. *Bilingualism: Language and Cognition, 15*, 594–615. https://doi.org/10.1017/ S1366728911000332

Gonzalez, G. (2011). Spanish heritage language maintenance: The relationship between language use, linguistic insecurity, and social networks. [Doctoral Dissertation, The University of Arizona].

Green, D. W., & Wei, L. (2014). A control process model of code-switching. *Language, Cognition and Neuroscience, 29*(4), 499-511.

Hayes-Bautista, D. E., & Chapa, J. (1987). Latino terminology: Conceptual bases for standardized terminology. *Am J Public Health American Journal of Public Health,77*(1), 61-68.

Henning, C. (2023). *fpc: Flexible Procedures for Clustering.*

Hulsen, M., De Bot, K. Weltens, B. (2002) Between two worlds. Social networks, language shift, and language processing in three generations of Dutch migrants in New Zealand. *International Journal of the Sociology of Language*, *153*, 27-52.

Kaan, E., Kheder, S., Kreidler, A., Tomić, A., & Valdés Kroff, J. R. (2020). Processing code-switches in the presence of others: An ERP study. *Frontiers in psychology*, *11*, 1288.

Krizman, J., Bradlow, A. R., Lam, S. S. Y., & Kraus, N. (2017). How bilinguals listen in noise: linguistic and non-linguistic factors. *Bilingualism: Language and Cognition*, *20*(4), 834-843.

Lippi-Green, R. (2012). *English with an accent: Language, ideology, and discrimination in the United States*. New York, NY: Routledge.

Lev-Ari, S. (2018). Social network size can influence linguistic malleability and the propagation of linguistic change. *Cognition*, *176*, 31-39.

Lev-Ari, S. (2017). Talking to fewer people leads to having more malleable linguistic representations. *PloS one*, *12*(8).

Lev-Ari, S. (2015). Comprehending non-native speakers: Theory and evidence for adjustment in manner of processing. *Frontiers in psychology*, *5*, 1546.

Mack, M. (1989). Consonant and vowel perception and production: Early English-French bilinguals and English monolinguals. *Perception & Psychophysics*, *46*(2), 187-200.

Marian V., Blumenfeld H.K., Kaushanskaya M. (2007). The language experience and proficiency questionnaire (LEAP–Q): Assessing language profiles in bilinguals and multilinguals. *Journal of Speech, Language, and Hearing Research, 50*, 940–967.

Marian, V., & Spivey, M. (2003). Competing activation in bilingual language processing: Within-and between-language competition. *Bilingualism*, *6*(2), 97.

Martínez, G. (2006). *Mexican Americans and language: Del dicho al hecho.*The University of Arizona Press.

Mayo, L. H., Florentine, M., & Buus, S. (1997). Age of second-language acquisition and perception of speech in noise. *Journal of speech, language, and hearing research*, *40*(3), 686-693.

McGowan, K. B. (2015). Social expectation improves speech perception in noise. *Language and Speech*, *58*(4), 502-521.

McAuliffe M., Socolof M., Mihuc S., Wagner M. and Sonderegger M. (2017). Montreal Forced Aligner: trainable text-speech alignment using Kaldi. In *Proceedings of the 18th Conference of the International Speech Communication Association*.

Mendoza-Denton, N. (2008). *Homegirls: Language and cultural practice among Latina youth gangs.* Malden, MA: Blackwell Publishing.

Meuter, R. F., & Allport, A. (1999). Bilingual language switching in naming: Asymmetrical costs of language selection. *Journal of Memory and Language*, *40*(1), 25-40.

Mexican: immigration and relocation in U.S. history: classroom materials at the library of congress: library of Congress. The Library of Congress. (n.d.). https://www.loc.gov/classroom-materials/immigration/mexican/

Montrul, S. (2010). Current issues in heritage language acquisition. *Annual Review of Applied Linguistics, 30*, 3.

Montrul, S. (2016). *The acquisition of heritage languages*. Cambridge University Press.

Morais, J., Bertelson, P., Cary, L., & Alegria, J. (1986). Literacy training and speech analysis. *Cognition, 24*, 45–64.

Muysken, P. (2000) *Bilingual speech: A typology of code-mixing*. Cambridge: Cambridge University Press.

Neuliep, J. W. & Speten-Hansen, K. M. (2013). The influence of ethnocentrisim on social perceptions of nonnative accents. *Language and Communication, 33*(3), 167-176.

Niedzielski, N. (1999). The effect of social information on the perception of sociolinguistic variables. *Journal of language and social psychology*, *18*(1), 62-85.

Nieto, D. (2009). A brief history of bilingual education in the United States. *Perspectives on Urban Education, 6*(1), 61-69.

Noe-Bustamante, L. (2019). Key facts about U.S. Hispanics and their diverse heritage. Retrieved, June 14, 2023, from https://www.pewresearch.org/short-reads/2019/09/16/key-facts-about-u-s-hispanics/

NUSUB-DB Paper Questionnaire (n.d.) Speech Communication Research Group Experiment Running. https://groups.linguistics.northwestern.edu/speech_comm_group/documents/nusubdb_allPages.pdf

Olson, D.R. (1996). Towards a psychology of literacy: On the relations between speech andwriting. *Cognition*, *60*, 83–104.

Ortiz López, L. (2023). El español en Puerto Rico. In F. Moreno-Fernández & R. Caravedo (Eds.), *Dialectología hispanica: The Routledge handbook of Spanish dialectology* (pp. 344- 358). New York, NY: Routledge.

Peterson G.E. & Barney H.L. (1952). Control methods used in a study of the vowels. *The Journal of the Acoustical Society of America, 24*, 175–184.

Poplack, S. (1980). Sometimes I start a sentence in Spanish Y TERMINO EN ESPAÑOL: Toward a typology of code-switching. *Linguistics*, *18*(7–8), 581–618.

Potowski, K. (2021). No child left monolingual: How and why to promote multilingualism in U.S. schools. In D. Cohn and H. Kahn (Eds.), *International Education at the Crossroads* (156-174). Indiana University Press.

Potowski, K., & Bolyanatz, M. (2012). *Reactions to (In)felicitous Codeswitching: Heritage Speakers vs. L2 Learners*. 15.

Potowski, K., & Matts, J. (2008) MexiRicans: Interethnic Language and Identity, *Journal of Language, Identity & Education, 7*(2), 137-160.

R Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/.

Rivera-Mills, S. V., (2012). Spanish Heritage Language Maintenance: Its legacy and its future. In S.M. Beaudrie & M. Fairclough (Eds.), *Spanish as a Heritage Language in the United States: The State of the Field* (pp. 21–42). Washington DC: Georgetown University Press.

Rosa, J. (2019). *Looking like a language, sounding like a race: Raciolinguistic ideologies and the learning of Latinidad.* New York, NY: Oxford University Press.

Rosa, J., & Flores, N. (2017). Unsettling race and language: Toward a raciolinguistic perspective. *Language in society, 46*(5), 621-647.

Rothman, J. (2007). Heritage speaker competence differences, language change, and input type: Inflected infinitives in Heritage Brazilian Portuguese. *International Journal of Bilingualism*, *11*(4), 359-389.

Rubin, D. L. (1992). Nonlanguage factors affecting undergraduates' judgments of nonnative English-speaking teaching assistants. *Research in Higher Education*, *33*(4), 511-531.

Samuel, A. G., & Kraljic, T. (2009). Perceptual learning for speech. *Attention, Perception, & Psychophysics*, *71*(6), 1207-1218.

Sebastián-Gallés, N., Echeverría, S., & Bosch, L. (2005). The influence of initial exposure on lexical representation: Comparing early and simultaneous bilinguals. *Journal of Memory and Language*, *52*(2), 240-255.

Shi, L. F. (2010). Perception of acoustically degraded sentences in bilingual listeners who differ in age of English acquisition. *Journal of Speech, Language, and Hearing Research, 53*(4). 821-835.

Silva-Corvalan, C. (2004). Spanish in the southwest. In E. Finegan & J. R. Rickford (Eds.), *Language in the USA: Themes for the twenty-first century* (pp. 205- 229). New York, NY: Cambridge University Press.

Staggs, C., Baese-Berk, M., & Nagle, C. (2022). The Influence of Social Information on Speech Intelligibility within the Spanish Heritage Community. *Languages, 7*(3), 231.

Stoessel, S. (2002). Investigating the role of social networks in language maintenance and shift. *International Journal of the Sociology of Language*, 93-132.

Thomas, E. R. (Ed.). (2019). *Mexican American English: Substrate influence and the birth of an ethnolect.* Cambridge University Press.

Tiv, M., Gullifer, J., Feng, R., & Titone, D. (2020). Using Network Science to map what Montréal bilinguals talk about across languages and communicative contexts. Journal of Neurolinguistics. DOI: 10.31234/osf.io/bmry2

Toribio, A. J. (2002). Spanish-English code-switching among US Latinos. *International journal of the sociology of language, 158*, 89-119.

Toribio, A. J. (2011). Code-switching among US Latinos. *The Handbook of Hispanic sociolinguistics*, 530-552.

Urciuoli, B. (1996). *Exposing prejudice: Puerto Rican experiences of language, race, and class.* Boulder, CO: Westview Press.

Vaughn, C. R. (2019). Expectations about the source of a speaker's accent affect accent adaptation. *The Journal of the Acoustical Society of America*, *145*(5), 3218–3232.

Woolard, K. A. (2007). Codeswitching. In A. Duranti (Ed.), *A companion to linguistic anthropology* (pp. 73-94). Malden, MA: Blackwell Publishing.

Zentella, A. C. (2004). Spanish in the northeast. In E. Finegan & J. R. Rickford (Eds.), *Language in the USA: Themes for the twenty-first century* (pp. 182- 204). New York, NY: Cambridge University Press.

Zentella, A.C. (1997). *Growing up bilingual: Puerto Rican children in New York.* Malden, MA: Blackwell Publishing.

Appendix A: Stimuli

Below is the list of all the used in Study 1 and Study 2

English only stimuli

1. A boy fell from the window.
2. The wife helped her husband.
3. Big dogs can be dangerous.
4. The shoes were very dirty.
5. The player lost a shoe.
6. Somebody stole the money.
7. The fire was very hot.
8. She's drinking from her own cup.
9. The picture came from a book.
10. The car is going too fast.
11. The paint dripped on the ground.
12. The towel fell on the floor.
13. The family likes fish.
14. The bananas are too ripe.
15. He grew lots of vegetables.
16. She argues with her sister.
17. The kitchen window was clean.
18. He hung up his raincoat.
19. The mailman brought a letter.
20. The mother heard the baby.
21. She found her purse in the trash.
22. The table has three legs.
23. The children waved at the train.
24. Her coat is on a chair.
25. The girl is fixing her dress.
26. It's time to go to bed.
27. Mother read the instructions.
28. The dog is eating some meat.
29. Father forgot the bread.
30. The road goes up a hill.
31. The painter uses a brush.
32. The family bought a house.
33. Swimmers can hold their breath.
34. She cut the steak with her knife.
35. They're pushing an old car.
36. The food is expensive.
37. The children are walking home.
38. They had two empty bottles.
39. Milk comes in a carton.
40. The dog sleeps in a basket.

41. The house had nine bedrooms.
42. They're shopping for school clothes.
43. They're playing in the park.
44. Rain is good for trees.
45. They sat on a wooden bench.
46. The child drank some fresh milk.
47. The baby slept all night.
48. The salt shaker is empty.
49. The policeman knows the way.
50. The buckets fill up quickly.
51. The boy is running away.
52. A towel is near the sink.
53. Flowers can grow in the pot.
54. He's skating with his friend.
55. The janitor swept the floor.
56. The lady washed the shirt.
57. She took off her fur coat.
58. The match boxes are empty.
59. The man is painting a sign.
60. The dog came home at last.

Spanish only sentences

1. El niño hace ruido en su cuarto.
2. Él prefiere tomar el desayuno en el comedor.
3. Yo recibí una carta hoy.
4. Él come salchichas con mostaza.
5. Él tomó café después de levantarse.
6. Las noticias no son siempre buenas.
7. Estuvimos esperando por dos horas.
8. La cocina estaba llena de hormigas.
9. El avión despegó al amanecer.
10. Necesitas un pasaporte para volver al país.
11. Él pagó su cuenta en efectivo.
12. La gallina saltó la cerca del corral.
13. Su hermano se quedó a cenar.
14. El perro está comiendo carne.
15. El niño menor pateó la pelota.
16. La bailarina estaba muy cansada.
17. La joven recibió un collar de perlas.
18. Ella prometió regresar muy pronto.
19. Mi abuela me regaló un par de pantalones.
20. Hoy hace mucho calor.
21. Su amiga está en el hospital.
22. Ella pasea por el parque.

23. Los niños juegan con el perro.
24. Las montañas están cerca de la playa.
25. El niño está tomando una limonada.
26. Ella tiene mucho calor también.
27. La muchacha se cepilla los dientes.
28. El niño no quiere jugar hoy.
29. El piso está cubierto de hojas.
30. La mamá gallina protegió sus huevos.
31. La familia compró la casa.
32. A mí me gusta la sopa de verduras.
33. Ayer me caí de la bicicleta.
34. Ellos trabajan en el estadio.
35. Los pasajeros están cansados de esperar.
36. El pasajero olvidó su pasaporte.
37. El perro está ladrando muy fuerte.
38. La iglesia está cerca del mercado.
39. Ellos escucharon música en el parque.
40. Ese vestido verde cuesta mucho dinero.
41. El piso está muy duro.
42. Los hombres generalmente usan pantalones largos.
43. El soldado estaba herido.
44. El policía lo conoció de inmediato.
45. Mi mamá trabaja con computadoras.
46. Las naranjas también son frutas.
47. Es posible que llueva hoy.
48. El hombre se quitó su sombrero.
49. La mujer está preparando verduras.
50. Finalmente encontró a su hermano.
51. El camión lleva fruta fresca.
52. La señora está sentada en su silla.
53. Ellos invitaron a unos amigos a cenar.
54. El tren está viajando muy rápido.
55. El papá olvidó sus llaves.
56. El niño se cayó de la escalera.
57. La princesa se casó con su sirviente.
58. Las orejas del ratón son enormes.
59. La niña compró helados.
60. No me gusta cuando llueve.

Code-Switched stimuli:

1. They heard un ruido extraño
2. The dog jugó con el palo
3. The book tells una historia

4. The matches están en la repisa
5. The new road está en el mapa
6. She lost her tarjeta de crédito
7. The team está jugando bien
8. They took some comida afuera
9. The young people están bailando
10. Mother cut el pastel de cumpleaños
11. The football game ya terminó
12. She stood cerca de la ventana
13. The kitchen clock estaba mal
14. They carried algunas bolsas
15. Someone is crossing la calle
16. She uses her cuchara para comer
17. The cat se acosto en la cama
18. They're running past la casa
19. He's washing his cara con jabón
20. The milkman maneja una camioneta chica
21. The bus leaves antes del tren
22. The bag se cayó de la repisa
23. They wanted algunas papas
24. They knocked on la Ventana
25. The two children se estan riendo
26. The fire truck esta en camino
27. Mother got una olla
28. The waiter trajo la crema
29. They called una ambulancia
30. He climbed up la escalera
31. El cocinero needs more carrots
32. Yo visito a mi grandma every day
33. A ella le gustan las romance novels
34. El niño plays with his cat
35. Los niños grandes went out to the yard
36. Tomamos cafe during breakfast
37. La niña esta looking for her doll
38. Yo me lavo los dientes before going to sleep
39. Mama nos lleva to school
40. El sol shines in the sky
41. El equipo wants to win and not lose

42. Los estudiantes visted the museum
43. La mama compro fruits and vegtables
44. El agua del river is lukewarm
45. El niño fell from the tree
46. Ellos cantaron all night
47. Su abrigo esta on the chair
48. El hombre esta painting the sign
49. El policia helped the man
50. Mi hermano tiene many interesting friends
51. Algunas viboras are not poisonous
52. El senor painted the house
53. Los deportes are very popular
54. El mantel amarillo covers the table
55. La senora works in an office
56. El equipo was playing well
57. La senora put on a coat
58. Las dos niñas are laughing
59. El pájaro flew over the sea
60. La niña was happy

Appendix B: Social network questionnaire

Below is a subset of the social network questionnaire used in the studies. It includes the instructions and the full layout for the family subsection. The layout for the other subsections (i.e., friends and relationships, classmates and/or work colleagues, clubs and/or religious organizations, and miscellaneous) are the same, but not included to save space.

Instructions

In this questionnaire we would like to gather information about your linguistic interactions with others. You will be asked about people in the following categories: family, friends, school/workplace, clubs/religious organizations, and miscellaneous.

Please make sure you only list an individual once, even if they fit more than one category. For example, if you have a friend that is also a work colleague, make sure you list that person in as either a friend or work colleague.

We realize that some questions may be difficult to answer. Please do your best and be as accurate as possible.

Block one: family

In a typical month, do you talk to any family members (both immediate and extended family, as well as significant others)?

Please indicate how many people in this category you interact with.

Options are 0 to 20+

If answered more than 0 the following is displayed:

Please write how many family members (both immediate and extended family) you typically talk to in a month in any language. Then, estimate the percentage of English and Spanish you use with this group.

	Percentage of English (1)	Percentage of Spanish (2)
Number of family members _____		

Please list up to 20 family members (both nuclear and extended family) you typically talk to in a month.

	Relation to you	Language(s) used	Native language(s) of individual	Do you use both languages in a single conversation with them?		Age Range	Communication with individual
1-20 rows				Yes (1)	No (2)		

Appendix C: Language background and attitudes questionnaire

Below is the language background and attitude questionnaire used in the studies. It includes the instructions and the full layout for an individual who listed knowing two languages. The layout for the other listing 3-6 adds a language block and changed the education block; everything else stays the same.

Start of Block: What languages do you know?

Please rank the languages you know, understand, or have studied in order of proficiency. (1= most proficient)

_____ English (1)
_____ Spanish (2)
_____ Other (please specify) (3)
_____ Other (please specify) (4)
_____ Other (please specify) (5)
_____ Other (please specify) (6)

End of Block: What languages do you know?

Start of Block: Questions for each language

Please answer the following questions about the first language you indicated on the previous page.

Language

_____

What dialect or accent of this language do you speak? (ex. American English, Mexican Spanish)

_____

At what age did you first learn this language? (Enter 0 as the age if this was a language spoken in your home)

_____

How long have you studied/spoken this language? (years) (Add up the number of years in which you actively studied/spoke this language)

_____

Do you currently speak this language on a regular basis?

- Yes (1)
- No (2)

In what country were you living when you first learned this language?

_____

In what context(s) did you learn this language? (check all that apply)

- ☐ At home (1)
- ☐ With friends (2)
- ☐ At school (3)
- ☐ At work (4)
- ☐ Language software (5)
- ☐ Online games (6)
- ☐ Other (please specify) (7) _____

Who do you currently speak this language with? (check all that apply)

- ☐ Parents (1)
- ☐ Siblings (2)
- ☐ Spouse/S.O. (3)
- ☐ Co-workers (4)
- ☐ Housemates (5)
- ☐ Extended family (6)
- ☐ Friends (7)
- ☐ Classmates (8)
- ☐ Professors/Teaching-Assistants (9)
- ☐ None of the above (10)
- ☐ All of the above (11)
- ☐ Other (please specify) (12)

_____

In what contexts do you currently use this language? (check all that apply)

- ☐ Watching television/videos (1)
- ☐ Listening to radio/podcasts (2)
- ☐ Reading for fun (3)
- ☐ Reading for school/work (4)
- ☐ Using social media/internet (5)
- ☐ Writing for school/work (6)
- ☐ Listening to music (7)
- ☐ Religious gatherings (11)
- ☐ None at all (8)
- ☐ All of the above (9)
- ☐ Other (please specify) (10)

_____

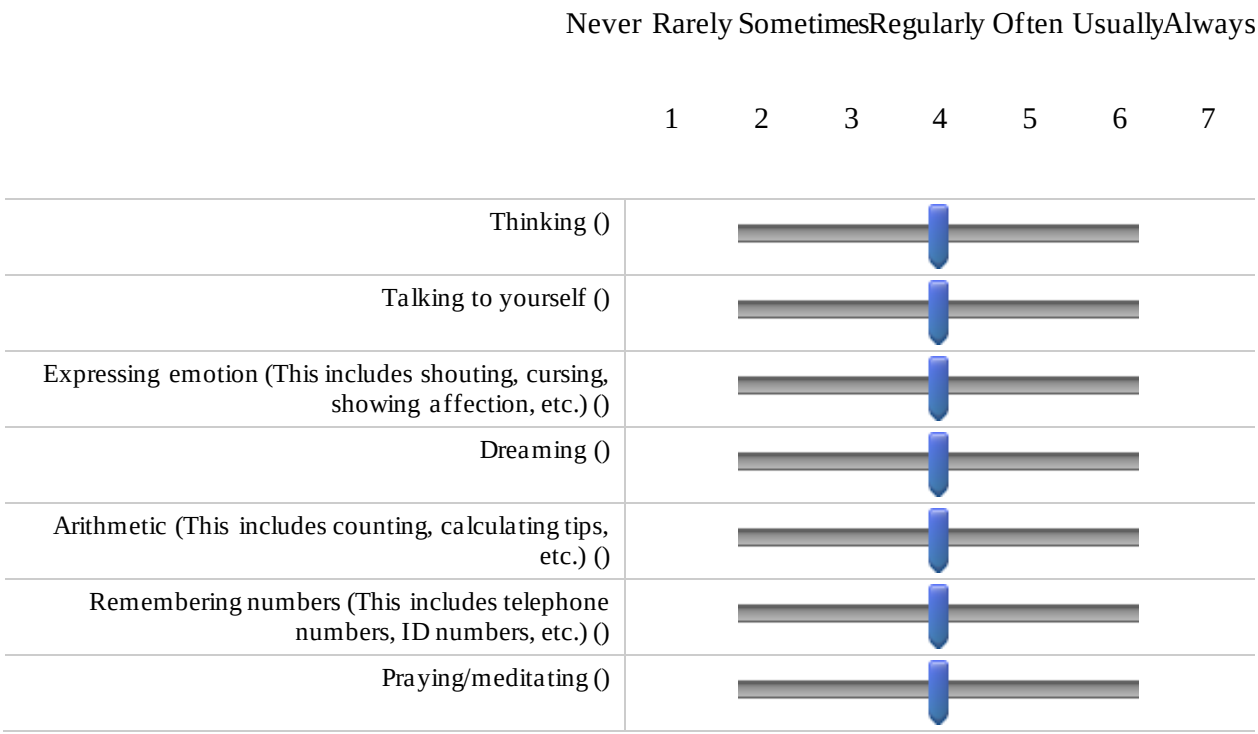
Have you studied this language at the high school and/or college level in a foreign/heritage language class setting?

- ○ Yes, currently (1)
- ○ Yes, in the past (2)
- ○ No (4)

Please use the scale to answer the following questions.

	Very poor	Poor	Limited	Average	Good	Very good	Excellent
	1	2	3	4	5	6	7
How would you judge your reading ability? ()							
How would you judge your writing ability? ()							
How would you judge your speaking ability? ()							
How would you judge your listening ability? ()							

How often do you use this language for the following activities?



End of Block: Questions for each language

Start of Block: Lived

Please list all the places you have lived for a total of 2 months or more. Make sure you fill out all the boxes, and type N/A if a question doesn't apply to you.
Place 1

- Country (1) _____
- Town (2) _____
- State/Province (3) _____
- How old were you when you first moved here? (4) _____
- Most frequently used language while you living here? (5) _____
- Do you currently live here? (6) _____
- If yes, then how long have you lived here? (7) _____
- If no, then how long have you lived here? (11) _____
- If you don't currently live here, have you regularly returned to visit this place? (10) _____
- If yes, how much time do you spend here per visit ? (8) _____

[repeated for up to 6 places]

End of Block: Lived

Start of Block: Education 2

Please enter the main languages of your education for each of the following education levels excluding foreign language classes. Percentages must add up to 100%

Primary Education

Language 1 : _____ (2)
Language 2 : _____ (3)

Total : _____

Secondary Education

Language 1 : _____ (1)
Language 2 : _____ (2)

Total : _____

University

Language 1 : _____ (1)
Language 2 : _____ (2)

Total : _____

Graduate School

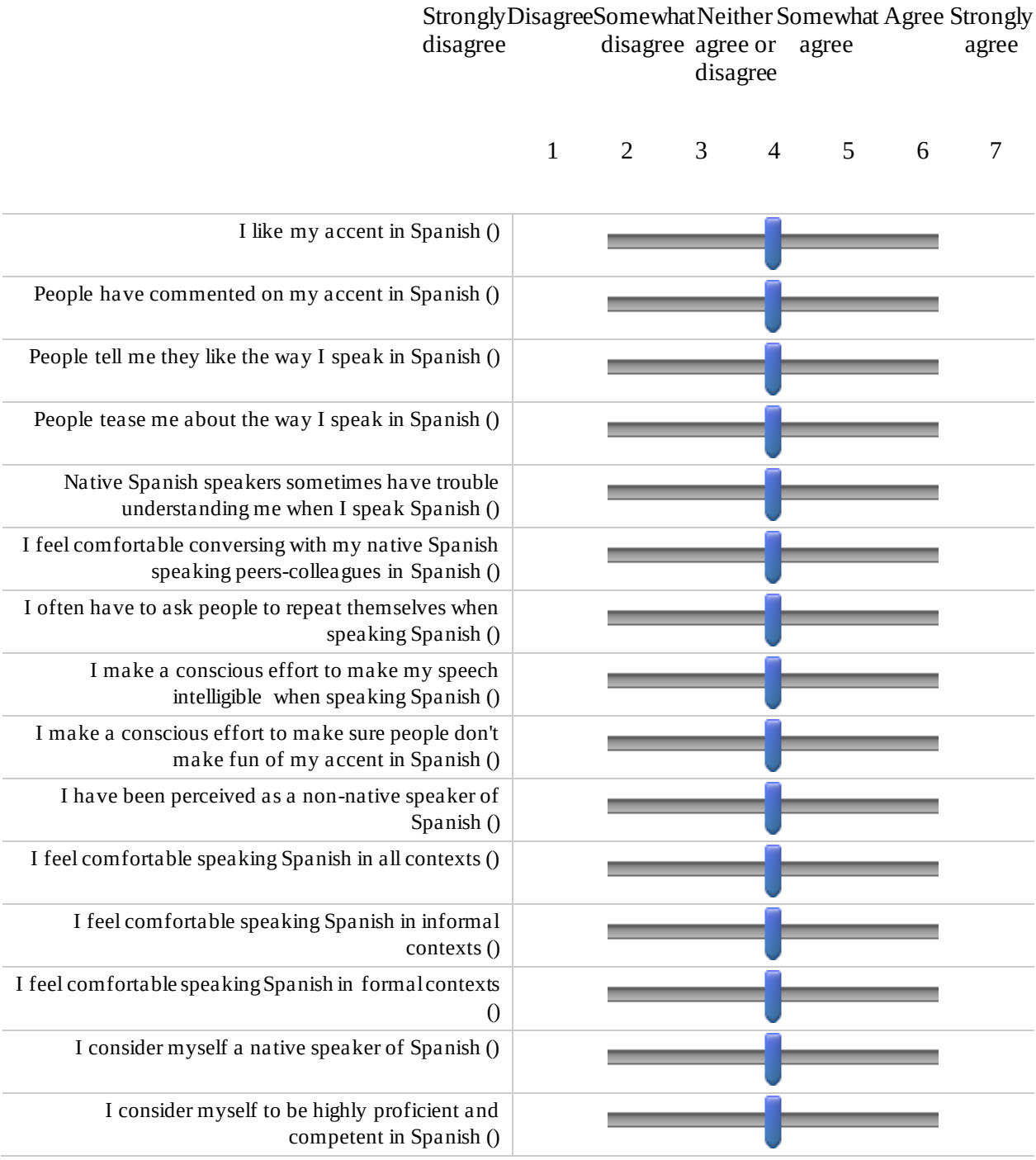
Language 1 : _____ (1)
Language 2 : _____ (2)

Total : _____

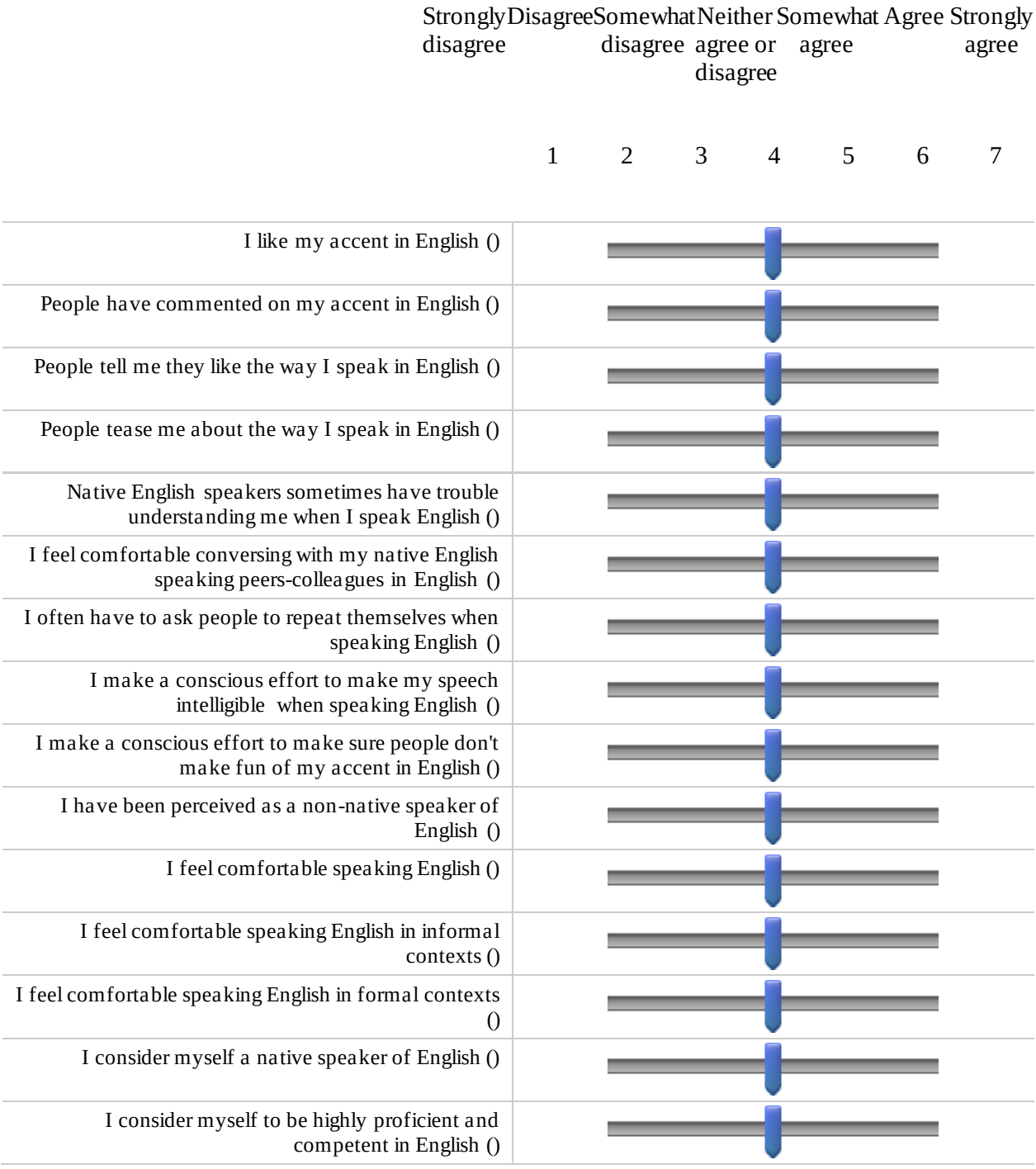
End of Block: Education 2

Start of Block: Accentedness

Please indicate to what extent you agree or disagree with the following statements about your own language



Please indicate to what extent you agree or disagree with the following statements about your own language



Please take some time to respond to the following open ended question. Feel free to write as much as you want in English, Spanish, or both languages.

What does English mean to you? What do you think about when you think about English? What does being an English speaker mean to you?

_____

_____

_____

_____

_____

Please take some time to respond to the following open ended question. Feel free to write as much as you want in English, Spanish, or both languages.

What does Spanish mean to you? What do you think about when you think about Spanish? What does being a Spanish speaker mean to you?

_____

_____

_____

_____

_____

End of Block: Accentedness

Start of Block: Code-switching

Please indicate to what extent you agree or disagree with the following statements about code-switching, which is when two languages are used in one sentence or conversation. For example, the follow sentence uses code-switching: The dog swims *en la playa*.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly agree
	1	2	3	4	5	6	7
It sounds pretty when speakers mix Spanish and English in conversation. ()							
The mixing of English with Spanish leads to the loss of Spanish. ()							
The mixing of English and Spanish enriches interactions in my community. ()							
It bothers me when speakers talk in Spanish and English at the same time. ()							
The mixing of English with Spanish helps to maintain Spanish. ()							
When I mix languages, others regard me as less intelligent. ()							
When I mix languages, I am more respected by my community. ()							

I mix languages:

- ☐ at home (1)
- ☐ at school (6)
- ☐ at work (7)
- ☐ with spouse/girlfriend/boyfriend (8)
- ☐ at family gatherings (9)
- ☐ other (please specify) (5) _____

I mix languages in writing:

- ☐ formal letters/e-mails — to whom? (1)
_____
- ☐ informal letters/e-mails — to whom? (6)
_____
- ☐ text messages — to whom? (7)
_____
- ☐ my journal (8)
- ☐ other (please specify) (5) _____

I mix languages in spoken speech:

- ☐ because I might not know a word (1)
- ☐ because it allows me to express myself more fully (8)
- ☐ because there is no translation for a concept (9)
- ☐ for added emphasis (7)
- ☐ to express emotion (10)
- ☐ to affirm my identity (11)
- ☐ just because I can (12)
- ☐ other (please specify) (13)
_____

I mix languages in writing:

- ☐ because I might not know a word (1)
- ☐ because it allows me to express myself more fully (8)
- ☐ because there is no translation for a concept (9)
- ☐ for added emphasis (14)
- ☐ to express emotion (10)
- ☐ to affirm my identity (11)
- ☐ just because I can (12)
- ☐ other (please specify) (13)

_____

Please take some time to respond to the following open ended question. Feel free to write as much as you want in English, Spanish, or both languages.

Do you consider code-switching to be an important part of your identity? Why or why not?

As a reminder, code-switching is when two languages are used in one sentence or conversation. For example, the follow sentence uses code-switching: The dog swims *en la playa*.

_____

_____

_____

_____

_____

End of Block: Code-switching

Start of Block: Cultural

Rate the strength of your connection to Mexican/Spanish Culture in the following categories using the following scale:

	None	Very weak	Weak	Moderate	Strong	Very strong	Extreme
	1	2	3	4	5	6	7
Way of life ()							
Food ()							
Music ()							
Art ()							
Cities/Town ()							
Sports teams ()							

Rate the strength of your connection to American/English Culture in the following categories using the following scale:

	None	Very weak	Weak	Moderate	Strong	Very strong	Extreme
	1	2	3	4	5	6	7

Way of life ()	
Food ()	
Music ()	
Art ()	
Cities/Town ()	
Sports teams ()	

Please use the scale to answer the following questions

	Strongly disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly agree
	1	2	3	4	5	6	7
I feel like myself when I speak English ()							
I feel like myself when I speak Spanish ()							
I identify with an English-speaking culture ()							
I identify with a Spanish-speaking culture ()							
It is important to me to use (or eventually use) English like a native speaker ()							
It is important to me to use (or eventually use) Spanish like a native speaker ()							
I want others to think I am a native speaker of English ()							
I want others to think I am a native speaker of Spanish ()							

Please take some time to respond to the following open ended question. Feel free to write as much as you want in English, Spanish, or both languages.

Do you think that Spanish and/or English are an important part of your culture? Of your identity? Why or why not?

_____

_____

_____

_____

_____

End of Block: Cultural

Appendix D: Additional Social Network Analysis – Study1

A logistic mixed-effects model that examined by-word accuracy of the English data depending on social information (monolingual versus L2-talker) and centered social network size (English only and both). All factors were contrast-coded. There were two sets of uncorrelated random effects factors: (1) by participant, with a random intercept and social information and English only social network size as random slopes, and (2) by item, with a random intercept and social information, English only, and both social network size as random slopes. Within each set, random effects were uncorrelated.

Results showed no significant effect of English only or both social network on accuracy in English transcriptions ($\chi^2(1)$s < 1.62, p > 0.12; see Table D.1).

Figure D.1: Transcription accuracy in English block by English only social network for Monolingual and L2-talker social information for Study 1

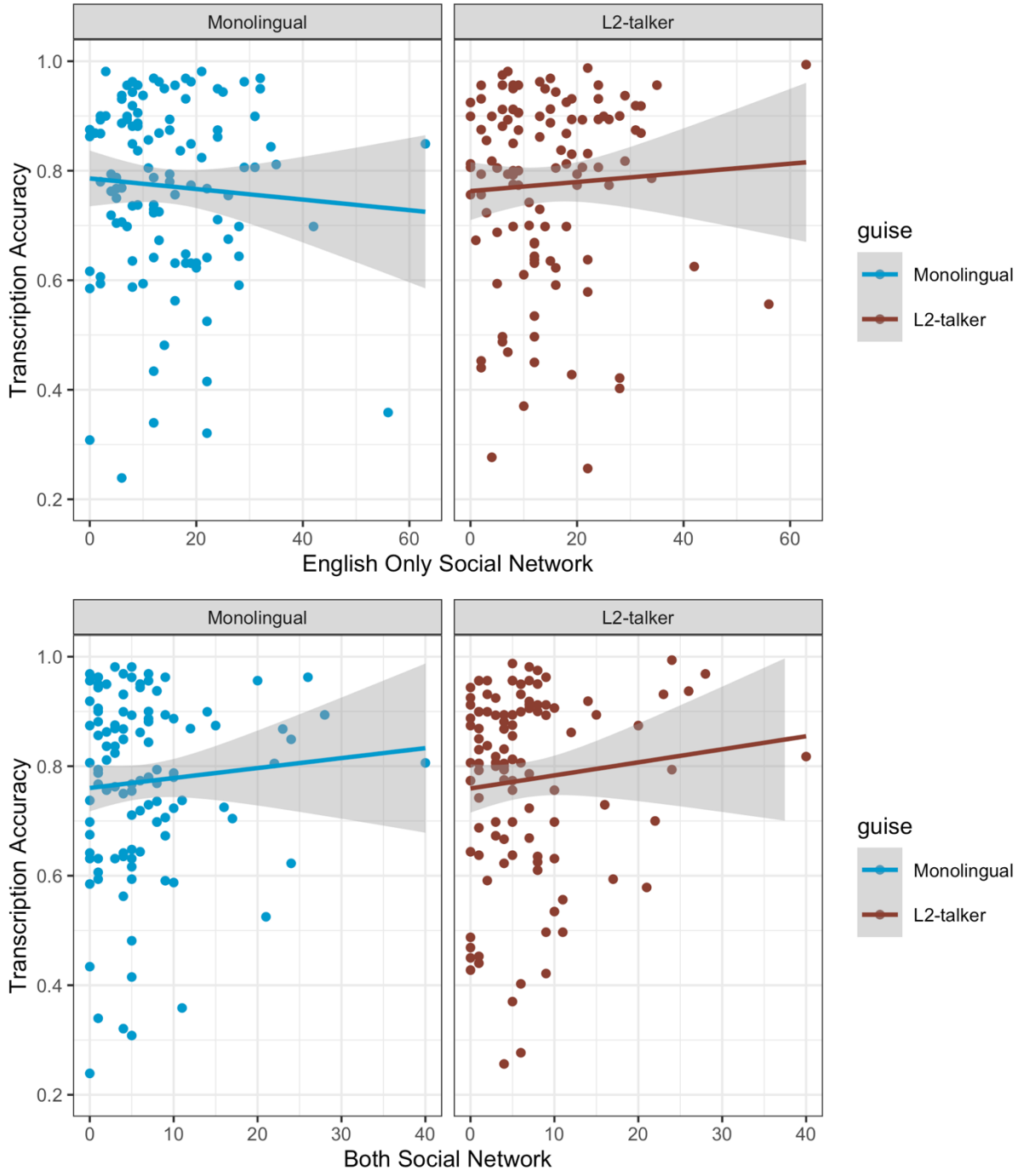


Table D.1: Results for logistic mixed effects model for accuracy of word transcription in English and English all and Spanish only social network size

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
Monolingual versus L2-talker	0.03	0.09	0.32	0.75
English only social network size	0.0008	0.009	0.09	0.93
Both social network size	0.01	0.01	0.94	0.35
Monolingual versus L2-talker X English only social network size	0.01	0.009	1.21	0.23
Monolingual versus L2-talker X Spanish only social network size	0.01	0.01	0.82	0.41

A logistic mixed-effects model that examined by-word accuracy of the Spanish data depending on social information (monolingual versus L2-talker) and centered social network size (Spanish only and both). All factors were contrast-coded. There were two sets of uncorrelated random effects factors: (1) by participant, with a random intercept and social information as random slopes, and (2) by item, with a random intercept and social information, Spanish only, and both social network size as random slopes. Within each set, random effects were uncorrelated.

Results showed no significant effect of Spanish only or both social network on accuracy in Spanish transcriptions ($\chi^2(1)$s < 1.81, p > 0.45; see Table D.2).

Figure D.2: Transcription accuracy in Spanish block by Spanish only and both social network for monolingual versus L2-talker social information for Study 1

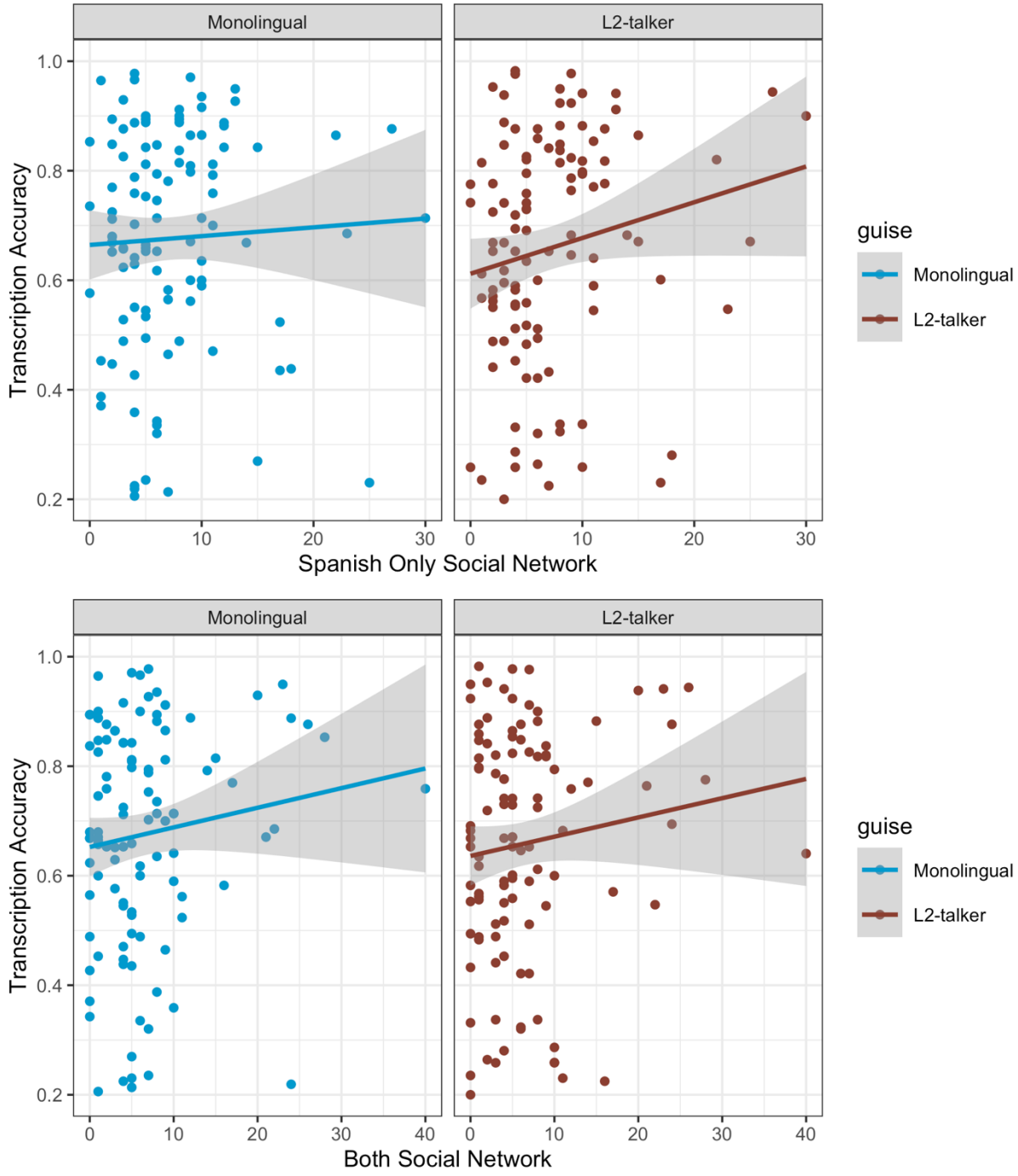


Table D.2: Results for logistic mixed effects model for accuracy of word transcription in Spanish all and Both social network size

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
Monolingual versus L2-talker	-0.07	0.09	-0.76	0.45
Spanish only social network size	0.02	0.02	1.05	0.29
Both social network size	0.02	0.02	1.15	0.25
Monolingual versus L2-talker X Spanish only social network size	0.03	0.02	1.81	0.07
Monolingual versus L2-talker X Both social network size	-0.01	0.01	-1.15	0.25

Appendix E: Additional Social Network Analysis – Study2

In order to understand the effect of social network depending on whether an individual spoke only one language with the individual, a logistic mixed-effects model that examined by-word accuracy of the English data depending on social network size (English only and both). All factors were contrast-coded. There were two sets of uncorrelated random effects factors: (1) by participant with a random intercept, and (2) by item, with a random intercept and English only and both social network size as a random slope. Within each set, random effects were uncorrelated.

Results showed no effect of English only ($\beta = 0.007$, *SE* $\beta = 0.006$, χ^2 (1)= 1.1, $p > 0.05$) or both social network ($\beta = 0.002$, *SE* $\beta = 0.01$, χ^2 (1)= 0.22, $p > 0.05$) in English transcriptions.

Figure F.1: Transcription accuracy in English block by English all and Spanish only social network for Study 2. The x-axis represents social network, while the y-axis represents the average by word accuracy in transcription for the English block.

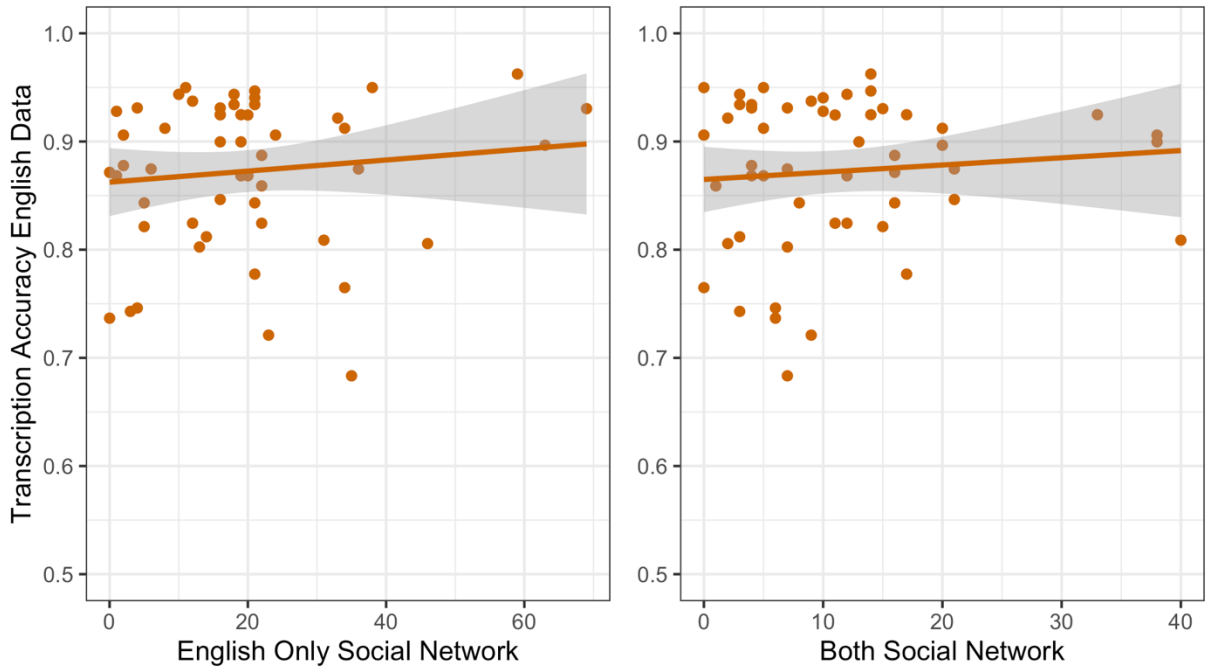


Table F.1: Results for logistic mixed effects model for accuracy of word transcription in English block and English only and Both social network size

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
English only social network size	0.007	0.006	1.1	0.27
Both social network size	0.002	0.01	0.22	0.83

A logistic mixed-effects model that examined by-word accuracy of the Spanish data depending on social network size (Spanish only and both). All factors were contrast-coded. There were two sets of uncorrelated random effects factors: (1) by participant, with a random intercept, and (2) by item, with a random intercept and Spanish only and both social network size as random slopes. Within each set, random effects were uncorrelated.

Results showed no effect of Spanish only ($\beta = 0.02$, *SE* $\beta = 0.02$, χ^2 (1)= 0.96, $p > 0.05$) or both social network ($\beta = 0.02$, *SE* $\beta = 0.01$, χ^2 (1)= 1.08, $p > 0.05$) in Spanish transcriptions.

Figure F.2: Transcription accuracy in Spanish block by Spanish all and English only social network for Study 2. The x-axis represents social network, while the y-axis represents the average by word accuracy in transcription for the Spanish block.

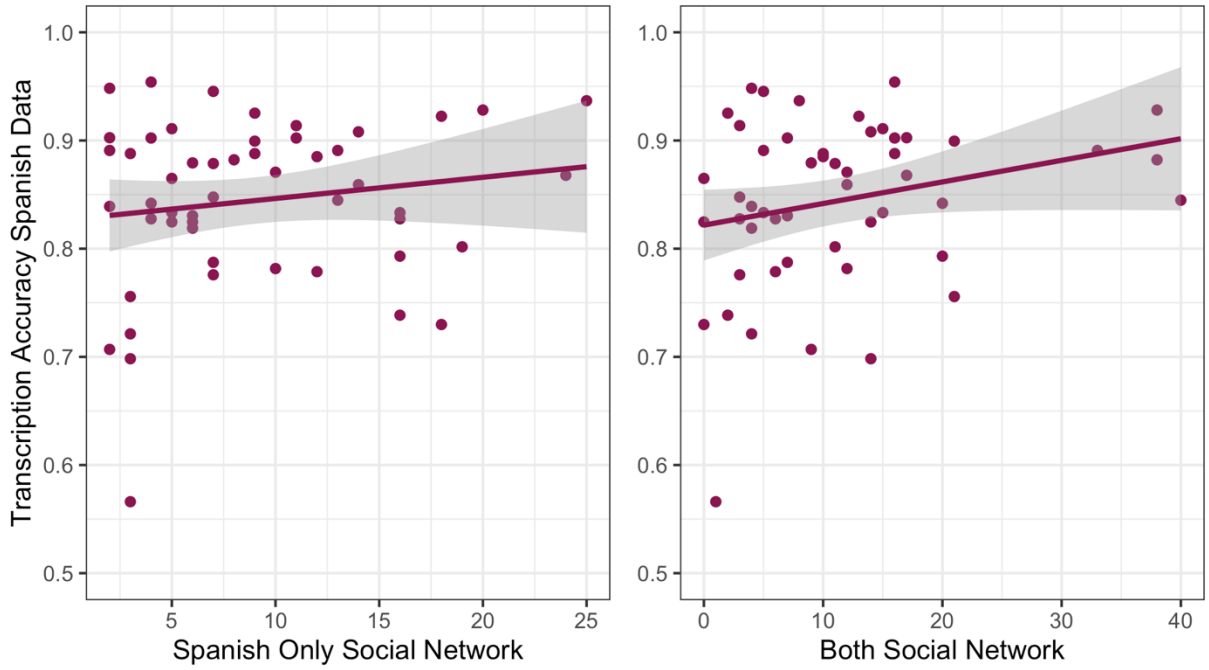


Table F.2: Results for logistic mixed effects model for accuracy of word transcription in Spanish block and Spanish all and both social network size

Fixed effects	**β**	***SE* β**	**χ^2**	**p**
Spanish all social network size	0.02	0.02	0.96	0.36
Both social network size	0.02	0.01	1.8	0.07