Attitudes to ASL-English Language Contact among Deaf and Hard-of-Hearing Users of ASL in the United States

by

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ABSTRACT

Language contact is ubiquitous in language use, and can be explained by centering language users and appealing to language ideologies. This dissertation takes this track by asking the question, *Who thinks what about English mouthing in American Sign Language (ASL)?* Mouthing here refers to language contact in the form of mouth patterns in sign languages that are recognisable as linked to (specific) spoken language words. Variation in experiences with ASL and English in the DHH community and mouthing have not received much treatment in ASL linguistics. This dissertation contributes to both topics by aiming to: (i) capture and categorise heterogeneity in DHH experience with ASL and English in the United States (ii) explore the relationship between DHH experiences and attitude to mouthing and (iii) explore the relationship between experiences of language mixing and attitude to mouthing. These goals are achieved by bringing together insights from sign language linguistics, social perception (of spoken languages), and anthropology. This broadens the general understanding of how attitudes arise from the experiences of individuals by including DHH people, creates a foundation for investigating and understanding cross-modal language contact, and models a means of engaging with sign language use that treats all DHH individuals equally while centering heterogeneity.

CHAPTER I

Introduction

The central question of this dissertation is: Who thinks what about English mouthing in American Sign Language (ASL)? Mouthings are mouth patterns articulated alongside manual signing that are recognisable as associated with specific spoken language words, and which may or may not be produced with vocalisation (Bisnath, 2024). The set of studies in this dissertation explore the who and the what in the question above among deaf and hard-of-hearing (DHH) signers of ASL in the United States. More specifically, the dissertation identifies and categorises types of DHH users of ASL, measures their attitude to English mouthing in ASL, and identifies correlates of this measurement. Asking and answering these questions contributes to understanding the heterogeneity of DHH experience in the United States, perception of contact linked to a second modality (multimodal language contact), and the influence of beliefs about language on perception. This is done by pursuing the following research goals to:

1. Categorise some of the heterogeneity of DHH experience with ASL and English in the United States, and in so doing, to present a model for how to investigate linguistic heterogeneity in similar linguistic contexts, as well as how to ask questions about the role of language attitude and perception in a signed language
2. Explore how DHH experience correlates with attitude to mouthing
3. Explore how experiences with and use of language mixing correlate with attitude to mouthing

The organisation of this chapter is as follows. I first define some relevant terminology in Section 1.1. I then identify the theoretical outlook (Section 1.2). Following this, I provide background on the target phenomenon, mouthing (Section

1.4), the minoritisation of deafness and ASL in the United States (Section 1.3), and mouthing in ASL (Section 1.5). Discussion of the latter summarises the general occurrence of mouthing (Section 1.5.1), the characteristics of user variation that have been targeted in use of mouthing (Section 1.5.2), and what is know about ideology and attitude to mouthing (Section 1.5.3). I end with situating the research goals in the context of ASL in the United States (Section 1.6), and the organisation of the dissertation (Section 1.7).

1.1 Language ideology and its relationship to language attitude

The study of language ideology in linguistic anthropology situates language use in the social and political contexts that language users are embedded in, and can explain observations about linguistic behaviour. This is reflected in the following definitions of language ideology as "sets of beliefs about language articulated by users as a rationalization or justification of perceived language structure and use" (Silverstein, 1979, 193), and "the cultural system of ideas about social and linguistic relationships, together with their loading of moral and political interests" (Irvine, 1989, 255) (see Woolard & Schieffelin, 1994; Irvine, 2022, for overviews). Language ideology is invoked in this dissertation to motivate investigating English mouthing in ASL by referencing the dominance of English and hearing culture in the United States and the beliefs that DHH individuals have about the social characteristics of who might use mouthing (see Section 1.3). Thus, language ideologies are not the target of this dissertation, but provide its conceptual and methodological motivation.

Attitude is an ideologically-implicated measurement[1] that parallels language ideology in having moral associations and linking beliefs about language to beliefs about language users. The following definitions are illustrative: "a psychological tendency that is expressed by evaluating a particular disfavor" (Eagly & Chaiken, 2005, 745) and more simply as, "evaluative reactions to different language varieties" (Dragojevic, 2017, 2) (see also Kircher & Zipp, 2022). However, attitude arises from the ideological systems that language users inhabit (Garrett, 2010)[2],

[1]There are other kinds of ideologically-implicated measures that are brought together under *regard*, which is "a range of non-linguist perceptions of, beliefs about, and responses to languages and varieties than those restricted to an evaluative dimension" (Preston & Niedzielski, 2013, 287). Perceptual dialectology is an example of a method that is not evaluative, but does capture beliefs about language.

[2]This should not be interpreted as meaning that attitudes are static.

and also feeds into language ideology. This cyclical relationship is put particularly well in the following:

> "the knowledge, feelings and behaviors that comprise attitudes are products of multiple ideological filters; at the same time, they feed back into the ideological landscape, shaping, changing, or reproducing it through their manifestations in social interaction" (Lee, 2016a, 37)

In sociolinguistics, attitude is typically measured with the speaker evaluation paradigm, and specifically the Matched Guise Task (Lambert et al., 1960); however evaluation can be collected in other ways that may be more or less overt, like direct questioning and the Implicit Association Test respectively (Garrett, 2010; Kircher & Zipp, 2022). Semantic differentials, which can be broadly categorised as having to do with status, like education, or solidarity, like friendliness, are used across less overt methods like the Matched Guise Task and the Implicit Association Test. The study of attitude in linguistics has been criticised by social constructionists as it frames attitude as a static property that can be measured experimentally. For constructionists, attitude is variable and can only arise within specific contexts. However, Soukup (2013) argues against this criticism, as what linguists refer to as attitude is not the same as what social constructionists do.

1.2 Ideology and attitude in language contact

Language contact occurs through language users[3] (Enfield, 2003; Erker, 2017; Rodríguez-Ordóñez, 2019), who have the agency to direct how it is manifested. Language is filtered through the psychologies of language users, which involves their subjectivity, emotional intelligence, unconscious judgements, and social identification in line with or in opposition to interlocutors (Enfield, 2003). The way that language users construct linguistic form disrupts the possibility of predicting the outcomes of contact-induced change (Thomason, 2000). Language attitudes, for instance, are a reason that contact-induced change does not follow in an entailment relationship based on the context of language contact, as attitudes themselves do not have such an entailment relationship, and can cause or perturb any kind of change (Thomason, 2000). Cognition and the views users have about language

[3]Throughout this dissertation I use "language user" to take a modality neutral stance. This is in opposition to terms like "speaker" or "signer" that implicate single modalities in language use (see also Kowalik, 2023, for use of the term to identify any user with any knowledge of a language).

are brought together more directly in Rodríguez-Ordóñez (2019), who explicitly argues that language ideologies should be targeted in language contact because of their explanatory power, and identifies perceptual methods used in sociolinguistics and social psychology as means of targeting ideology.

Language contact and minoritisation are often studied together as contact can become more salient in situations of power imbalance. Appealing to language ideology can be useful in these contexts to account for behaviours that may appear incompatible. This is illustrated by describing two cases – that of the Edah Haredit, an ultra-Orthodox conservative Yiddish-speaking minority found in Jerusalem and nearby Bet Shemesh, and speakers of Basque in the Basque Autonomous Country.

The Edah Haredit are a Jewish anti-Zionist community that views Israeli Hebrew as marking Zionist ideology and the dangers of the modern world, and Yiddish as reflecting "true" Jewishness. This does not preclude them from using Israeli Hebrew in everyday speech, as Israeli Hebrew words without 'Yiddishisation" is observed in adults and young children. Use of these words by young children suggests that they are receiving this input regularly from their parents, as they would not have regular exposure to Israeli Hebrew otherwise. However, Israeli Hebrew is actively avoided in certain contexts, with words from other languages preferred. Assouline (2017, 23–24) recounts an incident that illustrates how ideology can lead to avoidance – a 12-year-old guiding younger children prefers to use a Yiddish form of English "leopard" to identify the animal, as opposed to the Israeli Hebrew term (see also Assouline, 2018).

Basque, as used in the Basque Autonomous Country, is in contact with Spanish, and has been undergoing active revitalisation efforts by the Basque government. In this context, some speakers are viewed as more and less legitimate based on how they learned Basque. The *euskaldunzaharak* learn Basque through family transmission and are considered authentic users, while *euskaldunberri* who learned Basque outside the family are not considered authentic users (Ortega et al., 2014, 2015). The *euskaldunberri* would have grown up speaking Spanish, and learn Batua (Standard Basque), which is stigmatised (Rodríguez-Ordóñez, 2020) later in life. Differential Object Marking (DOM) in Basque has come to be associated with *euskaldunberri*, and though it is produced by both *euskaldunzaharak* and *euskaldunberri*, when it is produced by the latter, it is considered to be inauthentic use of Basque.

Both of these case studies exemplify how understanding the ideological context in which language use occurs can bring together behaviours that may appear incompatible. In both contexts, stigmatisation of linguistic varieties and language

users occurs because of the associations made between the two that arise from their specific socio-historical contexts.

In this dissertation, I take up the call to action of Rodríguez-Ordóñez (2019) by exploring attitude to English mouthing in ASL among DHH signers in the United States. Based on the connection with spoken language and the minoritisation of deafness and ASL in the United States, English mouthing is conceived of as English language contact and DHH ASL signers as ASL-English bilinguals (minimally). Language ideologies provide the motivation for doing this research, and are considered to be manifested in language attitude, which are measured using methods developed in sociolinguistics.

In the following sections, I discuss the targets of this dissertation, mouthing and the DHH community and ASL in the United States, more directly. First I describe what mouthing is (Section 1.4), followed by the stigmatisation of deafness in the United States, and one of its facets, the institutionalisation of English over ASL in deaf education (Section 1.3). I then narrow to summarising what is known about mouthing in ASL (Section 1.5), and situate the research goals in the overall discussion (Section 1.6).

1.3 Minoritisation and stigmatisation of deafness and ASL in the United States

Deafness in the United States is minoritised and stigmatised. DHH people in the United States are a demographic minority, accounting for fewer than 1 out of 20 people, as measured in 2001 and 2002 by the United States Census Bureau (Mitchell, 2006). Deaf or hard-of-hearing in this case refers to difficulty hearing "normal conversation" with hearing technology, and thus does not capture identification with deafness as a cultural identity, hereafter referred to as sociocultural deafness. Hamill & Stein (2011) report that 500 000 people in the United States identify as part of a deaf ethnolinguistic minority, though it is unclear how this number was calculated. More importantly than the relatively lower number of deaf *vs.* hearing people in the United States, is the stigmatisation of deafness, which can be found in all aspects of society, including education, healthcare, employment, and access to services (Harmer, 1999; Simms et al., 2008; Benito et al., 2016; Schniedewind et al., 2020). Dunn (2024), for instance, documents experiences

of deaf people in the United States losing job opportunities and fearing to mention their deafness in job application materials, as their experiences in the world have led them to believe that they will be excluded for it (see also O'Connell, 2016; Hamill & Stein, 2011). Stigmatisation also underlies the proliferation of medical procedures to treat deafness, as their existence assumes that deafness is something to be cured. This is reflected in medical technology like hearing aids and cochlear implants, and more recently, the use of gene editing to remove deafness in five children (Wang et al., 2024). The latter is particularly concerning as it has the potential to eradicate deafness, and thus deaf culture, completely (see Padden & Humphries, 2020, for critique of that idea of gene editing).

Deaf identity and use of ASL are intimately tied to each other (Reagan et al., 2021), and exist in the United States in the context of spoken standard English dominance. The latter has been referred to as standard language ideology and monoglot ideology, which identify the idealisation of a set of, typically spoken, linguistic practices viewed as invariable and transmitted institutionally (Silverstein, 2018; Lippi-Green, 2004). Standards are thus associated with socially privileged language users and are oppressive to those who do not belong to this group. As deafness is stigmatised in the United States, it goes without saying that DHH individuals are one such oppressed group. This section describes a manifestation of standard language ideology in deaf education (Spring, 2016) as schools are culturally important in DHH communities – they are likely to be the first place that DHH people can form communities and be exposed to a sign language.

In the history of deaf education, there have been efforts to prevent deaf children from learning sign languages in lieu of spoken ones. These efforts are associated with the 1880 Milan Conference that prescribed spoken languages in deaf education and proscribed sign languages for participating countries; however, efforts to teach speech began before that in the United States (Murray & Greenwald, 2010). This pedagogical orientation is termed oralism, and covers a range of practices that, in the United States, vary in how harshly use of English was enforced in opposition to use of manual communication. Manual communication here, as opposed to ASL, is used because in the case of "pure" oralism, any communication with the hands was proscribed. Even in pedagogies that allowed use of ASL, Nover (2000) notes that it was intended as a means of learning English; thus, ASL was not necessarily seen as valuable in itself, but as a tool to gain English proficiency (see similar framing in Wilbur, 2000).

World War I followed the Milan conference, which created negative sentiment

for foreign cultures in the United States. English was identified with American culture, and so speaking English, and doing it "clearly", was part of being American (Healey, 2023). Deaf people in the United States had by then been developing their own culture, and so were analogised with immigrants who were bringing their cultural practices to the United States. Oralist practices in schools (in the United States) then, were also a means of enculturing deaf students into Americanness by teaching them to speak English. This general strategy was not restricted to deaf people, but to all minoritised groups whose practices were perceived as not aligning with Americanness (see Spring, 2016, for more on schooling as a form of domination). Note that despite oralist policies, there was great variation in implementation of oralist policies, and active resistance from DHH individuals (Burch, 2000; Nover, 2000; Murray & Greenwald, 2010).

This brief recounting of movements in deaf education in the United States shows how deaf education in the United States placed English use above ASL use. This hierarchy is expected to influence the attitudes DHH people have for English contact phenomena, like mouthing.

1.4 What is mouthing?

Mouthing is defined as mouth patterns articulated alongside manual signing that are recognisable as associated with specific spoken language words, and which may or may not be produced with vocalisation (Bisnath, 2024) (see also coding of mouthing in Pizer, 2008). This definition of mouthing is meant to separate mouthings from mouth gestures, which are also meaningful mouth patterns articulated with signing, but which may not be recognisable as synchronic spoken language words. An example of mouthing is shown in Figure 1.1 This figure shows the Swedish Sign Language (STS) sign for the city Malmö with the pronunciation of Malmö in Swedish marked in IPA. The arrangement of the IPA symbols with the pictures above shows how the mouth shape changes across articulation of the sign to match the pronunciation of Swedish Malmö.

Mouthing is reported cross-linguistically in many sign languages, in multiple forms (Bisnath, 2024). Four types are identified in Bisnath (2024) that differ in how they appear with manual signs, and the grammatical roles they play (see also Crasborn et al., 2008; Mohr, 2012; Bank, 2015). They are *congruent* mouthing, the target of this study, *morpho-phonological* mouthing, *morpho-syntactic* mouthing, and *free* mouthing. These types are characterised by their co-occurence with manual sign-

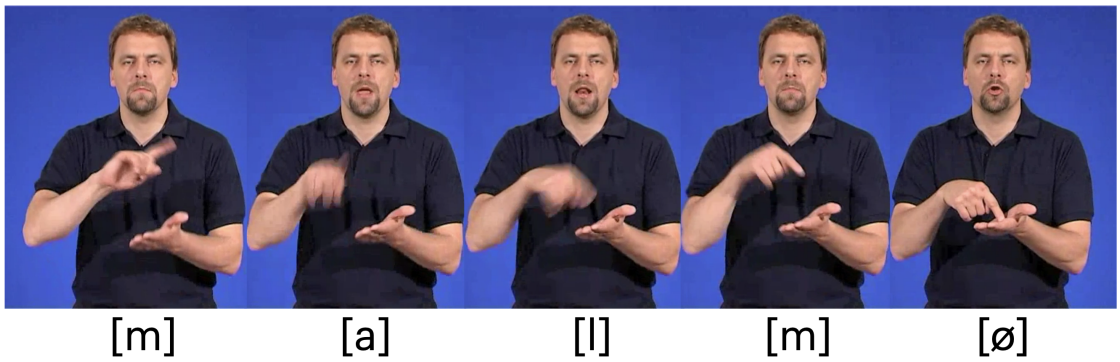


Figure 1.1: Example of mouthing in Swedish Sign Language (Svenskt teckenspråkslexikon, 2024, 6397)

ing, and the grammatical functions they perform. For example, *congruent*, *morpho-phonological*, and *morpho-syntactic* mouthing all co-occur with one or more manual signs, while *free* mouthing definitionally appears on its own. Additionally, *congruent* mouthing can be glossed in the same way as the manual sign it appears with (for example in Figure 1.1), while *morpho-phonological* and *morpho-syntactic* mouthing would not. *Congruent* mouthing then does not change or add to the meaning content of the manual sign it appears with, while *morpho-phonological* and *morpho-syntactic* mouthing do. *Morpho-phonological* mouthing shares a similarity with the manual sign it is articulated with, and specifies a type of the manual sign, while *morpho-syntactic* mouthing does not necessarily have a similarity, and can act in a variety of roles e.g. modifiers, complements. There are at least 20 other less well-documented functions of mouthing across sign languages, including marking identity (refer to Bisnath, 2024).

1.5 Mouthing in American Sign Language

The studies of mouthing in ASL that have been done identify some of the variability in the grammatical contexts mouthing is found in, and in who produces mouthing, but less is known about general use of mouthing across signers, attitude to mouthing, and variability in its form. A potential reason for this is the absence of a publicly available ASL corpus (Hochgesang et al., 2023). In this section, I briefly summarise what is known about English mouthing in ASL.

1.5.1 General occurrence of mouthing

Production of mouthing in ASL varies with the grammatical category of the manual sign being articulated. A study of 70 minutes of ASL data from 14 signers showed that presence of mouthing differs based on word class, with mouthing occurring most on nouns (≈80%) and adjectives (≈80%), followed by adverbs (≈60%), plain verbs (≈50%), directional verbs[4] (≈40%), pronouns (≈40%), and classifiers[5] (≈5%) respectively (Nadolske & Rosenstock, 2007). Note that the approximate percentages shown here identify the percentage of times a grammatical category appeared with mouthing. There are also differences in mouthing within categories, like verbs. The pattern of mouthing appearing most with nouns and adjectives, as opposed to other categories, is replicated to an extent in a study of four English-to-ASL interpreters (Weisenberg, 2009). The low prevalence of mouthing with classifiers is also found in an analysis of 20 signers with a mean age of 41 (range: 18–65) who had started learning ASL before age seven (Herbert & Pires, 2017). In preliminary work, Macias (2023) identifies cases of mouthing being used with pronominal pointing to mark gender.

Apart from the grammatical categories discussed above, fingerspelling crosses categories (see Padden & Gunsauls, 2003) and is targeted in studies of mouthing. Fingerspelling is a strategy that uses the ASL manual alphabet to manually represent English orthography. Compared to classifiers/depicting signs and English prepositions/conjunctions, mouthing occurs most with fingerspelling among Herbert & Pires (2017)'s participants. Across signers, mouthing is produced with fingerspelling 70–80% of the time. In a sample of 44 signers in the area of Gallaudet University and Washington, DC (USA), who had all done some education beyond high school, 31 (70.45%) produced mouthing while fingerspelling (Kulsar, 2019). Twenty-five had hearing parents (57%), 13 (30%) had two deaf parents, and 6 had one deaf and one hearing parent (14%). Similar rates of mouthing while fingerspelling is found in Emmorey & Petrich (2012)'s sample of 52 deaf signers who used ASL as their preferred language. 87% of participants used mouthing while fingerspelling real English words, and 76% used mouthing while fingerspelling nonce words. Twenty-seven of these signers were born deaf into signing families

[4]Directional verbs, also called agreeing or and indicating verbs, are a verb type in which different arguments are marked by placement in space. An agreeing verb will begin its movement in a location in space associated with a subject and end with the location associated with the object (Schembri et al., 2018).

[5]Classifiers, also called depicting signs, are handshapes that represent a type of noun and can stand in for a noun in certain contexts.

(52%), 16 were exposed to ASL before age seven (31%), and nine were exposed after age seven (17%). These findings show that mouthing is a relatively common strategy, at least when signers use fingerspelling, across a range of participant backgrounds.

Finally, there is contextual variation in use of mouthing. Mouthing occurred most in conversations (≈60%) and lectures (≈60%) compared to narratives (≈40%) (Nadolske & Rosenstock, 2007). Within academic lectures, four interpreters translating English to ASL produced mouthing more when they thought they were signing for a hearing audience *vs.* a deaf one (Weisenberg, 2009).

1.5.2 Research on who uses mouthing in ASL centers a narrow language acquisition profile

The focus on aspects of early ASL acquisition and use, like age-of-acquisition and deaf status of parents, is part of a general tendency in sign language linguistics. This is illustrated in the quote below from Lepic (2019, 8), which recognises that sign language linguistics has limited itself to a narrow swath of the signing population, and that the language use of excluded individuals is needed to represent ASL use accurately (see also Lucas et al., 2023).

> "An anonymous reviewer comments that sign language linguists typically work with language consultants who have acquired a sign language from birth, yet only 5–10 % of the ASL signing population meets this criterion. The reviewer reminds us that if we do not study the language development and communicative practices of the remaining 90–95 % of the ASL signing population, then we cannot claim to have a good idea of how linguistic constructions are represented in the minds of the people that make up the signing community."

Variation in how different kinds of signers use mouthing in perception and production has targeted different backgrounds but has centered narrow acquisition profiles characterised by early sign language acquisition. This is also evident in the descriptions of participants in the studies described in the previous section, as they too primarily identify age-of-acquisition or -exposure to ASL and the deaf status of parents. In Herbert & Pires (2017)'s sample, production of mouthing increases with increasing age-of-acquisition. In a sample of 100 signers who had begun acquiring ASL by age eight, those who grew up with a deaf parent produced less mouthing than those who did not (Lindeberg, 2022). In terms of deaf

identity, signers who identify as hard-of-hearing tend to produce more mouthing (Herbert & Pires, 2017). In terms of perception, deaf signers classified as acquiring ASL early *vs.* late differ in how much they look at the mouth – this is hypothesised to be because those who acquired ASL later may lipread more (Bosworth et al., 2020) (see also Emmorey et al., 2009, that compares deaf *vs.* hearing signers).

1.5.3 Attitude to mouthing in ASL is not well understood

Ideologies about mouthing can be found in discussions of authentic *vs.* high English contact ASL. For instance, mouthing is not viewed as part of "real" ASL (Nadolske & Rosenstock, 2007). Mouthing is also identified as a property of contact signing, which is defined as a type of signing showing properties of ASL and English (Valli et al., 1992). Other English-related features of contact signing include English word order, *that*-constructions, and use of prepositions. Preposition use is notable because the type of relations expressed with prepositional words in English would typically be expressed through use of space in ASL. Hill (2012)'s study of attitudes to varieties classified by community members as ASL, Mixed signing, and Signed Exact English (SEE) elicited commentary on use of mouthing from DHH community members. Mouthing was found in all varieties and evaluated positively/neutrally and negatively in both Mixed Signing and SEE. For instance, noticeable English mouthing was described/rated negatively by participants across all three varieties, but so was the absence of mouthing in Mixed signing and SEE.

Linguists have characterised ASL as using mouthing significantly less than other western sign languages in the global north, as illustrated by the following hyperbolic statement in Udoff (2014, 20): "ASL has one of the lowest rates of mouthing among established sign languages of the western world, and ASL's rich fingerspelling system subsumes some of the functions mouthing plays in other languages." Similar ideas are found elsewhere as in: "ASL has a longstanding reputation of hardly featuring any mouthings" (Bank, 2015, 111), "American Sign Language, while sparser in mouthing of English words than European sign languages..." (Sandler, 2009, 262), "the amount of mouthing varies from sign language to sign language, apparently being more frequent in ISL [Israeli Sign Language] and European sign languages than in ASL" (Sandler, 2009, 266). As there has been no large-scale measurement of mouthing in ASL apart from Nadolske & Rosenstock (2007)'s study of 14 signers, and no direct comparison, these ideas must be impressionistic. Incompatible with this is the idea that ASL makes use

of fingerspelling where other sign languages would use mouthing (Udoff, 2014), as mouthing very commonly appears with fingerspelling (Herbert & Pires, 2017; Kulsar, 2019), with signers even spontaneously producing it with nonce words (Emmorey & Petrich, 2012).

Overall, this review presents a complex picture of mouthing in ASL. A clear takeaway is that mouthing is differentially associated with grammatical categories. It appears that linguists may view mouthing as dissociated from ASL, which may arise from their knowledge of DHH community members in the United States and likely represents language ideologies, as opposed to frequency of use. Orientation to mouthing appears to be tied to ideas about what ASL is supposed to be, but there is no clear picture. This might be due to the complex nature of language ideology and attitude, or because attitude to mouthing in ASL has not yet been explicitly targeted (Hill, 2012, is an exception). Regardless of the specific reason, there remains much more room for exploring the range of variation in attitude to mouthing in ASL

1.6 Situating the research goals of this dissertation

The previous discussion identifies some spaces in the ASL literature that can be added to by exploring language contact and attitude. A clear theme is that much is left to be investigated about all aspects of mouthing in ASL. As such, the studies that are conducted in this dissertation are intended to be exploratory and to build a foundation for future research on mouthing and other contact-implicated features of ASL. Research on who uses mouthing in ASL follows the general tendency in sign language linguistics to target signers who acquired ASL early and have deaf parents, and/or to characterise participants by these properties (Section 1.5.2). There is little focus on capturing exposure and use of English (Lindeberg, 2022, is an exception), which is the dominant language of the United States and a target of deaf education, and thus expected to influence ASL use.

In line with the theoretical framing of centering language users in language contact (Enfield, 2003; Erker, 2017; Rodríguez-Ordóñez, 2019), this dissertation makes collecting heterogeneity in experience with English and ASL a goal (Research Goal 1). It will thus show some of the variation missed in research on ASL that arises from targeting signers with narrow sign language acquisition profiles. The literature shows that attitude to mouthing has not been targeted directly, and what is known is not linked to specific social characteristics of DHH individuals.

Meeting Goal 2 of investigating the relationship between DHH experiences and evaluation of mouthing will begin this research. Lastly, Research Goal 3 of exploring the influence of language mixing on evaluation of mouthing, will recontextualise the social meaning of mouthing in terms of experience with mixing English and ASL. These three goals will be achieved using an experiment and a survey.

1.7 Dissertation organisation

The organisation of this dissertation takes the following form. In Chapter II, I describe the development of the method, which includes my positionality, the research team, a general description of the experiment designed to evaluate mouthing, motivation of the aspects of participants' background and language experience targeted by the survey questions, and practicalities around distribution and data cleaning. In Chapter III, I describe the statistical analyses and results that characterise participants' language experience (Principal Components Analysis) and that identify types of DHH individuals in the United States based on their language experience (cluster analysis), followed by the broad profiles of individuals identified along with their social characteristics. In Chapter IV, I report the results of an evaluation of mouthing experiment and the aspects of participant experience that predict evaluation. This chapter provides a more detailed description of the experiment initially motivated in Chapter II. In Chapter V, I reanalyse the data from the Chapter IV by exploring the influence of beliefs about language mixing on evaluation. In the final chapter, Chapter VI, I bring together the findings of Chapters III, IV, and V. I identify the theoretical and methodological contributions of the dissertation, as well as opportunities for future research.

CHAPTER II

Centering Language Contact and Participant Subjectivities in Research Design

2.1 Introduction

This chapter describes the data collection methods and how they were developed. The methodological instrument itself consists of a language evaluation task, the Evaluation of Mouthing Task, and questions about language experiences and beliefs about language in a survey format constructed in Qualtrics (Qualtrics, Provo, UT) (University of Michigan eResearch ID.: HUM00220024). The entire study is multimodal and bilingual, employing ASL videos and written English. The list below shows each content section numbered from 1–13 with the number of questions in each section shown in parentheses. The numbers of each content section are used to refer to them throughout this chapter. Each participant who completed the survey answered 137 questions. Participants who indicated that they wanted to be compensated received $15.00 USD in the form of a debit card. The full survey can be found in Appendix 7.3. Note that as this study is exploratory, more questions were asked than were analysed – this chapter summarises across all questions and goes into greater detail on *only* those questions that were analysed.

1. Introduction & Consent (4)
2. Screening (2)
3. Practice (4)
4. Explanation of Evaluation of Mouthing Task

5. Evaluation of Mouthing Task (32) (participants assigned to 1 of 8 lists)
6. Background (14)
7. Comfort (9)
8. Experiences before entering school (19)
9. Experiences during school (25)
10. Experiences in a typical week (12)
11. Definition of mouthing in the study
12. Overt evaluation of mouthing (16)
13. Compensation information

The survey was primarily distributed through academic social networks from June 20th to the 27th 2023. I contacted sign language researchers with connections to ASL via e-mail, and asked them to distribute the survey to their social networks. I also posted the survey on LinguistList, a general linguistics listserv, and sign language listservs, namely that of the Sign Language Linguistics Society (SLLS), the National Deaf Center (NDC), and the Reddit community, r/deaf. In addition to this, my primary deaf collaborator, Sonya Carter (see Section 2.2.1 for more), distributed the survey to her social networks. The survey also reached David Player, a Black deaf American with an active social media presence, who shared the survey with his audience.

2.1.1 Organisation

I first describe the research team, which includes my positionality and its influence on this study (Section 2.2). I then identify the theoretical commitments driving the research design choices and their relationship with the core targets of data collection (Section 2.3). The conceptualisation and collection of these targets follow. They are evaluation of mouthing (Section 2.4), participant background (Section 2.5), and language experience (Section 2.6). The final section discusses the data cleaning process (Section 2.7).

2.2 Research team

2.2.1 Collaborators

I collaborated with three deaf Americans in doing this dissertation – Sonya Carter (SC), Brennan Terhune-Cotter (BTC), and River Frank (RF). My primary collaborator was SC who is a Black deaf woman living in Ann Arbor at the time of the study. I met SC through Sovoya Davis, a Black PhD researcher studying Black language at my home department at the University of Michigan, Ann Arbor. SC did not have any linguistics background but did have an interest in ASL and anthropology. SC and I met regularly over eight months from 2022–2023 to develop the Evaluation of Mouthing Task and survey questions, and to film these questions in ASL. Our languages of communication were ASL and written English. We used written English in asynchronous communication and when I was unable to explain myself further in ASL.

The sign language models in the Evaluation of Mouthing Task were BTC and RF. I connected with BTC through Dr. Corrine Occhino and BTC then connected me to RF. BTC and RF are both white and located in the geographical west of the United States. Thus, I collaborated with BTC and RF virtually only. BTC and RF are likely to have greater meta-linguistic awareness and knowledge of the linguistics of ASL than the typical deaf community member as BTC was a linguistics PhD student at the time of the study and RF had experience teaching ASL. I communicated with BTC and RF over e-mail in written English.

2.2.2 Positionality of research lead

In this positionality statement I follow the recommendations of Bucholtz et al. (2023) in describing my background and reflecting on how it has influenced the content and methods of this dissertation.

I am a hearing, Indo-Trinidadian, cis-woman from Trinidad & Tobago who speaks English and Trinidadian English Creole as first languages and is a first-generation university student. All of my education up to completion of my Bachelor's degree in Linguistics was done in Trinidad. Immediately following that I moved to the Netherlands where I did a Master's degree in Linguistics at the University of Amsterdam, and then a year after that I moved to Michigan, USA to do a PhD in linguistics at an R1 institution, the University of Michigan, Ann Arbor. Thus, I have experienced being a foreigner and an international student in the

Netherlands and in the United States for seven years, and doing research under the constraints of time-limited visas.

As an English-speaking cis-woman of Indian descent, I have been spared overt experiences of marginalisation, like racism, for the most part. However, my experiences growing up in a former British colony in the shadow of larger nations associated with whiteness, like the United States and the United Kingdom, have consistently made me aware of the interaction between marginalisation and language. For instance, in Trinidad many people do not consider themselves adequate users of English because of their use of the closely-related Trinidadian English Creole. Additionally, growing up in Trinidad, where people of Indian and African descent are the majority, and then coming to countries where they are not, has also shown me that minoritisation is context-dependent. For instance, I am not a minority in Trinidad, but I am in the United States. I bring these sensibilities to my work, and in this dissertation – they are reflected in the focus on English mouthing as a marginalised phenomenon (Bisnath, 2024), heterogeneity, and use of emergent means of categorisation.

In all of my experiences doing sign language research, I have been an outsider to the communities of investigation, which has influenced the questions I have asked and the ways I have asked them (see relevant discussions in Obasi, 2014; Kusters et al., 2017; Graham & Horejes, 2017; Pudans-Smith et al., 2019; Jones et al., 2021). In the Netherlands, I did research on Dutch Sign Language (NGT) using the Corpus NGT (Crasborn & Zwitserlood, 2008), and on Trinidad & Tobago Sign Language (TTSL). TTSL is the sign language of my home country, but as I was living in the Netherlands, I was not able to be a consistent member of the deaf community there. When I decided to do a PhD in the United States, my plan was to study TTSL and do fieldwork in Trinidad; however, for various reasons, including travel restrictions due to the COVID-19 pandemic, I had to shift focus. I say this to say that I did not apply to a PhD-granting institution based on presence of a local deaf community or with the intent to study ASL. Thus, the questions I have asked in this dissertation are those of an outsider, and are strongly motivated by my reading of ASL and linguistics literature. In some ways this may be beneficial, as I may have asked potentially obvious questions that had not yet received empirical support. However, this also means that the distinctions I have made may not be as nuanced as they could have been. The work that I have done would also be greatly improved by interview data and ethnography, but I do not have the cultural or linguistic expertise or social network needed to do this research and

interpret the findings appropriately (within the constraints of a five-year PhD programme). To illustrate, Dag Lindeberg, a Norwegian deaf scholar, notes that his being able to conduct interviews with approximately 100 deaf people in the United States was largely due to his deaf American wife's influence in her social networks (Lindeberg, 2022).

My collaborations with deaf Americans were limited by my basic proficiency in ASL. I collaborated with Sonya Carter to create the experimental stimuli and survey questions in English. However, the phrasing of these items in ASL may have been influenced by my proficiency. I am proficient enough to make myself understood with a highly accommodating partner, but it is still possible that important information may have gotten lost. Sonya Carter's use of ASL may have been influenced by English due to communicating with me during question development and filming. However, as the survey was intended to also include written English, avoiding English contact was not a priority. It was more important to me that a deaf American considered the way that questions were conveyed to be appropriate, and that the survey questions be presented by the same signer to avoid potential biases due to signer presentation. Finally, my proficiency in ASL may also have affected the speed of collaboration, and the limited the possibilities for extending this research as it was unfolding.

2.3 Research design motivation

The methods chosen and their implementation are motivated by commitments to centering language contact and the subjectivities of participants, and the research goals of collecting participant background information, language experience and evaluation of mouthing. The connections between theoretical commitments and research goals, and the outcomes are visualised in Figure 2.1. The research goals also mark the three major targets of data collection. In Figure 2.1, centering of language contact is linked to collecting variation in language experience. Centering of participant subjectivities is linked to all three research goals of describing participant heterogeneity, variation in language experience, and collecting evaluation of mouthing. The concrete outcomes of this framing are collecting data suitable for bottom-up analysis, taking a multimodal bilingual approach, use of self-report measures, and use of named languages. The overall approach visualised in Figure 2.1 had additional advantages of making the experiment and survey convenient, accessible, and inclusive, and allowed for exploration.

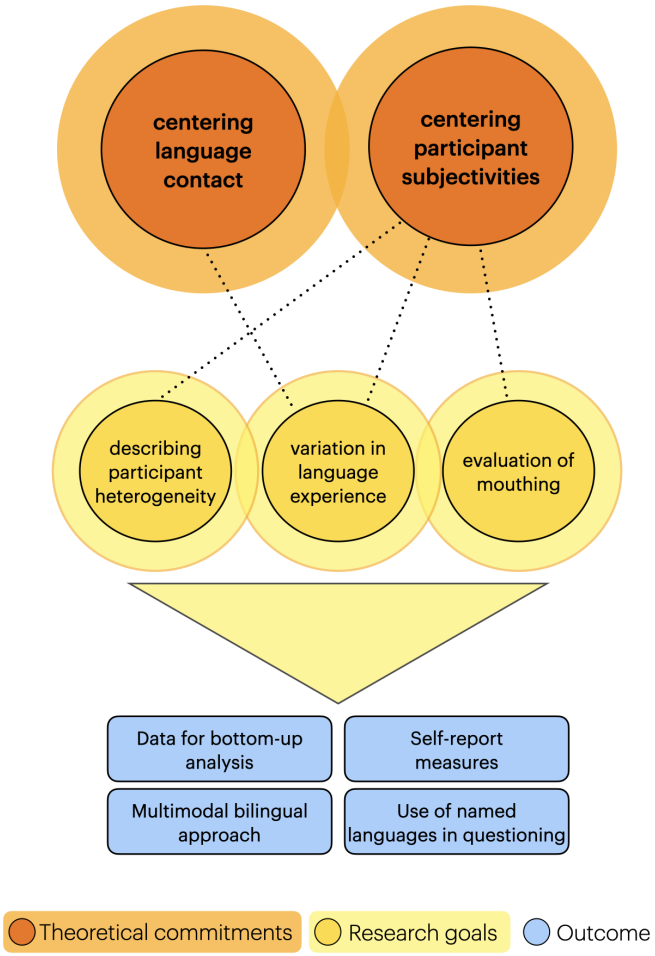


Figure 2.1: Motivations behind method

In the sections immediately following, I discuss how centering of language contact (Section 2.3.1) and participant subjectivities (Section 2.3.2) permeate the overall research design, and the practical outcomes. The research goals, which also represent the core targets of data collection are discussed in greater detail in Sections 2.4 on collecting language evaluation, 2.5 on describing participant heterogeneity, and 2.6 on identifying variation in language experience.

2.3.1 Centering language contact by taking a multimodal bilingual approach

The core way that language contact is centered in this dissertation is the use of a multimodal bilingual approach in the overall design. This is manifested in the use of ASL videos and written English in questioning without aiming to reduce English contact effects (see Noschese, 2021, for a design that aims to reduce En-

glish contact). It is likely that the ASL and English did not always convey exactly the same content, and so participants may have responded differently based on the language they viewed questions in. Participants may have been more inclined to respond to the written English prompts, as seeing the ASL videos would have required an additional click. A potential workaround for future studies would be to only include English text as captions on the videos, thus forcing participants to play videos; however, this could be a problem for those with low internet speeds, and could also cause others to drop out of the survey. Future similar studies would also benefit from determining if and how participants took advantage of the modalities available.

In collecting variation in language experience, participants were asked about their experience with ASL and English in different modalities, and their use of language mixing (see Section 2.6 and Chapter V for further details). The use of written English and ASL had the advantage of making the survey convenient, accessible, and inclusive. Participants did not necessarily have to look at all videos to do the survey, and those with differing levels of comfort using ASL and English had some choice in how they participated.

2.3.2 Centering participant subjectivities through self-reporting measures, use of named languages, bottom-up analysis

In centering participants' subjectivities, self-reporting and named languages were used to identify variation in language experience, and measures were chosen to collect continuous data for quantitative bottom-up analysis. Centering of subjectivities touches on all research goals: participant background is targeted to determine if and how the social characteristics of perceivers correlate with language experience and evaluation of mouthing, self-reported language experience is collected to describe participants using bottom-up methods, and evaluation of mouthing is targeted to identify participants' beliefs about mouthing. In the remainder of this section, I motivate the use of self-report measures, named languages, and the bottom-up approach to participant categorisation respectively.

In using self-reporting to collect language experience, it is assumed that the way participants report their language experience necessarily includes their subjective experiences. For instance, self-reported use of codeswitching reliably indicates actual production among Spanish-English bilinguals in southeastern Pennsylvania, USA (Cox et al., 2020) and for Fiji Hindi users in Wellington, New Zealand (Shameem, 1998). However, self-reports are influenced by the modality targeted

and ideas about proficiency – reporting of oral proficiency in Fiji Hindi is less accurate than that for aural proficiency (Shameem, 1998), and Spanish-English bilinguals who think of themselves as more proficient in English tend to over-report their use of English (Cox et al., 2020). Similarly, L1 users of English learning French as a second language who reported more anxiety about their French competence were more likely to under-report their abilities compared to their less anxious counterparts who tended to over-report their abilities (MacIntyre et al., 1997). Variation among groups may also exist, as in the case of immigrants to Germany – individuals identified as men tended to over-estimate their German abilities compared to those identified as women, as did students with Turkish heritage compared to those of other immigrant backgrounds. Together, these studies illustrate the utility of self-reporting in paralleling actual language use, but that the subjectivity of the reporter must be considered.

Assuming that self-reporting incorporates participant orientation motivates the use of named languages, specifically English and ASL, in survey questions. In the context of ASL in the United States, I expect that invoking ASL and English as named languages will elicit ideological associations due to the dominance of English and the tenuous variable nature of the distinction between ASL and English. The latter is reflected in linguistics in proposals of continua between ASL and English, the delineation of varieties based on (English) language contact like Pidgin Sign English (PSE) and Contact Signing (Lucas & Valli, 1990), and analogies with pidgins and Creoles e.g. Fischer (1978)'s comparison of ASL with Hawai'ian Creole (see also Fischer (2013), and criticism of framing of ASL as a Creole by Lupton & Salmons (1996)). More specifically, Hill (2012) shows that attitudes to signing identified as more and less resembling and diverging from ASL and English differed.

Bottom-up measures, specifically Principal Components Analysis (PCA) and cluster analysis, were used to categorise participants, and thus the DHH community in the United States. These methods form categories based on patterns in the data – as all input data is based on self-reported language experience, which is assumed to include participant beliefs about ASL and English, this means that all types identified incorporate participant subjectivities[1]. PCA and cluster analysis require or are more suited for continuous data, and so all questions involving rating used continuous scales (see Figure 2.2 below) with quantitative markings from

[1]This is said with the caveat that PCA and cluster analysis are strongly dependent on researcher interpretation of their output.

0–100 and three qualitative labels in English. This included language experience questions and the evaluation task. The details of the PCA and cluster analysis analyses can be found in Chapter III.

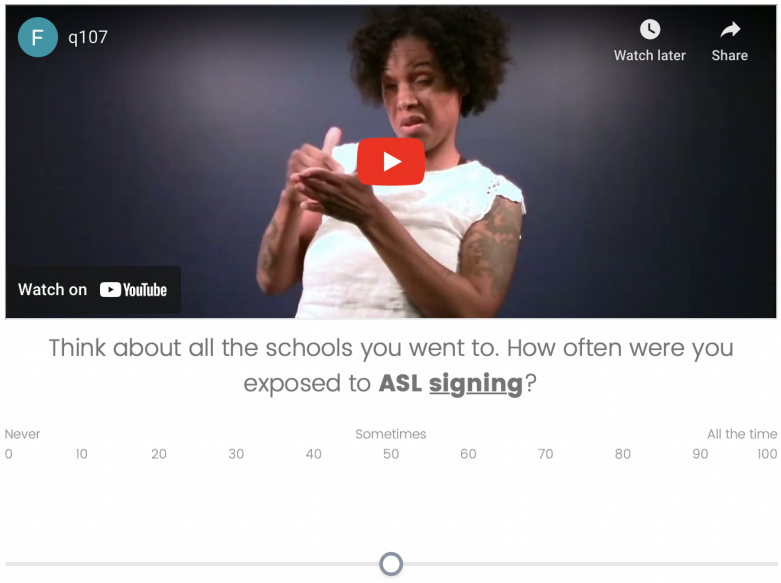


Figure 2.2: Sample language experience question showing slider scale

2.4 Collecting evaluation of mouthing

Evaluation of mouthing was targeted at two levels of explicitness – one that is relatively higher and one that is relatively lower. The core difference between these levels is in if participants were explicitly told that they were being asked about mouthing or not. The less explicit level was targeted using an experiment, the Evaluation of Mouthing Task.

The Evaluation of Mouthing Task was presented fifth in the study chronology shown above, immediately following information about the survey, consent, participant screening, and practice using the slider scale employed. Explicit evaluation took the form of questions including the term "mouthing", and come at the end of the survey before participants were able to indicate that they would like to be compensated for their participation. Immediately before explicit questioning, participants were provided with a definition of mouthing. This was done because "mouthing" can mean different things. Before this point in the survey, "mouthing" was not used at all; however, participants may have gleaned that mouthing was

the research target based on the Evaluation of Mouthing Task they did earlier.

The description of mouthing given to participants that distinguishes between mouthing and mouth gesture is glossed in ASL and English in Figure 2.3. The video in ASL is found here: `Mhttps://youtu.be/wzXUur0c09o`. In the gloss, the first lines in small capitals represent ASL signs, and the regular text immediately below is an English translation. Only the most relevant non-manual markers are shown – that is, the contrast between the sign PLATE produced with English mouthing "plate", and the sign PLATE with the mouth gesture for small, which means "small plate". The mouthing is represented as "___plate" in red, and the mouth gesture for small as "___OO" in green over the signs they are produced with.

QUESTIONNAIRE MOUTHING MEAN WHAT
What does mouthing mean in this questionnaire?

___plate
MOUTHING SAME ENGLISH WORD. EXAMPLE PLATE.
Mouthing resembles English words. For example, plate (produced with mouthing "plate").

___plate
MOUTH MOVEMENT YOU SEE PLATE SAME ENGLISH WORD
The mouth movement you see in "plate" resembles the English word.

____OO ____OO
DIFFERENT PLATE. MOUTH MOVEMENT PLATE NOT MOUTHING
This is different from "small plate". The mouth movement you see in small plate is not mouthing.

Figure 2.3: Gloss of description of mouthing given to participants

2.4.1 Developing the Evaluation of Mouthing Task

The details of the Evaluation of Mouthing Task are described in Chapter IV to place it closer to analysis of the findings arising from it. This section describes the motivation behind the task and its development. The first section describes existing methods that the Evaluation of Mouthing Task draws on and issues specific to adapting them to sign languages (Section 2.4.1.1). This section includes a full description of the Task. Details on how mouthing is represented in the Evaluation of Mouthing Task are presented in Section 2.4.1.2, followed by the evaluation terms themselves in Section 2.4.1.3. In the final section, information that would be needed to do similar experimental work on mouthing is identified (Section 2.4.1.4).

2.4.1.1 Collecting evaluation of multimodal phenomena indirectly

The Evaluation of Mouthing Task is a novel contribution that draws on speaker evaluation tasks like the Matched Guise Task and Verbal Guise Task (Lambert et al., 1960) which have been used to examine language attitudes indirectly. This approach, as opposed to directly asking language users what they think, is intended to draw out participants' "true" attitudes, which may differ from established societal hierarchies (e.g. Grondelaers & van Hout, 2010). Attitudes elicited in this way may also correlate with language variation more strongly than those that are more directly asked about e.g. in interviews or ranking tasks (see Kristiansen, 2010, on attitudes to varieties of Danish).

A typical Matched Guise Task employs audio of the same multi-varietal speaker producing the same text in different varieties. The participant is led to believe that different speakers are producing these varieties, and is asked to rate these varieties for characteristics of interest. Typical characteristics have to do with status, like education, or solidarity, like regional identity, of speakers (Chen & Cao, 2013; Díaz-Campos & Killam, 2012; Loureiro-Rodriguez et al., 2013; Magro, 2016; Lee, 2021), but studies have also been directed at the aesthetic properties of languages themselves (Hilton et al., 2022; Mooshammer et al., 2023). Evaluation of unseen speakers for such traits can be used as a proxy for attitude towards users of particular linguistic forms. The Verbal Guise Task is similar to the Matched Guise Task, but the different varieties are produced by different people. Two issues to contend with are the visual nature of sign languages and small nature of DHH communities. First, Guise tasks typically take a unimodal perspective on language, exploiting *only* the aural component of spoken languages. This has the advantage of reducing the number of social variables to control for, but the same approach cannot be used with sign languages. Sign languages are produced with the face, hands, and body, making it difficult or impossible to conceal the identity of signers in a naturalistic way. The Verbal Guise Task provides a potential way of overcoming this issue, as it makes use of multiple producers. It has also been used in attitude research about ASL (Fenn, 1992) (see Anderson & Benford, 2012, for a method targeting ASL and English). In this case, different signers were used and attempts were made to maintain similarity in appearance and dress; however, there was a confound in that participants were able to recognise some of the signers. This exemplifies the second issue to be accounted for: the small nature of the deaf community can make it difficult to find sign models who will not be recognised by participants, and to find enough models. The former is a problem because partic-

ipants' judgements of the signers and signing are likely to be skewed by their real world knowledge of the signer. The latter problem is linked to the development of this study in Ann Arbor, Michigan (USA), which does not have a large deaf community. The aforementioned problems could potentially be mitigated with avatar technology, however this method is nascent and was unavailable to the researcher at the time of study (Lee et al., 2020).

The goal of the Evaluation of Mouthing Task is to collect evaluation in a more unconscious way that Matched Guise-type tasks can achieve, but for sign languages. A potential alternative is the Implicit Association Test (IAT) (Greenwald et al., 1998) which aims to collect language users' automatic associations between a linguistic form and a valenced term by constraining response time. Participants may be presented with the relevant linguistic form and two terms from a semantic differential like "good" and "bad", and asked to select a term as quickly as possible. In another variation, they may also be presented with the linguistic form and a single term, and asked to respond as quickly as possible. In both cases their reaction times are recorded. In the first case, faster selection of a term indicates a more automatic association, and in the second, incongruent pairings are expected to elicit slower reaction times (e.g. Loudermilk, 2015). The IAT was not pursued for two main reason. First, the effects of modulating quantity and quality of mouthing in ASL signing may require longer linguistic stimuli than is appropriate for the IAT. Second, the IAT requires collection of reaction times. For this type of measure to be comparable across participants, there should be consistency across the machine types used to do the task. However, ensuring this consistency would have required in-person data collection which would have limited sample size.

In the Evaluation of Mouthing Task, more unconscious attitudes to mouthing are collected by not explicitly telling participants that they were evaluating English mouthing. The issue of not being able to obscure the faces of sign models was dealt with by counterbalancing across sign model, topic, mouthing condition, and order of presentation – thus no participant saw the same model producing any content in the same way. The issue of signer recognition was dealt with head on by asking participants to indicate if they knew the signers they had seen. Those participants who had were removed from the primary analysis. A description of the full task is given below.

Participants view two videos showing different levels of mouthing and after each video they answer 14 questions. The type of questions and the order in which they appear is shown in the list below (refer to Table 4.5 for more). Numbers in

parentheses show the number of questions.

1. comprehension
2. language identification
3. signing aesthetics evaluation (4)
4. deaf identity evaluation (4)
5. open comment on signing
6. open comment about sign model
7. rating of ASL-English mixing
8. familiarity with sign model

Participants were randomly assigned to 1 of 8 lists. Each list contained two videos that were counterbalanced for the following properties: level of mouthing (high *vs.* low), sign model (BTC *vs.* RF), topic (COVID-19 vaccines *vs.* Hurricane Ian), and order of presentation (high mouthing before low, *vs.* low mouthing before high). Given this setup, each participant provided five evaluations of high mouthing and five for low mouthing. This was unavoidable as collecting more responses would have required more signer models, which I did not have easy access to. More models would also have increased the chance of them being recognised by participants. Future studies would be improved by collecting more evaluations per participant.

2.4.1.2 Description of and modulation of mouthing

Mouthing can take multiple forms that vary in the grammatical functions they perform (Crasborn & Bank, 2014; Mohr, 2012; Bisnath, 2024). A single type of mouthing, congruent mouthing (following Bisnath, 2024, 's terminology), is used in the experimental stimuli. This type of mouthing is called "congruent" because it can be glossed in the same way as the manual sign it accompanies – thus it reinforces the manual sign but does not modify it. An example of a congruent mouthing construction is the ASL sign CAT accompanied with mouthing of English /kat/(see also 1.1 in Swedish Sign Language). The prevalence of congruent English mouthing in ASL has not yet been studied; however, based on its use in

other sign languages, it is likely to be the most frequent type of mouthing (Bisnath, 2024).

Quantity and quality of mouthing were targeted in the Evaluation of Mouthing Task. Quantity is how much mouthing appears in a stimulus video. Modulating quantity stems from previous research on metalinguistic attitudes to mouthing in Italian Sign Language (LIS) in which publicly-available videos of signing with "many mouthings", "mouthing", "few mouthings", and "no mouthings" were chosen (Fontana & Ferrara, 2019). In the present research, two quantities were chosen: low and high. Low mouthing refers to complete absence of mouthing and high to full articulation of mouthing with *all* manual signs. Quality refers to the syllables mouthed. In the case of low mouthing, there are no aspects of quality to control. In high mouthing, signers are instructed to articulate all syllables of associated English words. Note that high and low mouthing stimuli are not intended to be fully naturalistic. They represent extremes that can inform future researchers about the size of effects to expect when making more fine-grained distinctions.

2.4.1.3 Evaluation terms

The evaluation terms are drawn from Hill (2012) which investigated a similar topic, language attitudes in the American deaf community. In that study, participants classified videos into three categories: ASL, Mixed, and Signed English, and rated them for how much they thought the signing evoked the following evaluation terms, which were presented in written English: "pure", "beautiful", "smooth", "educated", "deaf", "hearing", "deaf community leader", and "strong deaf person". The present study conveyed the terms in both ASL and written English (see Figures 2.4 and 2.5 for the signs used in the task). These are tied to deafness and use of ASL in the context of English and hearing cultural dominance, and thus can be used to understand attitude for English contact phenomena.



Figure 2.4: Aesthetics evaluation terms in ASL



Figure 2.5: Deaf identity evaluation terms in ASL

2.4.1.4 Considerations in evaluating mouthing experimentally

English mouthing in ASL can be difficult to control experimentally due to its variable nature, and the lack of research on the nature of mouthing. In the list below I identify properties that would have been useful to know when developing the stimuli in the present study, and which would be needed to develop more controlled and/or naturalistic stimuli in general.

1. Frequencies of ASL signs in different registers. Some impressionistic ratings are available in ASL-LEX 2.0 (Sehyr et al., 2021); however, most databases are unable to connect frequency to salience. For example, the term "COVID" has been salient and culturally relevant worldwide since 2019; however, it will not appear in spoken or signed language databases that predate 2019.

2. Frequencies of mouthings in specific discourse contexts e.g. how often is the ASL sign CAT produced with mouthing when first introduced *vs.* later in discourse?

3. Likelihood of a certain mouthing appearing with a certain sign e.g. how often is the ASL sign CAT produced with mouthing?

4. Typical form of a mouthing e.g. is Standard American English "cat" typically produced with or without a final alveolar closure i.e. /ka/ *vs.* /kat/?

5. Salience of individual mouthings e.g. how salient would mouthing of word like "tuba" in Standard American English, which would involve two closures and lip rounding, be compared to "bay', which has one closure?

In this study, issues 1–3 were not major problems because the two conditions needed required sign models to either produce mouthing with all manual signs or with none of them. Regarding issue 4, signers were allowed to use their own discretion to decide how to produce mouthing based on their knowledge of the goals of this study. This seemed the most logical approach given the lack of research available, as the sign models are ASL experts and would know best.

2.4.2 Explicit questioning

Explicit questioning closely followed the Evaluation of Mouthing Task, in that it targeted the same evaluation terms identified in Section 2.4.1.3. The major differences were that the evaluation term was negated and mouthing was mentioned

explicitly. Negation was done by inserting the NOT negator before the evaluation term and adding non-manual markers. Thus, the question *The signing in the video you just saw looks beautiful. How much do you agree?* asked in the experiment would have been altered to *How much do you agree that mouthing makes ASL not beautiful?*

Using simple negation as opposed to antonyms was chosen in an effort to maintain consistency with the questions asked in the evaluation task, and to avoid the inconsistencies that would have come up in trying to find appropriate antonyms for all evaluation terms. However, in hindsight, this negation may have made use of the agreement scale awkward, as participants would have had to indicate agreement with a negative statement. This kind of rating was also not found anywhere else in the survey. Thus, these explicit questions were ultimately not analysed.

2.5 Describing heterogeneity in participant background

Participant background in this study refers to their social characteristics. These characteristics were targeted to investigate how the social characteristics of perceivers might influence evaluation of mouthing. A broad overview of the social variables analysed can be found in (Table 2.1), followed by the motivations for their selection in Sections 2.5.1 to 2.5.9 respectively. Motivations consist of brief summaries of how the relevant social characteristic varies in ASL (and/or other sign languages where relevant) and its interactions with other social characteristics, and discussions of how each characteristic could map onto language experience broadly. Section 2.5.10 describes those aspects of language background that were not analysed.

Deaf identity (DEAF-ID), gender (GENDER-ID), cultural group (CULTURAL-ID), school (SCHOOL), and highest degree (DEGREE-ID) are collected using a combination of multiple choice and multiple answer questions. If participants grew up with deaf family (DEAF-FAM) is determined using a yes/no multiple choice question. Birthyear (BIRTHYEAR) and age-of-acquisition (AOA) are collected with open responses.

2.5.1 Deaf identity

Deaf sociocultural identity (DEAF-ID) refers to how DHH people label themselves in terms of their orientation to deaf culture and use of signing. This is a categorical variable with the following levels: deaf only, hard-of-hearing only, both. Deaf sociocultural identity is not necessarily linked to hearing levels (audiological identity). Deaf sociocultural identity is associated with nativeness, use of ASL, and schools attended (see Section 2.5.2 for links to education). ASL use is argued to be the most important part of constructing deaf identity in the United States (Reagan, 2002). There is also an opposition between signing and speech, in which those with socioculturally deaf identities in the United States perceive signing as very important and clear speech not, in contrast to those with culturally hearing identities (Bat-Chava, 2000). Therefore, those who identify as deaf might be expected to have greater experience signing. Regarding mouthing specifically, identity is linked to production, as signers who identify as hard-of-hearing are 1.75 times more likely to produce mouthing in ASL than those who identify as deaf Herbert & Pires (2017, 7). Lindeberg (2022) also reports that signers who have at least one deaf parent produce less mouthing than those who do have not deaf parents.

2.5.2 School

The SCHOOL variable identifies the type of school(s) participants attended, specifically mainstream and/or deaf schools, thus the levels of this categorical variable are deaf and mainstream, deaf only, mainstream only, neither. Those who attended deaf schools *only* are expected to have more experience with ASL than those who only attended mainstream schools (Henner et al., 2016), as they will minimally have had more direct language experiences with deaf classmates. Relatedly, more English exposure is expected for those who *only* attended mainstream schools (Cripps & Supalla, 2012), as they are embedded in a majority hearing context that they may not always have full access to through interpreters (Slobodzian, 2011).

Deaf identity is also linked to the types of schools attended, specifically attendance at deaf schools compared to mainstream ones (Bat-Chava, 2000). This occurs regardless of pedagogical orientation (more or less oriented towards sign language teaching and deafness) within a deaf school, as those who attend these schools encounter and socialise with a deaf community earlier than those who attend mainstream schools. In the case of the latter, they may only begin developing a deaf identity as adults.

2.5.3 Highest degree

The DEGREE-ID variable identifies the highest degree that participants have acquired. It is a categorical variable with the following levels: high school, bachelor's (includes professional degrees), advanced (master's or doctoral degree), other. As education is associated with written language, more advanced degrees are expected to be associated with reading and writing English more, particularly during school. However, educational advancement is not equally available or accessible across individuals (Woodcock et al., 2007; van den Heuij et al., 2022) for multiple intersecting reasons including financial requirements, lack of language accessibility for parents making decisions for their children and for students, lack of support, and having mixed identities (Follain-Grisell, 1988). Data from the National Deaf Center shows that fewer Black deaf (15.6%) and Latino/a/x/ deaf (15.6%) people in the United States have a Bachelor's degree compared to white deaf people (23.8%) (Bloom et al., 2024). Quotes (1)–(4) below from four different first-generation, deaf Latino/a students are illustrative of some of these issues.

(1) "I felt stressed out about finances and really wanted to stay at Gallaudet. But I gave up and left the university." (Torres, 2019, 28)

(2) "Being deaf, a Latina, and an American... I had a hard time identifying myself. I was confused...I lived in three different worlds: as a Latina, living in the Deaf world, and living in America." (Torres, 2019, 30)

(3) "My parents did not understand the academic meetings or how to interact with teachers because there were no Spanish interpreters." (Torres, 2019, 23)

(4) "My mother had a hard time making decisions related to the selection of my courses because she was not familiar with the high school curriculum because she left school in Mexico in the third grade to help her family." (Torres, 2019, 23)

2.5.4 Deaf family

The DEAF-FAM variable identifies if participants grew up with deaf family or not. The levels of this variable are yes and no. This experience is often part of "native" signer characterisation, and may even be the sole criterion as in Lindeberg (2022). The status of parents is also often reported (e.g. Best et al., 2010; Emmorey et al., 2020; Frederiksen & Mayberry, 2022). People who have deaf parents are assumed to have acquired ASL or another sign language through vertical transmission, and thus have more experience using ASL. These participants may be more likely to claim deaf identity, due to their experiences and the preferences of their parents. For instance, Thumann-Prezioso (2005) reports about deaf parents who choose to label their hard-of-hearing child as deaf partially because they wanted them to be part of deaf culture. In terms of mouthing, in a sample of signers who had acquired ASL by age seven, those who had a deaf parent produced less mouthing than those who did not (Lindeberg, 2022).

2.5.5 Age-of-acquisition

AOA or age-of-acquisition is the age that participants began to learn ASL, and is a continuous variable in this study. Participants who began to learn ASL earlier are expected to have more experience with ASL than those who began later purely based on time. There may also be differences in learning of other languages, like English, due to the effects of language deprivation in early childhood (e.g. Skotara et al., 2012; Hall, 2017); however, these effects on multilingualism are not well understood (Koulidobrova & Pichler, 2021). Lexical access is influenced by neighbourhood density in signers with higher age-of-acquisition, but not in those with a lower age-of-acquisition (Caselli, 2015; Malaia et al., 2020). In a study of ASL produced in pairs of deaf signers who had acquired ASL before age seven and in the teenage years and were familiar with each other, those with a higher age-of-acquisition were found to produce more mouthing (Herbert & Pires, 2017, 7).

2.5.6 Gender identity

GENDER, sometimes conflated with biological sex, is a commonly targeted variable in sociolinguistic studies. In this study it is a categorical variable with the following levels: male, female, non-binary/third gender. Gender and other variables may interact as social institutions have not always been accessible to all genders. Higher education for instance, has not always been equally open to all genders in

the United States, and Gallaudet University in particular has banned women in its history (Evans et al., 2017).

2.5.7 Cultural identity

As with gender, variation due to cultural identity (CULTURAL-ID) can influence language experience. In this study CULTURAL-ID is categorical with the following levels: Black/African American, American Indian/Alaska Native, White, Asian, native Hawaiian/other Pacific Islander, Middle Eastern/North African, other. In the United States in particular, racial segregation in the educational system affected how Black deaf students were educated and who they socialised with, resulting in dialectal variation (Lucas et al., 2022). This segregation no longer exists in the same way, which leads to the expectation that age and cultural identification will intersect to produce different language experiences. Black signers produce different signs (Lucas et al., 2001) and name varieties differently compared to white signers. When asked to label an ASL-English contact variety, Contact Signing, 37% of white signers label it as ASL compared to 87% of Black signers.

2.5.8 Age

AGE is a well-known index of variation in language use. In this study, it is a continuous variable calculated from an open-response question asking participants for the year they were born in ($2023 - \textit{birthyear}$). In sign languages, age is associated with lexical variation (Stamp et al., 2014), differences in depicting constructions (McKee et al., 2021), and constructed action (Puupponen et al., 2022) (see Lucas & Bayley, 2011, for overview). In ASL, age is linked to lexical variation in the sign for DEAF which interacts with region (Bayley et al., 2000), and with differences in language attitude. Noschese (2021) reports that younger signers of ASL appear to believe that older varieties are more "correct" because older signers received less education, despite their knowledge that older signers were educated under oralist systems.

2.5.9 Region

REGION is a *post hoc* category derived from participants reporting the state that they currently live in; therefore, it represents the region that the participant was in at the time of data collection. The states comprising each region are listed below.

1. South, *Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, Washington, D.C., West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, Texas*

2. Midwest, *Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota*

3. Northeast, *Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, Pennsylvania*

4. West, *Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming, Alaska, California, Hawaii, Oregon, Washington*

Lexical and phonological variation in ASL that is linked to the intersection of age and region in the United States has been reported, with some of this variation assumed to be linked to schools (Bayley et al., 2000, 2002).

2.5.10 Unanalysed aspects of participant background

Table 2.2 shows the aspects of language background that were collected but not analysed. They primarily have to do with use of hearing technology, namely cochlear implants and hearing aids. There is also a question about the city that participants spent the most time between ages 0–18.

Information about hearing technology can give an indication of the level of access participants may have had to spoken language, and potentially correlate with orientation to deafness. As these interventions are meant to increase perception and production of spoken language, participants who have experienced them are expected to have more English language experience than those who have not (Tomblin et al., 1999; Geers & Sedey, 2011; Iwasaki et al., 2012). They are of interest because of the medicalisation of deafness and the increasing availability of these technologies (Sorkin & Buchman, 2016; Teagle et al., 2019). Furthermore, use of these technologies may influence participants' orientation towards deaf/hard-of-hearing identity, the quality and quantity of spoken language input they receive, and their use of spoken language resources. However, asking about presence of hearing technology on its own was not informative enough – it would have been more useful to also know how long participants had used those technologies and how often. Given the length of the survey, it was not feasible to go into that level of additional detail, and so these questions were ultimately removed from further analysis.

The final question that was not analysed asked for the city that participants had spent the most time from ages 0–18. Geographical information is useful because it can be used to make assumptions about dialectal differences. City information is particularly useful for DHH individuals, as cities can be cross-referenced with historical information to make assumptions about if participants would have lived in or near places with deaf communities. For instance, if a participant had grown up in Washington, DC, it might be reasonable to assume that they would have had contact with deaf culture given the presence of Gallaudet University. It was not feasible to do this analysis in this dissertation, but it will be done in the future.

2.6 Collecting data on variation in language experience

In this study, language experience is conceived of as language input and output at three different periods in life (see Table 3.1 for means). For practical reasons, this is kept separate from the social characteristics of participants, however as Section 2.5 describes, all social characteristics are expected to have an influence on language experience. Input and output refer to perception *and* production of ASL, English and ASL-English mixing in different modalities (listed below in English and gloss of ASL manual signs used in videos). Including mixing is in line with the methodological design goal to center language contact (recall Section 2.3). Multiple modalities are targeted because of this study's framing of DHH individuals as bilinguals, but note that modality is not explicitly expressed in item 5.

1. spoken English, SPEAK ENGLISH
2. English writing, WRITE ENGLISH
3. English mouth forms (lipreading), LIPREAD ENGLISH
4. ASL signing, SIGN ASL
5. mixture of English and ASL, MIX ENGLISH ASL

The three points in life targeted are listed below with glosses of their phrasing in ASL in brackets. These periods are targeted because language access and experiences in these periods are formative, and will influence how participants *report* their language experience.

1. before entering school, BEFORE START SCHOOL

2. during school, SCHOOL

3. in a typical week, NORMAL WEEK

The period before entering school is targeted because DHH children have heterogeneous early language acquisition experiences, often to the extent that they experience some form of language deprivation (Hall, 2017; Hall & De Anda, 2021). They may also experience different kinds of medical interventions, like speech therapy, cochlear implants and/or hearing aids depending on the levels of access their families and communities have to these technologies, and their interest in and knowledge of their availability.

Language experience during formal education is targeted because schools are sites of individual interaction with socio-political goals and ideologies (Cushing, 2021), that can be so strong as to result in racially-segregated sign language varieties (Lucas et al., 2022). Schools are also particularly important as they are sites of sign language transmission and creation – they are one of the few places that DHH people gather in relatively high numbers (in urban contexts) (Fenlon & Wilkinson, 2015).

Language experience in a typical week is meant to give an idea of the language use patterns that are currently most familiar to participants, and are potentially more important than experiences during childhood and school when participants report their language experience in a survey.

2.7 Participant exclusion criteria

After seven days of data collection, 2405 responses were downloaded from Qualtrics. This number includes complete and incomplete responses. The likely reason for the large number of responses is a bot attack arising from posting the study on Reddit. The survey may also have been attractive to human respondents because it promised $15.00 USD in compensation. At the end of data cleaning, 310 responses remained.

The procedure for removing fraudulent responses is shown chronologically in the list below. Two core goals in this process were to be as conservative as possible, and for automatic removal based on open responses to be motivated by repetition, as opposed to singular instances. That is, a response was determined as questionable if it was unusual based on the researcher's intended meaning and understanding of American culture **and** if it appeared multiple times in the same

typed form *across* responses. Thus, a singular instance of a response typed in a specific way would not be automatically removed, e.g. "As Good As Gold", but the same occurring more than once would. Given this approach, it is likely that legitimate responses were removed as well as fraudulent ones.

1. manual visual inspection of data for patterns in responses
2. remove responses that are completely blank except for mandatory questions
3. remove responses with a total response time < 20 minutes. This cutoff time was selected based on the researcher's intuition about how long it would take a human to read 177 items quickly
4. manually remove responses with the same answers that occurred in chunks of time that differed by small increments e.g. responses with the same answers that began at 05:30, 05:31, 05:32, 05:33, 05:34 etc. These kinds of responses were easy to identify visually in CSV format as they occurred in chunks
5. remove participants who indicated that they did not understand the consent form (q13)
6. automatically remove any participant who self-identified as hearing (even if they also identified as deaf)
7. manually evaluate responses to open answer questions and collect repeated questionable ones, q35[2], q59, q60, and q161 (refer to Table 2.3)
8. automatically remove questionable responses to open questions using list in previous step.
9. manually remove remaining responses to open questions that seem questionable and were not in English
10. remove participants with suspect or implausible ages i.e. less than 18 or more than 100. Ages less than 18 were suspect because participants being 18 years or older was a screening requirement.

[2]The responses to this question within the domain of education may have been legitimate as education is particularly important in deaf culture. However, the use of more generic terms, as opposed to identifying specific schools, seems more likely if the question was being thought of in this way.

Fraudulent responses could have been avoided or lessened by including preemptive measures, like CAPTCHA (Completely Automated Public Turing test to tell Computers and Humans Apart) at the beginning of the survey to weed out bots that cannot complete these checks successfully. Attention checks also should have been included, given the length of the survey. In particular, attention checks that required participants to look at ASL videos could have been done. This would serve two purposes: to ensure that participants had some basic level of ASL proficiency, and to avoid the use of written English which can be more easily parsed by bots than video.

Variable	Description	Levels
DEAF-ID	*self-identified deaf identity*	deaf only, hard-of-hearing only, both, missing
SCHOOL	*combination of deaf and/or mainstream schools attended*	deaf+mainstream, deaf only, mainstream only, neither
DEGREE-ID	*highest degree participants had acquired*	high school , bachelor's (includes professional degrees), advanced (master's or doctoral degree), other
DEAF-FAM	*if participant grew up with deaf family or not*	yes/no
AOA	*age that participants began to learn ASL*	(continuous)
GENDER-ID	*self-identified gender identity*	male, female, non-binary/third gender
CULTURAL-ID	*self-identified cultural identity*	black/african american, american indian/alaska native, white, asian, native hawaiian/other pacific islander, middle eastern/north african, other
AGE	2023−*year of birth*	(continuous)
REGION	*region in the United States that participants currently live in*	south, midwest, northeast, west, missing

Table 2.1: Description of social variables and categories within

Question	Levels
Do you have a cochlear implant?	yes/no
Have you ever had a cochlear implant?	yes/no
Do you have hearing aids?	yes/no
Do you have a cochlear implant?	yes/no
Where did you spend the most time between ages 0–18? (city)	open response

Table 2.2: Description of unanalysed social variables and categories within

No.	Question	Questionable response
q35	*What is your cultural identity?*	"bachelor degree", "senior high school", "high school", "knowledge", "certain university", "high school graduation", "master", "college", "undergraduate", "college graduate", "collegiate", "free and independent", "surdomute", "university", "signs"
q59	*Where did you spend the most time between ages 0–18? - State*	"america", "deaf and hard-of-hearing people", "deaf people", "dwell for a long time", "family", "good", "happy", "normal", "work"
q60	*Where have you lived the longest? - State*	[same as q59]
q161	*In this survey, we will define mouthing as movements of the mouth that look like specific English words. For example,* PLATE. *The mouth movement you see looks like the English word "plate". This is different from small plate. The mouth movement in small plate is not mouthing. What do you think about this description of mouthing? Please type below*	e.g. "not bad", "words must be standardized", "NO", "none", "as good as gold", [descriptions about lips and mouths], "assist sign language to make others understand the meaning better", "the shape of a person's lips", "literacy development", "English language development", "cognition: math", "cognition: science", "physical development-health", "the descriptions are sometimes difficult to understand"

Table 2.3: Questionable responses to open questions

2.8 Summary

This dissertation draws on data collected from an online experiment to evaluate English mouthing in ASL and a survey. The experiment is a novel adaptation of Guise tasks, that are founded in evaluation of spoken language, for sign languages. The methods used are motivated by theoretical commitments to centering language contact and participant subjectivities, and the research/data collection goals of identifying participant background, language experience, and evaluation of mouthing. The concrete decisions arising out of this framework were to use self-report measures and named languages, collect data suitable for bottom-up analysis, and to take a multimodal bilingual approach. These decisions made the experiment and survey convenient, accessible, and inclusive. All methods were developed in collaboration with deaf Americans. During development and data collection, two key issues were difficulties in finding enough signer models for the experiment, and survey fraud. These issues are discussed and suggestions for improvement made – improvements in other domains are also included where relevant.

CHAPTER III

Characterising Language Contact Experiences of Deaf and Hard-of-Hearing Signers of ASL

3.1 Introduction

This chapter aims to categorise some of the heterogeneity of DHH experience with ASL and English in the United States, and in so doing, to present a model for how to investigate linguistic heterogeneity in similar linguistic contexts.

Social characteristics like gender identity, racialisation, age, and class influence how individuals are socialised and thus influence their language use. This leads to linguistic variation that can be linked to social characteristics. Variation can also be associated with the use of a single named language, that can extend to the formation of different dialects. An example of the first case is of African American speakers of North American English used in D.C. (USA) producing back vowels with more fronting in the oral cavity than speakers of European descent (Lee, 2016b). The second case can be illustrated by gender-based dialectal differences in Irish Sign Language used in Dublin in the 1980s arising out of gender-based segregation and changes in the deaf education system (LeMaster, 1997). For example, the male- and female-identified signs for GREEN differ in three phonological parameters – handshape, location and movement. In the male-identified sign, the index finger moves down the cheek while in the female-identified sign the thumb and index finger touch and move in a circular motion in front of the chest. Variation across named languages also occurs – Gullifer & Titone (2020) show that the sociocultural and psycholinguistic experiences of bilinguals is related to language choice in different contexts (see also Titone & Tiv, 2023).

The relationships between social characteristics and language use can and have been used to make generalisations about how groups behave. One strategy is to

pre-identify categories of a social characteristic in a population and characterise the linguistic behaviour of individuals who fall within those groups; however, category identification can privilege certain kinds of individuals over others and thus mask variation. A clear example of this is the native/non-native dichotomy in use in sign language linguistics. In this division, a "native" signer is typically defined as one who acquired the relevant sign language by the age of 3 from parents, and non-natives are all others; however, there is variation in how native signer is defined (Costello et al., 2006; Cheng et al., 2021). The focus on early acquisition aligns with the dominant practice in linguistics (Cheng et al., 2021), but is also of particular relevance in deaf populations because deaf children typically experience language deprivation which can alter brain development and cognition broadly (Cheng et al., 2019). The native/non-native dichotomy has also been shown to have utility, as differences have been detected in how these groups process and use sign languages (Morford et al., 2008; Novogrodsky et al., 2017; Zorzi et al., 2022). In the case of mouthing specifically, signers classified as "native" have been found produce mouthing at a statistically significant lower rate than those classified as non-native (Herbert & Pires, 2017; Lindeberg, 2022).

Despite this utility, there are multiple conceptual and practical issues with essentialising the language use of individuals to groupings like "native" *vs.* non-native. These issues limit understanding of what language use and experience is like in deaf communities, and obscure potential similarities in language experience that can occur at the intersection of social experiences.

First, the native/non-native dichotomy does not meaningfully engage with the known heterogeneity within deaf communities that arises from differences in language acquisition (Hall & De Anda, 2021). Prioritisation of nativeness is part of an attempt to isolate a "pure" form of ASL, namely one that is free of spoken language influence. However, this stance ignores the social context of use of ASL in the United States, specifically the dominance of English. In this context, DHH individuals necessarily have knowledge of forms of English which is evidenced by phenomena like mouthing and fingerspelling in ASL and other sign languages. Focussing on nativeness thus does not give a complete picture of the linguistic repertoires in use within DHH communities.

Second, "native" users are valued more than non-natives, and thus are overrepresented in sign language description (Zorzi et al., 2022). Studies of the syntax of ASL, for instance, tend to be solely based on small samples of native signers. For example, Petronio & Lillo-Martin (1997) analysis of *wh*-questions in ASL is based

on the intuitions of native signers, and Frederiksen & Mayberry (2016) description of reference tracking draws on 8 native signers. This situation is not unique to the study of ASL – research on relativisation in Italian Sign Language (LIS) (Cecchetto et al., 2006) and question-answer pairs in French Sign Language (LSF) (Hauser, 2019) both rely on the intuitions of 3 "native" signers each.

Third, the "native" category captures a narrow profile of experience that is unlikely to generalise across sign language populations as most DHH people are born into families that do not know a sign language[1], and thus cannot have the experience of acquiring a first language through vertical transmission in the typical way (Quer & Steinbach, 2019) (however see Zarchy & Geer, 2023). In the United States, Mitchell & Karchmer (2004b) estimate that approximately 4.4% of DHH children and youth have deaf parents, and 8.3% have parents who are deaf or hard-of-hearing.

Lastly, not all sign language communities have signers who would fit native criteria (Costello et al., 2006). This is not directly applicable to signing in the United States but is a broader conceptual issue that affects the study of sign languages in general.

3.1.1 Orientation and research questions

These issues together create a situation in which little is know about the heterogeneity of use and users of ASL in the United States (a potential exception is research on Black ASL like McCaskill et al. (2011)). More importantly, a focus on narrow acquisition conditions ignores other aspects of language experience that also influence language use, and may be more directly relevant at the time of study. For instance, bi- and multilingualism research shows that daily language use and experience, as opposed to static conditions of acquisition, influence linguistic behaviour (Gullifer & Titone, 2020).

In light of this background, this chapter directly targets variation in the language experiences of DHH ASL users in the United States. Three core assumptions are that language and social experience are entangled with eachother, DHH individuals are best framed as ASL-English bilinguals minimally, and that similar language experiences can arise in multiple ways. A data-driven bottom-up approach is taken to minimise imposing categories based on social characteristics, instead

[1]Note that in some communities, sign languages are used by deaf and hearing people. This kind of sign language can be found using the terms rural, village, micro-community and/or shared sign language

opting to characterise users based on their experiences using ASL, English, and mixing ASL and English at three different points in life. The relationships between these experiences and nine social characteristics of interest are then investigated to understand if and how social characteristics, individually and in groups, pattern with different language experiences. These goals are formulated as two research questions listed below. Question 2 is evaluated by testing predictions that are updated as the chapter proceeds. See Section 3.1.3 for the initial predictions based on the literature, Section 3.3 for predictions that are made specific to language experience as measured in this study and Section 3.5.5 for the final set of predictions and evaluations.

1. How do DHH users of ASL in the United States group together based on their experiences with ASL and English?

2. How are social characteristics distributed within the emergent groups found in question 2?

By targeting heterogeneity and theorising outside of "nativeness", this chapter will begin to show who is being erased in current linguistics research, and the diversity of experiences that are conflated under top-down labels and assumptions like "native" *vs.* non-native.

3.1.2 Chapter organisation

Section 2.6 describes and motivates how language experience is defined and conceptualised in data collection. Section 2.5 describes the social characteristics selected for investigation, and motivates their selection by discussing how they are linked to variation and experience with ASL and English. Section 3.1.3 identifies a set of tentative predictions about how social characteristics and language experience, as characterised in this study, might be linked. Section 3.2 describes the final characterisation of language experience after conducting a Principal Components Analysis (PCA). These language experience variables differ from those described in Section 2.6, and so the tentative predictions in Section 3.1.3 are updated in Section 3.3. In Section 3.4 the process of identifying profiles of language experience using cluster analysis is outlined. Section 3.5 describes the clusters that emerge in terms of language experience and social characteristics individually. Section 3.5.6 discusses how social characteristics pattern across clusters. Sections 3.7 and 3.8 discuss the findings and conclude the chapter respectively.

3.1.3 Preliminary expectations

The list below identifies tentative predictions about how language experience might map onto individual social characteristics. Predictions are only made for deaf identity, age-of-acquisition, school, and highest degree (DEAF-ID, AOA, SCHOOL, DEGREE-ID), as it is easier to imagine how quantity of language input and output could vary. It is more difficult to formulate predictions about how gender identity, cultural identity, birthyear, and region (GENDER-ID, CULTURAL-ID, BIRTHYEAR, REGION) might map on to language use, but variation related to them is expected as they influence the varieties signers are exposed to, and the conditions of this exposure.

1. greater overall use and exposure to ASL → lower age-of-acquisition, grew up with deaf family, attendance at deaf schools, deaf identity
2. greater use and exposure to ASL before entering school → lower age-of-acquisition
3. greater production of English → hard-of-hearing identity, did not grow up with deaf family, higher age-of-acquisition, mainstream schools
4. greater exposure to written English → higher level of education
5. greater exposure to oral forms of English during school → mainstream school

3.2 Defining language experience

The language experience variables identified in Section 2.6 are categorised using a Principal Components Analysis (PCA) to identify composite language experience variables. This approach is theoretically and methodologically motivated.

Theoretically, it is expected that signers' experiences with various forms of languages at the three points in time examined in this study will correlate with each other, as the time periods are chronological. Participants also are not expected to have equal access to all language forms targeted at all periods. For instance, the experience participants report with ASL during childhood might be related to their experience with English during the same time. The presence of strong correlations among variables was confirmed in the data by finding the determinant of a correlation matrix made with the input variables (done with `psych` package

(Revelle, 2023) in R). A determinant value ≥ 0.00001 indicates that the collinearity in the data is not overly high. The value obtained on the input variables was 9.852905^{-10}, indicating that in their current state, they are highly collinear.

The theoretical expectations and collinearity testing show that correlations in how participants answer language experience questions is expected and are present, but do not concretely identify or quantify these relationships. Stated differently, it is unknown how a participant's answer about how often they used English during childhood might influence their answer about how often they use English in their current life. PCA can remedy this issue in the current data by making it possible to identify and specify correlations among different measurements like these across the entire sample. PCA is also methodologically advantageous as it reduces dimensionality and collinearity, making it more amenable to cluster analysis which will be used to categorise language experience (see Section 3.4).

3.2.0.1 Introduction to Principal Components Analysis (PCA)

Principal Component Analysis (PCA) can be used to produce a smaller set of *new* variables that are independent. PCA takes a set of continuous variables as input and creates new variables, or components, that are linear combinations of the input variables. The components are created to maximise the amount of variance represented in the data. Each variable comprising each component have a weighting which indicates how much they contribute to the component. This weighting is called a variable's loading, with a higher value meaning a higher contribution. Below is a schematisation of what a linear combination for one component could look like.

$$\text{Component 1} = Loading_a(Variable_a) + Loading_b(Variable_b) + Loading_c(Variable_c)$$

After a set of components has been decided upon, scores can be extracted for each component for each participant. This is done by first centering the raw data, and inputting participants' values for individual variables into the component equations. For example, to calculate a participant's score for Component 1 above, their raw scores for $Variable_a$, $Variable_b$ and $Variable_c$ would be centered and then input to the Component 1 equation. Across participant scores for the same component, Variable scores would change but Loadings would remain the same.

3.2.0.2 Broad description of the sample

The initial sample consists of 310 participants. Table 3.1 below summarises their *raw* responses to questions about language experience (described in Section 2.6). In the table, "SD" refers to standard deviation, and "SE" to standard error.

Table 3.1: Summary of raw language experience data

Language Experience	Mean	SD	SE
EXPOSURE TO SPOKEN ENGLISH BEFORE SCHOOL	69.88	23.73	1.35
EXPOSURE TO SIGNED ASL BEFORE SCHOOL	61.45	25.64	1.46
EXPOSURE TO ASL-ENGLISH MIXING BEFORE SCHOOL	60.60	25.31	1.44
LIPREADING ENGLISH BEFORE SCHOOL	61.31	24.66	1.40
READING ENGLISH BEFORE SCHOOL	63.60	25.56	1.45
SPEAKING ENGLISH BEFORE SCHOOL	58.68	28.66	1.63
WRITING ENGLISH BEFORE SCHOOL	61.09	27.46	1.56
SIGNING ASL BEFORE SCHOOL	59.13	26.86	1.53
ASL-ENGLISH MIXING BEFORE SCHOOL	56.49	27.44	1.56
EXPOSURE TO SPOKEN ENGLISH IN SCHOOL	72.76	19.85	1.13
EXPOSURE TO ASL SIGNING IN SCHOOL	70.79	21.36	1.21
EXPOSURE TO ASL-ENGLISH MIXING IN SCHOOL	67.14	22.84	1.30
LIPREADING ENGLISH IN SCHOOL	69.83	21.73	1.23
READING ENGLISH IN SCHOOL	73.25	21.29	1.21
SPEAKING ENGLISH IN SCHOOL	64.10	26.77	1.52
WRITING ENGLISH IN SCHOOL	76.78	19.34	1.10
SIGNING ASL IN SCHOOL	69.62	21.92	1.25
ASL-ENGLISH MIXING IN SCHOOL	68.50	22.12	1.26
EXPOSURE TO SPOKEN ENGLISH IN A TYPICAL WEEK	71.43	20.96	1.19
EXPOSURE TO ASL SIGNING IN A TYPICAL WEEK	72.85	20.28	1.15
ASL-ENGLISH MIXING IN A TYPICAL WEEK	69.26	19.80	1.12
LIPREADING ENGLISH IN A TYPICAL WEEK	70.16	20.75	1.18
READING ENGLISH IN A TYPICAL WEEK	75.92	18.96	1.08
SPEAKING ENGLISH IN A TYPICAL WEEK	62.44	28.41	1.61
WRITING ENGLISH IN A TYPICAL WEEK	73.80	21.15	1.20
SIGNING ASL IN A TYPICAL WEEK	73.17	20.52	1.17
ASL-ENGLISH MIXING IN A TYPICAL WEEK	68.85	21.61	1.23

3.2.0.3 Method

An initial PCA (pca1) was conducted using the `psych` package in R (Revelle, 2023) with a correlation matrix of the raw data and the number of components to be extracted set to the number of variables. Use of a correlation matrix means that the data is scaled and centered. In pca1, 100% of the variance is explained with

the same number of components as variables which does not reduce dimensionality. To identify an appropriate number of components, a scree plot/the elbow method is used as a heuristic for determining the number of components to specify in a subsequent PCA (pca2) (Hutcheson, 2020) (see Appendix 7.1). The standard method is to choose the number of components above the point where the plot begins to plateau. In this case, five components, which account for 71% of the variance in the data, were selected for specification in pca2.

The patterning of the pca2 components was inspected and found to be difficult to interpret. More specifically, a coherent theme in variables with loadings above 0.30 on individual components was difficult to identify. The loading of a variable refers to how much it contributes to a component; therefore, higher loadings mean higher contributions. Identification of themes is based on patterns in language and modality, and time period. Because of this, two orthogonal rotations – `'oblimin'` and `'promax'` in `psych` – were conducted and compared. pca3, the `'promax'` rotation, produced variable combinations that were judged to be the most interpretable.[2]

Rotated components are interpreted because they are intended for cluster analysis and aligned with sign language and linguistics literature on the influence of childhood language experience. However, the mean complexity score was 1.6, with several variables having a complexity above 2.0. A complexity of 1.0 indicates that there is clear loading onto a single component, which is favourable, while scores above 2.0. are considered unfavourable because they make interpreting individual components difficult

To remedy this, those seven variables with a complexity $\geq$ 2.0 (READING ENGLISH BEFORE SCHOOL, WRITING ENGLISH BEFORE SCHOOL, ASL-ENGLISH MIXING BEFORE SCHOOL, EXPOSURE TO SPOKEN ENGLISH IN SCHOOL, EXPOSURE TO ASL SIGNING IN SCHOOL, ASL SIGNING IN SCHOOL, SIGNING ASL IN A TYPICAL WEEK) were removed from the analysis. The level of correlation in this new dataset was assessed using the Kaiser-Meyer-Olkin (KMO) criterion. KMO indicates that there are relationships in the dataset that could be reduced – without these relationships PCA would not be useful The KMO identified is 0.84, which is "meritorious".

[2]Jolliffe (2002) discusses pros and cons of interpreting rotated components and alternatives. This decision was primarily based on the `'promax'` rotation producing components that tended to group the same language form together, while the `'oblimin'` rotation tended to group based on time period and thus mix language forms together. The latter is undesirable because predictions based on language experience become more difficult to make.

A fourth PCA (pca4) was conducted with the final dataset with both `'oblimin'` and `'promax'` rotations. These rotations produced very similar components, so the `'promax'` rotation was chosen because it is more commonly used. The details of this PCA and its interpretation are discussed in the following section.

3.2.0.4 Results & Interpretation of Principal Components

A summary of pca4 is shown below in Table 3.2. The notation [1], [2], [3], [4] and [5] marks the number of the principal component where [1] captures the most variance of all the components, and [5] the least. The importance of each component is measured by its eigenvalue, which is shown in the *SS Loadings* row. The *Proportion Variance* row shows how much of the variance in the dataset is explained by each component. In the *Cumulative Variance* row we see that the five components extracted explain 74% of the input data and that components 1 and 2 explain 32% of the data. The mean item complexity is 1.3 with one variable, LIPREADING ENGLISH BEFORE SCHOOL, cross-loading onto components 2 and 4, but the overall complexity is 1.6, which is below the 2.0 cutoff used to remove variables above.

Table 3.2: pca4 (promax rotation, 5 components)

Component	[1]	[2]	[3]	[4]	[5]
SS loadings	3.40	3.03	3.03	2.73	2.60
Proportion variance	0.17	0.15	0.15	0.14	0.13
Cumulative variance	0.17	0.32	0.47	0.61	0.74
Proportion explained	0.23	0.20	0.20	0.18	0.18
Cumulative explained	0.23	0.43	0.64	0.82	1.00

The components derived from pca4 are interpreted as shown in the following list in *descending* order of the variance they capture in the data. Variable names chosen to capture what each component represents based on the input variables that load $\geq$ 0.30 are shown in SMALL CAPS. In these names, "exposure" is used to refer to language input, and "experience" to refer to input and output. Numbers in square brackets identify the component number and are used as abbreviations when necessary in tables and figures going forward. This list links to tables that shows the variables comprising each component listed in descending order of loading weight with loading values shown in parentheses within tables.

1. [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK (Table 3.3)

2. [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME (Table 3.4)

3. [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK (Table 3.5)

4. [4] EXPERIENCE WITH ASL BEFORE SCHOOL (Table 3.6)

5. [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME (Table 3.7)

The new composite variables generally pattern around modality and language. English experience is split into experience producing and perceiving written English (Table 3.3), exposure to spoken forms of English (Table 3.4), and experience speaking English (Table 3.7). Experience with ASL-English mixing and ASL are captured in components 3 and 4 respectively (Tables 3.5, 3.6). The importance of English is not unexpected as English is the dominant language in the United States, and a target in education. It may also be that English experience was made salient due to the bilingual nature of the survey (see Noschese, 2021, for a rating survey designed to reduce English influence). A secondary pattern in the composite variables is that they brought together experience during school and in a typical week, as in [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK and [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK. Exposure before school accounted for parts of [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME and [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME, and all of [4] EXPERIENCE WITH ASL BEFORE SCHOOL.

Table 3.3: Description of Component 1 [1]

component name	[1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK
comprising variables	WRITING ENGLISH IN SCHOOL (0.93), WRITING ENGLISH IN A TYPICAL WEEK (0.91), READING ENGLISH IN SCHOOL (0.89), READING ENGLISH IN A TYPICAL WEEK (0.85)

Table 3.4: Description of Component 2 [2]

component name	[2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME
comprising variables	LIPREADING ENGLISH IN A TYPICAL WEEK (0.89), LIPREADING ENGLISH IN SCHOOL (0.87), LIPREADING ENGLISH BEFORE SCHOOL (0.69), EXPOSURE TO SPOKEN ENGLISH IN A TYPICAL WEEK (0.67), EXPOSURE TO SPOKEN ENGLISH BEFORE SCHOOL (0.61)

Table 3.5: Description of Component 3 [3]

component name	[3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK
comprising variables	ASL-ENGLISH MIXING IN A TYPICAL WEEK (0.94), ASL-ENGLISH MIXING IN SCHOOL (0.82), ASL-ENGLISH MIXING IN A TYPICAL WEEK (0.75), EXPOSURE TO ASL-ENGLISH MIXING IN SCHOOL (0.65), EXPOSURE TO ASL SIGNING IN A TYPICAL WEEK (0.54)

Table 3.6: Description of Component 4 [4]

component name	[4] EXPERIENCE WITH ASL BEFORE SCHOOL
comprising variables	WRITING ENGLISH BEFORE SCHOOL (0.92), EXPOSURE TO SIGNED ASL BEFORE SCHOOL (0.90), EXPOSURE TO ASL-ENGLISH MIXING BEFORE SCHOOL (0.79)

Table 3.7: Description of Component 5 [5]

component name	[5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME
comprising variables	SPEAKING ENGLISH IN A TYPICAL WEEK (0.93), SPEAKING ENGLISH IN SCHOOL (0.91), SPEAKING ENGLISH BEFORE SCHOOL (0.80)

Figure 3.1 visualises correlations among the new composite variables (see Appendix 7.1 for values). Most correlations are positive and occur with [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK and [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME. The strongest positive correlation occurs between [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME and [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME. This correlation appears plausible as greater exposure to orally-produced English could logically lead to greater production of spoken English. The only negative correlation is that between [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK and [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME. There is very little correlation between [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK and [4] EXPERIENCE WITH ASL BEFORE SCHOOL possibly because written English learning begins in earnest in school, and ASL learned before school is unlikely to have been mediated much by written English.

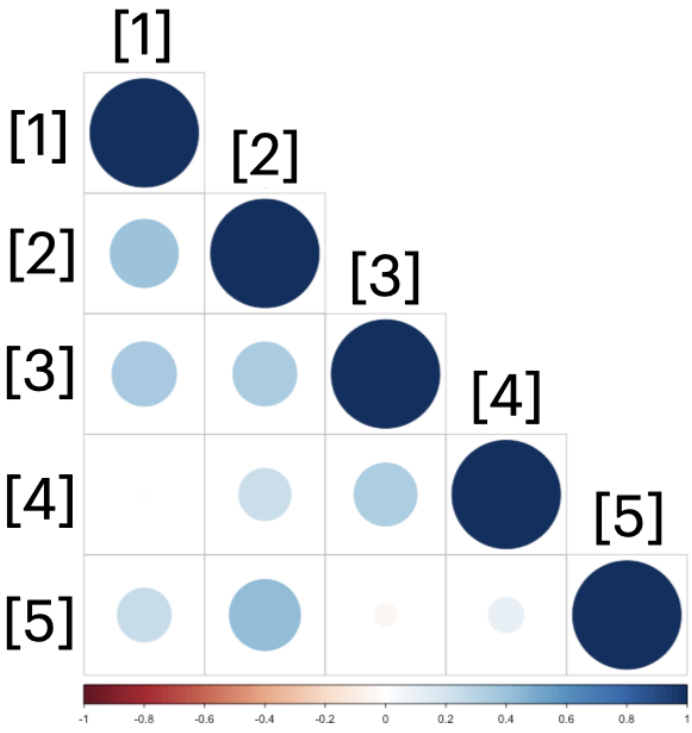


Figure 3.1: Principal Components Correlation Plot

3.2.0.5 Summary

PCA identified five composite language experience variables (components). In arriving to the final PCA, seven of the initial variables were excluded because they negatively impacted interpretation of individual components. These variables primarily targeted language experience before school and in school (READING ENGLISH BEFORE SCHOOL, WRITING ENGLISH BEFORE SCHOOL, ASL-ENGLISH MIXING BEFORE SCHOOL, EXPOSURE TO SPOKEN ENGLISH IN SCHOOL, EXPOSURE TO ASL SIGNING IN SCHOOL, ASL SIGNING IN SCHOOL, SIGNING ASL IN A TYPICAL WEEK). Recall that exposure to oral forms of English primarily has to do with use and exposure to lipreading while experience speaking English has to do with production of spoken English. The five composite variables identified account for 74% of the total variance in the original data and have a mean complexity of 1.3. These variables capture [1] EXPERIENCE WITH WRITTEN ENGLISH DURING SCHOOL AND IN A TYPICAL WEEK, [2] EXPOSURE TO ORAL FORMS OF ENGLISH BEFORE CHILDHOOD, DURING SCHOOL AND IN A TYPICAL WEEK, [3] EXPERIENCE WITH ASL-ENGLISH MIXING DURING SCHOOL AND IN A TYPICAL WEEK, [4] EXPERIENCE WITH ASL DURING CHILDHOOD, and [5] EXPERIENCE SPEAKING ENGLISH IN CHILDHOOD, DURING SCHOOL AND IN A TYPICAL WEEK.

The two most important variables have to do with experience with written English during school and in a typical week, and exposure to oral forms of English before childhood, accounting for 32% of the variance in the data. Note, however, that the proportion of variance that each variable accounts for is similar, ranging from 13% to 17%. The scores for the five composite language experience variables are visualised in Figure 3.2.

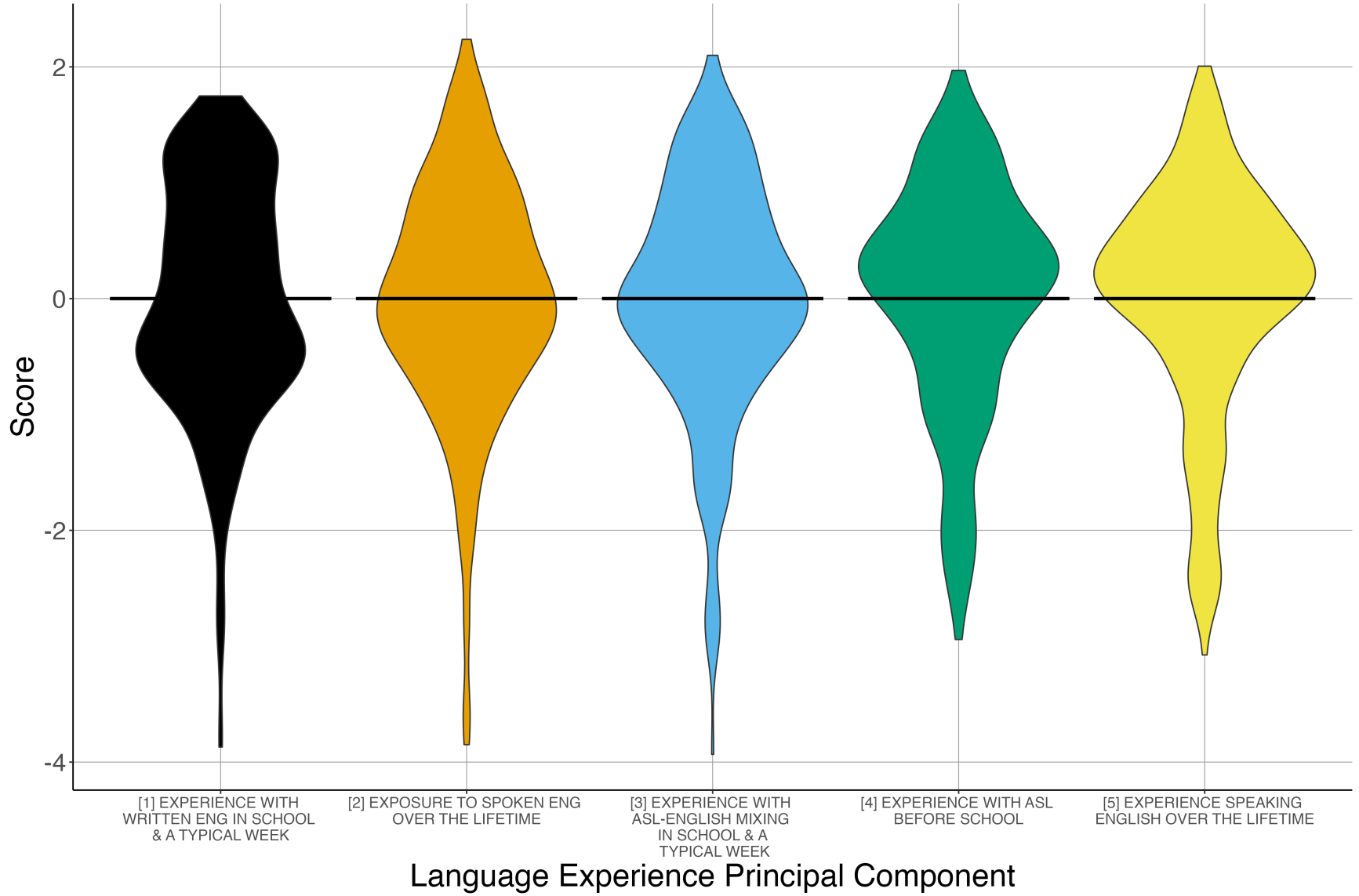


Figure 3.2: Distribution of Composite Language Experience Scores

3.3 Updated expectations

This section updates the expectations outlined in Section 3.1.3 based on the language experience variables derived from PCA. These expectations are made in terms of clusters, and will be used to discuss how social characteristics are distributed within the clusters that are found (research question 2). Note that the new language experience variables are composite and thus the labels for them, while generally capturing the essence of the comprising variables, should not be read as fully transparent.

1. cluster with greatest [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK → highest proportion of members with mainstream education and members with higher degrees

2. cluster with greatest [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME → highest proportion of members with mainstream education, higher degrees and hard-of-hearing identity

3. cluster with greatest [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK → highest proportion of members with mainstream education

4. cluster with greatest [4] EXPERIENCE WITH ASL BEFORE SCHOOL → highest proportion of members with who attended deaf schools, have deaf family, and claim deaf identity

5. cluster with greatest [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME → highest proportion of members with mainstream education and who claim hard-of-hearing identity

3.4 Profiling language experience using cluster analysis

This section describes the cluster analysis process used to classify participants based on their language experience as measured by the composite variables derived from PCA. Cluster analysis is used as a data-driven emergent means of identifying participant groups, as opposed to imputing *a priori* categorisations based on social characteristics. Emergent categorisation of this kind has proved useful in classifying the language experiences of DHH children below the age of 3 as an alternative to top-down categories (Hall & De Anda, 2021), and in identifying types

of deaf identities (Bat-Chava, 2000). Outside of sign linguistics, cluster analysis is a general means of multidimensional categorisation – it has been used to identify types of L2 learners (Baker & Hinde, 1984; Sparks et al., 2012) and individuals with Autism Spectrum Disorder and Specific Language Impairment (Baker & Hinde, 1984; Cabell et al., 2010), and cognitive profiles of epileptic patients (Reyes et al., 2020). One caveat is that cluster analysis presupposes the existence of clusters and thus will always find them – given the goals of this study and heterogeneity of DHH people, this assumption is a reasonable one to adopt. In pursuing cluster analysis, the goals were to obtain clusters that (i) are not extremely disproportionate in size, and (ii) are differentiated based on language experience variables.

3.4.1 Input data screening

The input to the cluster analysis are the composite language experience variables derived from PCA. These variables were screened for their amenability to cluster analysis. This includes testing collinearity and clustering tendency and identifying outliers.

Outlier identification: Outliers were identified by finding the Mahalanobis Distance (D^2) of each observation using the `mahalanobis` function in R and removing those that did not fall within the 95% confidence interval of a Chi-square distribution. Mahalanobis Distance is calculated as shown below where x is a vector of the five component scores for each observation, μ is the center or mean of the entire distribution, and Σ a 5x5 covariance matrix of the component scores. Recall that the distribution exists in 5-dimensional space as each participant has 5 scores corresponding to the five principal components extracted.

$$D^2 = (x - \mu)'\Sigma^{-1}(x - \mu)$$

Forty-one outliers (13%) were identified from an initial set of 310 observations. Visual inspection shows that participants identified as outliers tend to respond at the extremes of the scales.

The decision to remove outliers is not trivial, particularly in a project of this type that is interested in the heterogeneity of DHH experience. Inspection of the raw responses did not reveal a large number of participants responding entirely at the absolute minimum or maximum of the scale, which might suggest non-meaningful engagement with the survey questions. Theoretically, the only impossible set of responses would be one where participants claim no experience with

any form of English, ASL or English-ASL mixing which would suggest an inability to understand the survey questions themselves; however, no participant shows this behaviour. Hair et al. (2019) identify three types of observations that outliers may represent: (i) true anomalies, that do not represent the general population (ii) representative groupings of small groups (iii) small samples of actual groups. They recommend that type (i) outliers be excluded; however, as this study is the first of its kind, there is no foundation for determining if participants identified as outliers are type (i). Methodologically, outlier removal is recommended because outliers can skew the results in ways that are not representative of the population and reduce the quality of clustering output (Nowak-Brzezińska & Gaibei, 2022). In the context of this study, it is difficult to balance these theoretical and methodological concerns. For this reason, cluster analysis on datasets before and after outlier removal are conducted and compared, and the best solution selected (see Section 3.4.3).

Collinearity: There should be some analysable relationships (correlation), among variables, but they should not be perfectly correlated or redundant. Multicollinearity was assessed by finding the determinant of a correlation matrix of the input variables. The outcome for the dataset before and after outlier removal are 0.48 and 0.13 respectively, indicating that neither shows too high collinearity. This is an expected outcome as the dataset contains PCA scores which were created to reduce collinearity.

Clustering tendency: Clustering tendency was assessed by calculating Hopkins statistic using the `fpc` package (Hennig, 2023). The value for the datasets before and after outlier removal are 0.72 and 0.73 indicating a high tendency to cluster in both.

3.4.2 Cluster analysis specification

In cluster analysis, dissimilarity and method (partitioning procedure) (Hair et al., 2019) must be specified. Recall that each participant has scores for five composite language experience variables, so clustering is occurring in five-dimensional space. Decisions about how to specify the cluster analysis are made by trying to balance conceptual motivations, the goals in Section 3.4.3, standard clustering practices.

The dissimilarity measure (also called distance) is the means of determining how much participants differ. There are two broad types: correlation and distance. A correlation measure identifies patterns by making groups based on correlations

between variables. A distance measure considers the magnitude in the values of individual variables, with higher values indicating lower similarity. There are multiple types of correlation and distance measures: correlational measures include *Pearson* and *Spearman*, distance measures include *Euclidean*, *Manhattan*, and *Mahalanobis*. Distance measures are more commonly used than correlation measures, as they are viewed as simpler to interpret. However, in this study, dissimilarity is specified using *Pearson* correlation, because grouping participants by their overall patterns in language use is more in alignment with the goal of characterising participants by their overall language experience, as opposed to extremes. If a distance measure was used, participants could be grouped based on extreme values in a single domain of language experience. *Pearson*, as opposed to *Spearman*, was chosen out of convenience, as it is readily available in clustering packages in R; however, it should be noted that *Pearson* dissimilarity is sensitive to outliers (Kassambara, 2017).

The partitioning procedure, or algorithm, is the means of grouping participants. The two major types are: hierarchical and non-hierarchical. A major difference between the two is in how the number of clusters to be formed is identified. Hierarchical methods may be agglomerative (bottom-up) or divisive (top-down). In an agglomerative approach, participants begin in their own clusters and are then progressively grouped. Note, however, that the researcher must still determine how many clusters to select. In a non-agglomerative approach, all participants begin in a single cluster. Different types of linkages within agglomerative hierarchical methods include *single*, *complete*, *average*, *Ward's*, *centroid*. Key differences among them are the types of clusters they produce e.g. inter-cluster *vs.* intra-cluster variance, relative size, shape, and their sensitivity to outliers.

Hierarchical methods are chosen as opposed to non-hierarchical ones due to the exploratory nature of this study. In non-hierarchical approaches, the number of clusters and the beginning points of each cluster must be specified by the researcher. These specifications are typically informed by previous analyses, which are not available for this study. The two linkage methods selected are: *average* and *complete*. Other options were pre-tested, but these two were chosen because they appeared to be the most promising. The *complete* and *average* methods differ in how distance between clusters is measured: in the *complete* method, it is the largest distance between single points in cluster 1 vs cluster 2 while in the *average* method it is distance between the average distance of members of cluster 1 *vs.* that in cluster 2. The *complete* method tends to produce compact clusters while *average*

produces clusters with small intra-cluster variance and equal inter-cluster variance (Kassambara, 2017; Hair et al., 2019). The *average* method is also relatively robust to the effects of outliers, while *complete* is susceptible to them.

3.4.3 Selecting final data set and linkage method

The cluster analysis was done using *Pearson* correlation and a hierarchical algorithm. The remaining decisions to be made are if the input data set should contain outliers or not, the linkage method to use, and the final number of clusters. Determining if to include outliers or not and linkage method are intertwined as certain linkage methods are more susceptible to the influence of outliers than others. The final decisions are made by choosing a solution with the best internal validation metrics. This is done stepwise as shown below:

1. Step 1 & 2: Remove solutions that produce disproportionate clusters (Divjak & Fieller, 2014; Hair et al., 2019)
2. Step 3: Compare how well clustering solutions reflect original data using cophenetic correlation
3. Step 4: Compare how well cluster solutions correlate with individual language experience variables and measures of cluster compactness

3.4.3.1 Step 1: Selecting number of clusters, *k*

The Silhouette method is used to identify the optimal number of clusters. Silhouette width measures internal consistency within clusters and separation between clusters. Average silhouette ranges from -1 to +1 with higher values indicating better clustering. The optimal number of clusters identified was 2, which was used as a starting point for testing solutions due to the exploratory nature of this study. In addition to a 2-cluster solution, 3-, 4- and 5-cluster solutions are also tested.

3.4.3.2 Step 2: Comparison of frequencies of members within clusters

In the second step, the number of members in each cluster for all cluster solutions was compared. This was done to remove solutions that contained clusters that were very disproportionate. Table 3.8 and 3.9 show the these findings with

the number of members in each cluster separated by commas[3]. Solutions that contained clusters with less than 10% of the total number of participants per data set were excluded. In the case of the the dataset before outlier removal, this number is 31, and for the data set after outlier removal it is 27. This heuristic results in only the five-cluster solution using the complete method on the data without outliers being removed. The solutions that are moved to the Step 3 are highlighted in gray.

Table 3.8: Frequencies within clusters formed from data before outlier removal *(n=310)*

Distance	**Linkage**	k	**Frequencies**
pear	average	2	131, 179
pear	average	3	82, 179, 49
pear	average	4	44, 179, 49, 38
pear	average	5	44, 82, 49, 97, 38
pear	complete	2	162, 148
pear	complete	3	80, 148, 82
pear	complete	4	80, 148, 34, 48
pear	complete	5	34, 148, 34, 48, 46

Table 3.9: Frequencies within clusters formed from data after outlier removal *(n=269)*

Distance	**Linkage**	k	**Frequencies**
pear	average	2	75, 194
pear	average	3	43, 194, 32
pear	average	4	43, 80, 32, 114
pear	average	5	43, 69, 32, 114, 11
pear	complete	2	157, 112
pear	complete	3	45, 112, 112
pear	complete	4	45, 72, 112, 40
pear	complete	5	45, 28, 112, 44, 40

3.4.3.3 Step 3: Compare cophenetic correlation coefficient

The third step is to find the cophenetic coefficient of the remaining solutions (highlighted in gray). The cophenetic correlation coefficient is a measure of how well the clustering solution preserves the original distance matrix. A comparison

[3]order of numbers does *not* correspond to chronological cluster order

of the coefficients is shown below in Table 3.10 with two of the highest and best coefficients produced highlighted in gray.

Table 3.10: Cophenetic coefficients

Outliers	Distance	Linkage	Cophenetic
yes	pear	complete	0.5390843
no	pear	complete	0.5686925
yes	pear	average	0.6815392
no	pear	average	0.695149

Based on this table it appears that a solution with *Pearson* dissimilarity and average linkage is most promising. This is explored in the fourth and final step where this specification is examined on the data before and after outlier removal for how it relates to the individual language experience principal components.

3.4.3.4 Step 4: Comparison of relationships with language experience

Testing the relationships between the solutions and language experience principal components is motivated by the overarching goal to separate participants by language experience (see Section 3.4.3). This is done with linear regression using `lme4` (Bates et al., 2015) with principal component score as the dependent variable and cluster solution as the predictor. Therefore five regressions are conducted for each solution. Clustering solutions that are significantly associated with a higher *number* of components are considered best. If all components are not significantly correlated, solutions in which there is significant correlation with components 1 [1] and 2 [2], which account for the greatest variance in the raw data, will be preferred.

Table 3.11 shows the findings of the significance testing as well as Silhouette width (recall Section 3.4.3.1) and Dunn's index for the solutions tested. Dunn's Index (range: 0 to ∞), like Silhouette width, determines how compact and connected clusters are, and their separation. A higher Index is interpreted as better. All solutions shown are specified for *Pearson* distance and *average* linkage. Note that the cophenetic for this specification is the same within a dataset regardless of the value of k – the data with outliers has a cophenetic of 0.68 and the data without has a cophenetic of 0.70.

Table 3.11: Significance of relationships with language experience components ([1] to [5]) by clustering solution (distance = *Pearson*, linkage = average)

Outliers	***k***	**Silhouette**	**Dunn**	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**
yes	2	0.41	0.02	sig	sig	insig	insig	insig
no	2	0.43	0.03	sig	sig	sig	insig	insig
yes	3	0.42	0.02	insig	sig	sig	sig	sig
no	3	0.40	0.03	sig	sig	sig	sig	sig
yes	4	0.38	0.02	insig	sig	sig	sig	insig
no	4	0.45	0.02	sig	sig	sig	sig	sig

Overall, the findings shows that the data after outlier removal performs relatively better than that before outlier removal in terms of correlations between clusters, separation between clusters, and matching of cluster members to a cluster. However, in absolute terms, the cluster solution is not ideal. The significance testing suggests that cluster solutions where there are more than two clusters perform best (highlighted in gray), as they all show significant relationships with all five of the language experience principal components, meaning that language experience correlates with cluster membership for all language experience variables. Figure 3.3 illustrates separation between the clusters, which are marked using colour. All plots show component 1 on the x-axis and each plot shows a different component on the y-axis. These plots are constrained to two-dimensions, but recall that the clusters are defined in five dimensions.

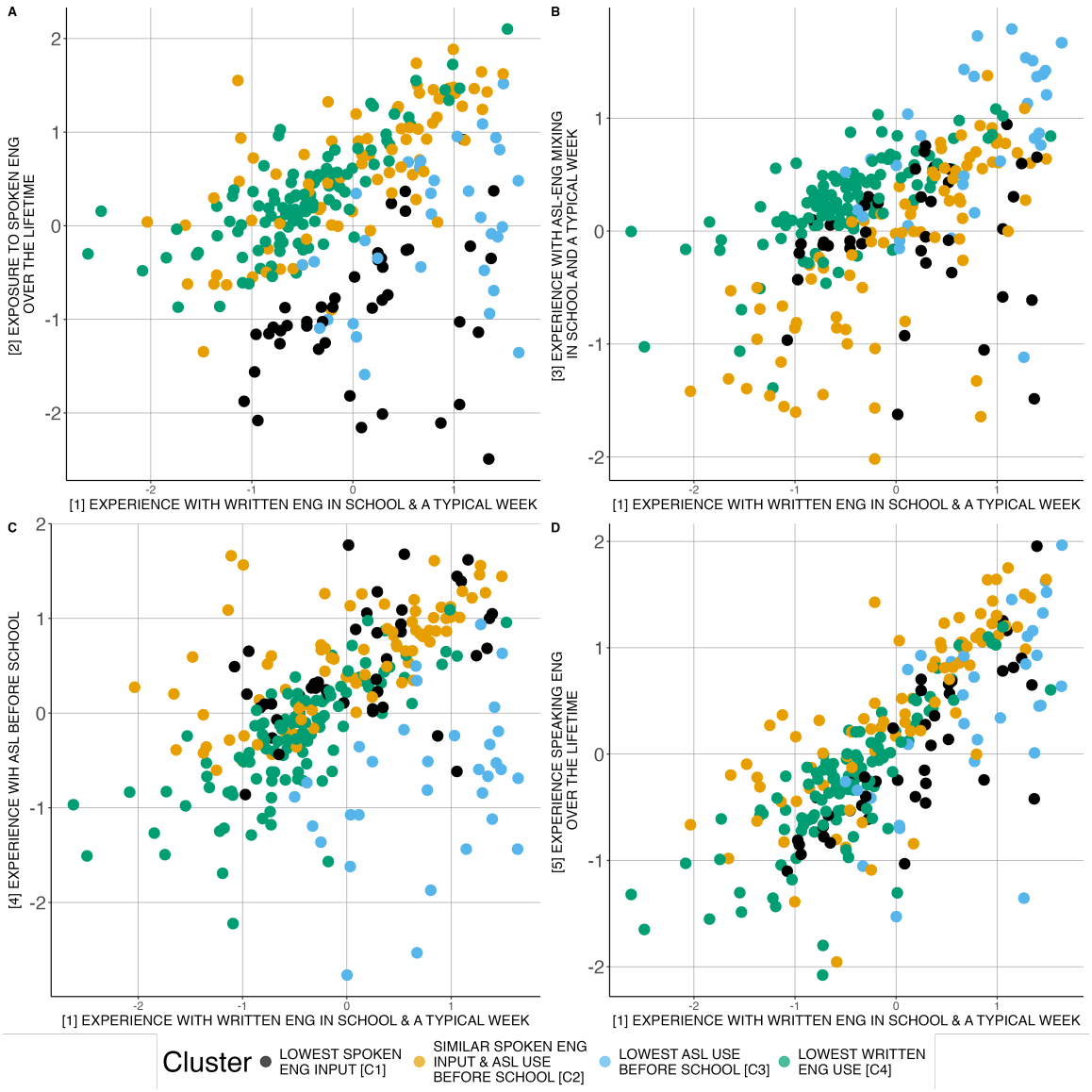


Figure 3.3: Illustration of cluster separation on language experience component [1] *vs.* [2] (plot A), [3] (plot B), [4] (plot C), and [5] (plot D) (k=4) (n=269)

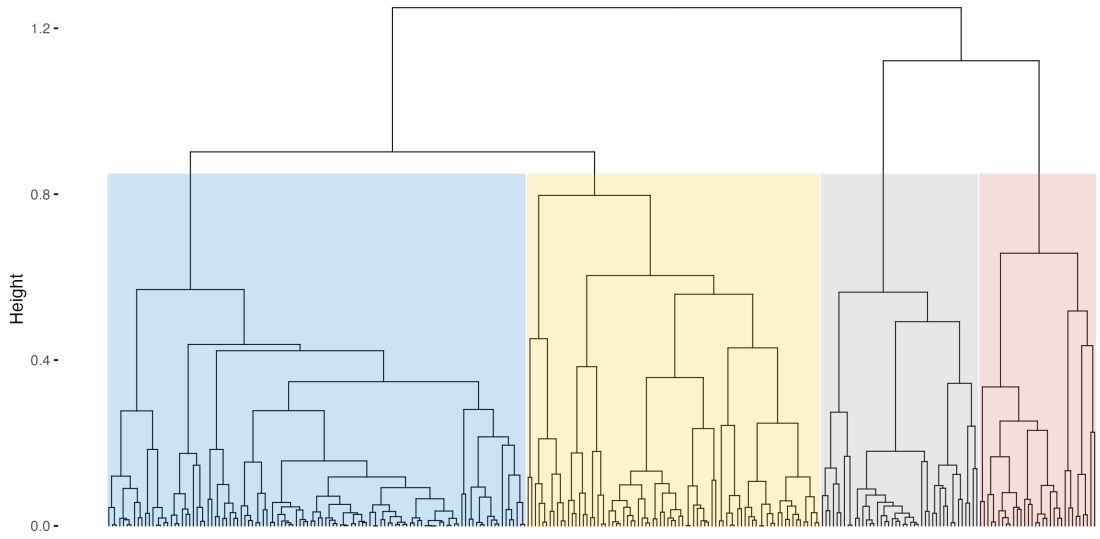


Figure 3.4: Dendrogram of final cluster solution (k=4)

3.4.4 Final cluster solution

The final cluster solution is specified for *Pearson* distance, a hierarchical method using *average* linkage, with k set to 4 clusters and outliers removed (n=*269*). Figure 3.4 visualises this solution as a dendrogram with clusters differentiated by colour. Note that the order of colouration from left to right does *not* reflect cluster number. The properties of this solution are summarised in Table 3.12 below. The order of member frequency in this table corresponds to clusters 1, 2, 3 and 4 respectively, thus the order of clusters in the dendrogram from left to right is 4, 2, 1, 3.

Table 3.12: Summary of properties of final cluster solution

Property	**Value**
outliers	no
method	hierarchical
distance	*Pearson*
linkage	*average*
cophenetic coefficient	0.695149
silhouette width	0.42
Dunn's Index	0.02
k	4
cluster members frequencies	43, 80, 32, 114

Overall, the final cluster solution preserves the structure of original data relatively well (cophenetic coefficient). Members of clusters are somewhat matched to their cluster, and separate from other clusters (Silhouette width), but the clusters themselves are not very compact (Dunn's Index).

The following explains the above summary in more detail making reference to the dendrogram and table directly above. Recall that the cophenetic coefficient shows how well a cluster solution preserves the structure of the original clustering input data. This coefficient is approximately 0.70, which is close to the value that is considered to be good, 0.75. The silhouette width is 0.42, which is not ideal, but is somewhat acceptable as this value falls between solutions in which *"a sample could be assigned to another cluster as well"* (0) and one that is *"well-clustered"* (1) (Divjak & Fieller, 2014, p.432). Dunn's Index shows how compact clusters are, with the goal in clustering *"to maximise inter-cluster difference and maximise intra-cluster similarity"* (Saitta et al., 2008, 3). Dunn's Index ranges from 0 to ∞, with higher scores considered better; therefore, the final clustering solution has an extremely low Dunn's Index, indicating that the difference between clusters is very small and/or the similarity within clusters is very low. Despite this issue, the final solution remains the best option as the best Dunn's Index (0.20) was attained by a highly disproportionate cluster solution – *Euclidean* distance, *average* linkage, with k=2 clusters consisting of 267 and 2 members.

3.5 Language experience profiles and associated social characteristics

This section answers research questions 1 and 2 in combination by describing the four language experience profiles identified with cluster analysis and their social characteristics. Before beginning, the terminology that will be used to refer to each cluster from this point forward, and which is listed below, is explained. This list also links to sections that describe each cluster. In these labels "ENG" is an abbreviation for "English", "INPUT" refers to language exposure, and "USE" refers to language input and output. C1, C2 etc. at the end of labels are abbreviations marking the cluster number, and are used in figures and tables where necessary.

These labels are derived from the language experience patterns within each cluster, which are shown in Figure 3.5. The means on the *y*-axis are of Principal Component scores derived from *z*-scored raw data, and numbers in parentheses in the legend show the number of members in the relevant cluster. These labels are specific to the dataset and methods used in this study, and are reductive to facilitate reading while maintaining a level of description and distinction. Thus, researchers who may intend to draw on this work in the future should take care to contextualise the meaning of each label, and be mindful of the variation within clusters.

1. Cluster 1: LOWEST SPOKEN ENG INPUT [C1] (Section 3.5.1)
2. Cluster 2: SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] (Section 3.5.2)
3. Cluster 3: LOWEST ASL USE BEFORE SCHOOL [C3] (Section 3.5.3)
4. Cluster 4: LOWEST WRITTEN ENG USE [C4] (Section 3.5.4)

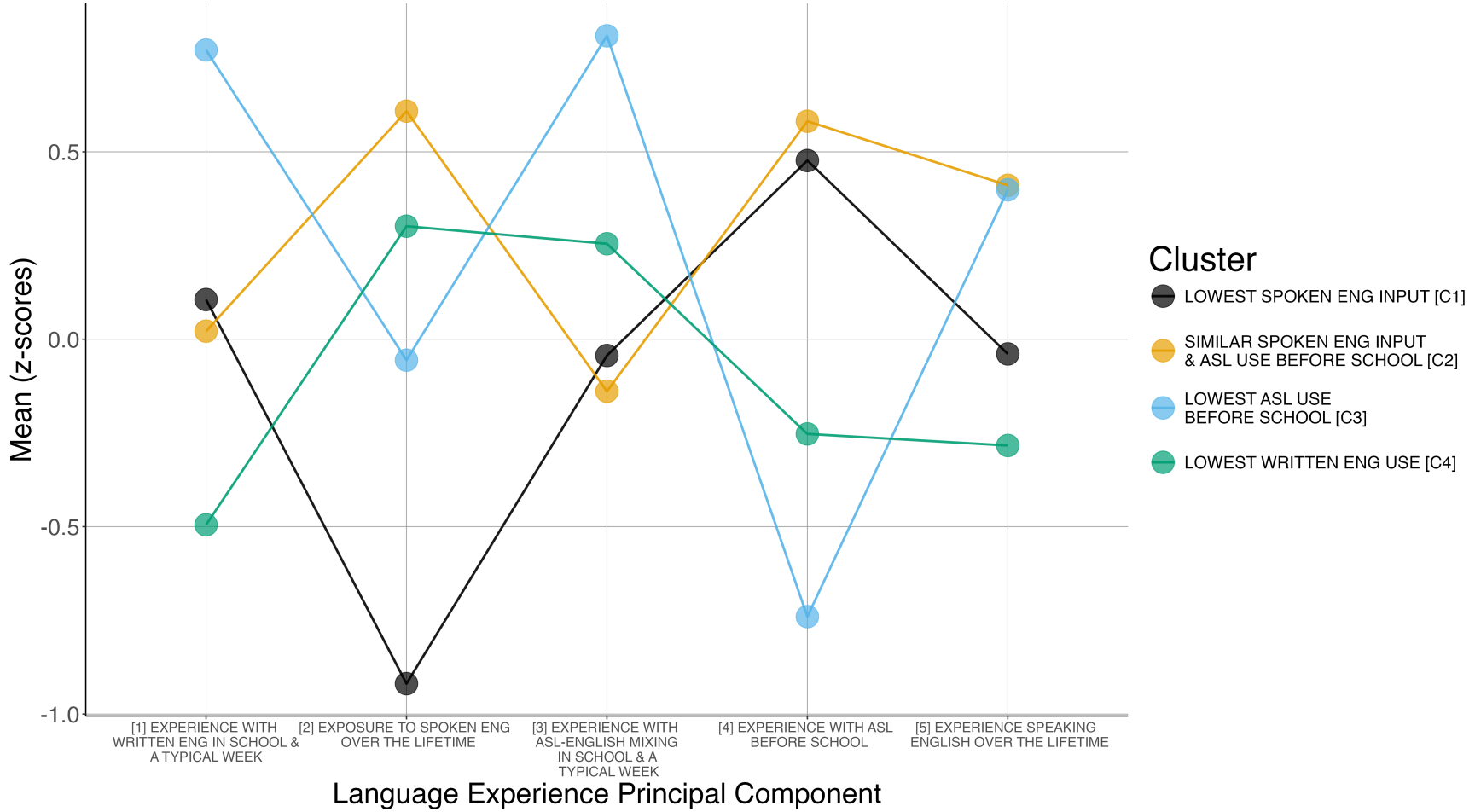


Figure 3.5: Language experience patterns by cluster (*k*=4) *(n=269)*

3.5.1 Description of LOWEST SPOKEN ENG INPUT [C1] *(n=43)*

The LOWEST SPOKEN ENG INPUT [C1] cluster, as its name suggests, report the lowest [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME. Participants in this cluster report relatively higher and equal [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK and [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK, and across all of their experiences, they report the highest [4] EXPERIENCE WITH ASL BEFORE SCHOOL. This profile appears to be associated with deaf identity, not having grown up with deaf family, having attended deaf schools only, and not having pursed education beyond the high school level.

Table 3.13: LOWEST SPOKEN ENG INPUT [C1]

Category	**Percentage of each Category level within CLUSTER**
DEAF-ID	*deaf only* (67%), *hoh only* (14%), *both* (12%), missing (7%)
DEAF-FAM	*yes* (30%), *no* (70%)
SCHOOL	*deaf only* (58%), *mainstream only* (12%), *both* (26%), *neither* (5%)
DEGREE	*high school* (58%), *bachelor's* (26%), *advanced* (14%), missing (2%)
GENDER-ID	*male* (58%), *female* (35%), *non-binary/third* (7%)
REGION	*west* (33%), *midwest* (14%), *south* (33%), *northeast* (16%), missing (5%)
CULTURAL-ID	*white* (40%), *Black/African American* (42%), *Asian* (5%), *American Indian/Alaska Native* (12%), *other* (2%)
AGE	30 (SD = 6, m = 30)
AOA	7 (SD = 7, m = 3)

3.5.2 Description of SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] *(n=80)*

The SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] cluster shows the most [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME and [4] EXPERIENCE WITH ASL BEFORE SCHOOL, and the least [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK and [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK. Members report [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME at a middling level. Participants have a greater likelihood of having attended deaf schools in general and also deaf and mainstream schools, being female, and are associated with a lower likelihood of having a high school diploma as their highest degree. The latter means that these members are more likely to have pursued education beyond high school.

Table 3.14: SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2]

Category	**Percentage of each Category level within CLUSTER**
DEAF-ID	*deaf only* (45%), *hoh only* (27%), *both* (14%), missing (8%)
DEAF-FAM	*yes* (54%), *no* (46%)
SCHOOL	*deaf only* (46%), *mainstream only* (9%), *both* (35%), *neither* (10%)
DEGREE	*high school* (33%), *bachelor's* (49%), *advanced* (16%), missing (3%)
GENDER-ID	*male* (58%), *female* (41%), *non-binary/third* (1%)
REGION	*west* (19%), *midwest* (25%), *south* (30%), *northeast* (24%), missing (3%)
CULTURAL-ID	*white* (56%), *Black/African American* (35%), *Asian* (3%), *American Indian/Alaska Native* (6%)
AGE	31 (SD = 6, m = 30)
AOA	9 (SD = 5, m = 8)

3.5.3 Description of LOWEST ASL USE BEFORE SCHOOL [C3] *(n=32)*

The LOWEST ASL USE BEFORE SCHOOL [C3] cluster report having the least [4] EXPERIENCE WITH ASL BEFORE SCHOOL and the most [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK and [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK. Their [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME and [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME is middling. This profile is associated with hard-of-hearing identity, attending mainstream schools only, not having grown up with deaf family, and identifying as female.

Table 3.15: LOWEST ASL USE BEFORE SCHOOL [C3]

Category	**Percentage of each Category level within CLUSTER**
DEAF-ID	*deaf only* (25%), *hoh only* (56%), *both* (6%), missing (13%)
DEAF-FAM	*yes* (31%), *no* (69%)
SCHOOL	*deaf only* (22%), *mainstream only* (47%), *both* (19%), *neither* (13%)
DEGREE	*high school* (44%), *bachelor's* (50%), *advanced* (6%)
GENDER-ID	*male* (53%), *female* (47%)
REGION	*west* (9%), *midwest* (22%), *south* (34%), *northeast* (34%)
CULTURAL-ID	*white* (56%), *Black/African American* (38%), *Native Hawaiian/Other Pacific Islander* (3%), *other* (3%)
AGE	27 (SD = 7, m = 25)
AOA	13 (SD = 6, m = 12)

3.5.4 Description of LOWEST WRITTEN ENG USE [C4] *(n=114)*

Members of the LOWEST WRITTEN ENG USE [C4] cluster report having the least [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK and the most [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME and [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK. Members of this cluster have similar [4] EXPERIENCE WITH ASL BEFORE SCHOOL and [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME, and is higher than their [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK. This profile is associated with a somewhat greater likelihood of identifying as deaf or hard-of-hearing, not having attended deaf or mainstream schools, and reporting a bachelor's degree as their highest degree.

Table 3.16: LOWEST WRITTEN ENG USE [C4]

Category	Percentage of each Category level within CLUSTER
DEAF-ID	*deaf only* (45%), *hoh only* (36%), *both* (11%), missing (7%)
DEAF-FAM	*yes* (51%), *no* (49%)
SCHOOL	*deaf only* (34%), *mainstream only* (12%), *both* (32%), *neither* (21%)
DEGREE	*high school* (33%), *bachelor's* (58%), *advanced* (9%)
GENDER-ID	*male* (68%), *female* (32%)
REGION	*west* (28%), *midwest* (29%), *south* (21%), *northeast* (18%), missing (4%)
CULTURAL-ID	*white* (43%), *Black/African American* (49%), *Native Hawaiian/Other Pacific Islander* (1%), *Middle Eastern/North African* (1%), *Asian* (1%), *American Indian/Alaska Native* (4%), *other* (2%)
AGE	30 (SD = 6, m = 30)
AOA	8 (SD = 5, m = 7)

3.5.5 Evaluation of predictions

The predictions formulated in Section 3.3 primarily target SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2], LOWEST ASL USE BEFORE SCHOOL [C3], LOWEST WRITTEN ENG USE [C4], AOA, and proportions of SCHOOL, DEAF-ID, DEGREE and DEAF-FAM. They are reformulated to more closely match cluster membership as shown below. To reformulate the

1. highest [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL

WEEK → LOWEST ASL USE BEFORE SCHOOL [C3] → highest proportion of members attending mainstream schools and with higher degrees

2. lowest [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME → SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] → lowest proportion of members attending mainstream schools and claiming hard-of-hearing identity, highest proportion of members with lower degrees

3. highest [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK → LOWEST ASL USE BEFORE SCHOOL [C3] → highest proportion of members attending mainstream schools

4. lowest [4] EXPERIENCE WITH ASL BEFORE SCHOOL → LOWEST ASL USE BEFORE SCHOOL [C3] → lowest proportion of members attending deaf schools, growing up with deaf family and claiming deaf identity, highest age-of-acquisition

5. lowest [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME → LOWEST WRITTEN ENG USE [C4] → lowest proportion of members attending mainstream schools and claiming deaf identity

These predictions are first examined broadly by testing if cluster membership is independent of the categorical social characteristics in question using the Chi-square method. This testing shows that cluster membership is not independent of the four social categories named in the predictions (SCHOOL, DEAF-FAM, DEAF-ID) and DEGREE. It also shows that GENDER-ID is not independent of cluster, which was not part of the predictions.

Category 1	**Category 2**	X^2	*df*	***p*-value**
CLUSTER	DEAF-ID	19.19	19	$<.05$
CLUSTER	SCHOOL	42.21	9	$<.05$
CLUSTER	DEGREE	19.62	9	$<.05$
CLUSTER	DEAF-FAM	10.13	3	$<.05$
CLUSTER	GENDER-ID	14.65	6	$<.05$
CLUSTER	CULTURAL-ID	21.07	18	$>.05$
CLUSTER	REGION	17.67	12	$>.05$

Table 3.17: Chi-square testing of relationship between cluster membership and categorical social characteristics

In Table 3.18 below, the predictions are reformulated in terms of cluster, and evaluated in terms of proportions. The "cluster", "category" and "level" columns

identify the relevant clusters, social category, and level within that category being targeted respectively. The "prediction" column identifies what proportion[4] of the level is expected. So, in the first row, SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] are expected to show the lowest proportion of members attending mainstream schools only compared to all other clusters. The "borne out" column identifies if a prediction was met or not. Cases that are borne out are highlighted. Overall more than half of the predictions are not borne out and those that are borne out are primarily linked to LOWEST ASL USE BEFORE SCHOOL [C3].

Cluster	**Prediction**	**Category**	**Level**	**Borne out**
SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2]	lowest	SCHOOL	*mainstream*	yes
	lowest	DEAF-ID	*hard-of-hearing*	no
	highest	DEGREE	*high school*	no
LOWEST ASL USE BEFORE SCHOOL [C3]	highest	SCHOOL	*mainstream*	yes
	highest	DEGREE	*bachelor*	no
	lowest	SCHOOL	*deaf*	yes
	lowest	DEAF-FAM	*yes*	yes
	lowest	DEAF-ID	*deaf*	yes
LOWEST WRITTEN ENG USE [C4]	lowest	SCHOOL	*mainstream*	no
	lowest	DEAF-ID	*deaf*	no
	highest	AOA	N/A	no

Table 3.18: Evaluation of predictions about how language experience and social characteristics are related

[4]the exception is AOA which is continuous. It is evaluated in terms of cluster means instead.

3.5.6 Mapping of social characteristics on to language experience profile

Evaluation of the predictions show that relative extremes of individual aspects of language experience are not straightforwardly mapped on to individual social characteristics. This suggests that a more holistic view of language experience, as identified by language experience clusters could be more promising. Based on this the distribution of individual social characteristics within clusters is examined and described in Sections 3.5.6.1 to 3.5.6.9. The general structure of each section is as follows: description of the frequencies and proportions of each level within a category in the entire dataset and identification of clusters with the greatest and lowest proportions of each level, and discussion of observed *vs.* expected frequencies obtained from Chi-square testing.

3.5.6.1 Deaf identity (DEAF-ID)

Across the entire sample, there are 124 participants who identify as deaf (46%), 92 who identify as hard-of-hearing (34%), and 31 who identify as both DHH (12%). There are missing identity values for 22 participants. Figure 3.6 shows the proportions of each category of DEAF-ID in each cluster. LOWEST SPOKEN ENG INPUT [C1] shows the highest proportion of members identifying as deaf only, and conversely the lowest proportion of members identifying as hard-of-hearing only. LOWEST ASL USE BEFORE SCHOOL [C3] show the opposite pattern. As shown in Table 3.17, DEAF-ID and cluster are not independent ($X^2 = 19.19$, $df = 9$, $p = .02$). This appears to be driven by a relationship between claiming deaf identity if someone belongs to LOWEST SPOKEN ENG INPUT [C1], and claiming hard-of-hearing identity if someone belongs to LOWEST ASL USE BEFORE SCHOOL [C3] – more participants claim deaf identity and fewer claim hard-of-hearing identity than expected in LOWEST SPOKEN ENG INPUT [C1], and vice versa for LOWEST ASL USE BEFORE SCHOOL [C3] (see Table 3.19).

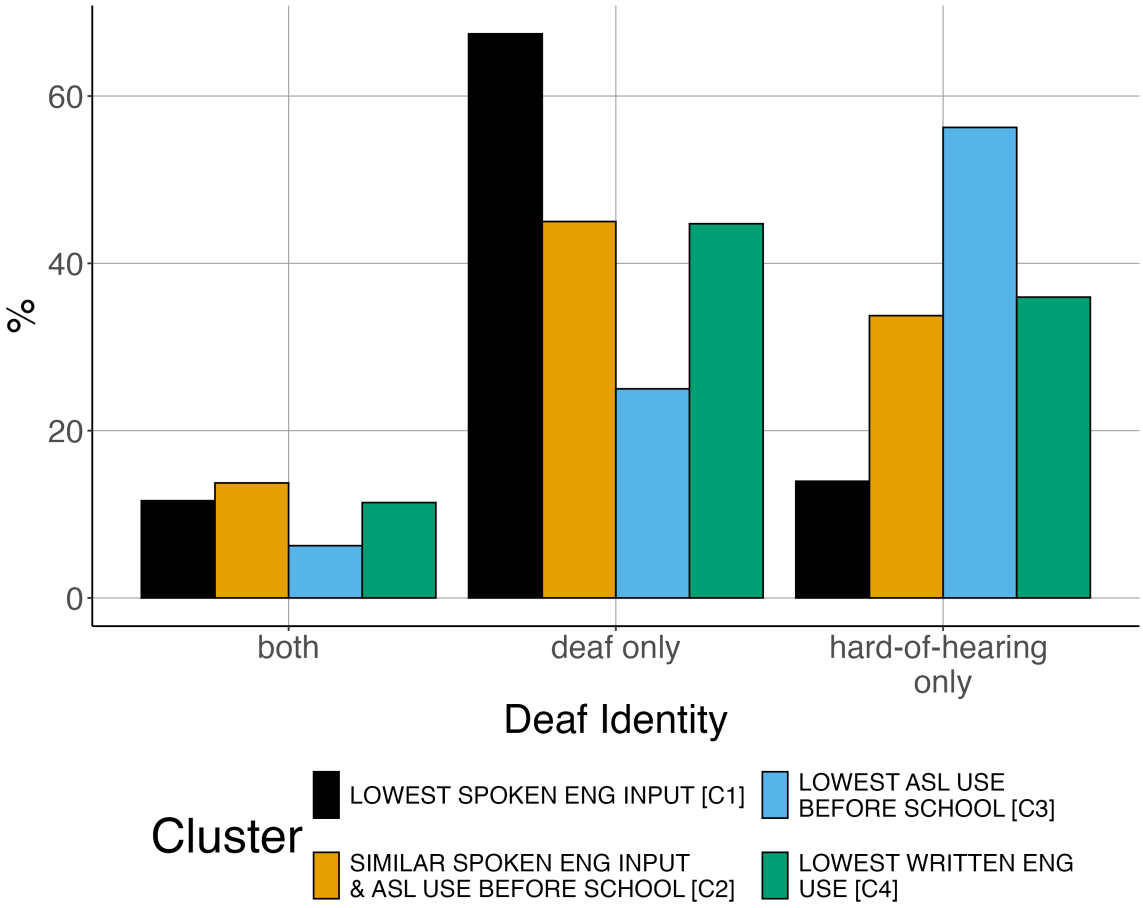


Figure 3.6: Comparison of DEAF-ID across clusters

Cluster	Deaf	HOH	Both
LOWEST SPOKEN ENG INPUT [C1]	+9	−9	0
SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2]	−1	0	+2
LOWEST ASL USE BEFORE SCHOOL [C3]	−7	+7	−2
LOWEST WRITTEN ENG USE [C4]	−2	+2	0

Table 3.19: Difference in observed and expected frequency of DEAF-ID categories

3.5.6.2 Deaf family (DEAF-FAM)

Across the sample, 124 participants report having grown up with deaf family (46%) and 145 report not having done so (54%). In terms of proportions, there is almost even split between members of SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] and LOWEST WRITTEN ENG USE [C4] reporting that they grew up with deaf family and not, while in LOWEST SPOKEN ENG INPUT [C1] and LOWEST ASL USE BEFORE SCHOOL [C3], more members report not having grown up with deaf family (see Figure 3.7). Comparison of expected *vs.* observed frequencies obtained from Chi-square testing (X^2 = 42.21, df = 9, p = 3.009e-06) (see Table 3.20 for frequencies) shows that LOWEST SPOKEN ENG INPUT [C1] and LOWEST ASL USE BEFORE SCHOOL [C3] did not grow up with deaf family than expected, and vice versa for SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] and LOWEST WRITTEN ENG USE [C4]. The similarity between LOWEST SPOKEN ENG INPUT [C1] and LOWEST ASL USE BEFORE SCHOOL [C3], and SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] and LOWEST WRITTEN ENG USE [C4], is surprising, as the members of these pairings report very different amounts of exposure to ASL before entering school – LOWEST SPOKEN ENG INPUT [C1] and SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] report experience above the mean, while LOWEST ASL USE BEFORE SCHOOL [C3] and LOWEST WRITTEN ENG USE [C4] and report experience below the mean.

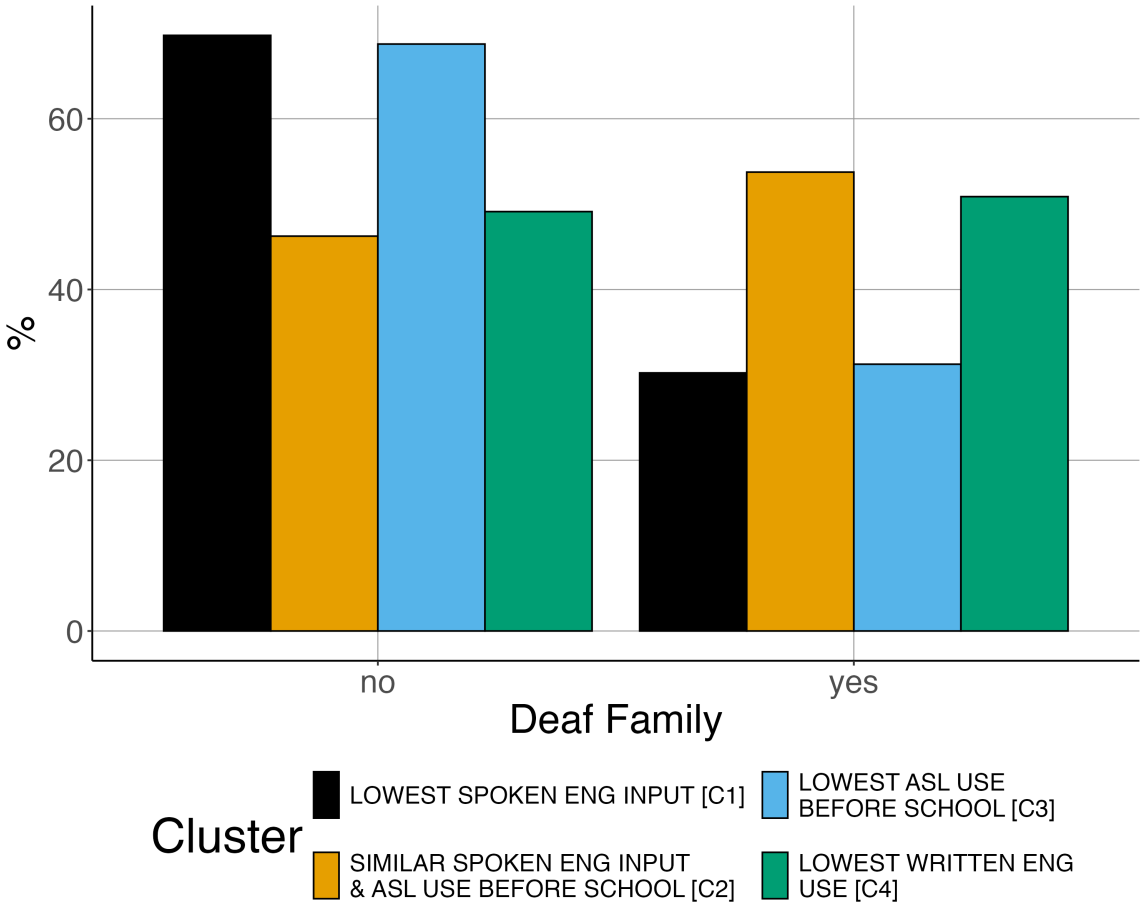


Figure 3.7: Comparison of DEAF-FAM across clusters

Cluster	Yes	No
LOWEST SPOKEN ENG INPUT [C1]	-7	$+7$
SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2]	$+6$	-6
LOWEST ASL USE BEFORE SCHOOL [C3]	-5	$+5$
LOWEST WRITTEN ENG USE [C4]	$+5$	-5

Table 3.20: Difference in observed and expected frequency of DEAF-FAM categories

3.5.6.3 School (SCHOOL)

Across the full sample, 108 members report having gone to deaf schools only (40%), 41 having attended mainstream schools only (15%), 82 having attended both deaf and mainstream schools (30%), and 38 not having attended deaf or mainstream schools (14%). LOWEST SPOKEN ENG INPUT [C1] show the greatest proportion of members having attended deaf schools only and the lowest having attending mainstream schools only while the opposite pattern is observed in LOWEST ASL USE BEFORE SCHOOL [C3]. The frequency of members having attended deaf schools only is higher than expected in LOWEST SPOKEN ENG INPUT [C1], while the frequency of those having attended mainstream schools only is higher in LOWEST ASL USE BEFORE SCHOOL [C3]. SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] and LOWEST WRITTEN ENG USE [C4] report having attended both deaf and mainstream schools at the highest proportion, and the frequencies within these clusters are higher than expected (see Table 3.21). LOWEST SPOKEN ENG INPUT [C1] and SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] report greater experience with ASL before entering school than ASL-English mixing after entering school, while LOWEST ASL USE BEFORE SCHOOL [C3] report the opposite pattern. This aligns with what would be expected in terms of attendance at deaf schools only, as people who have more experience with ASL before entering school may have grown up in environments that are more oriented to deaf culture.

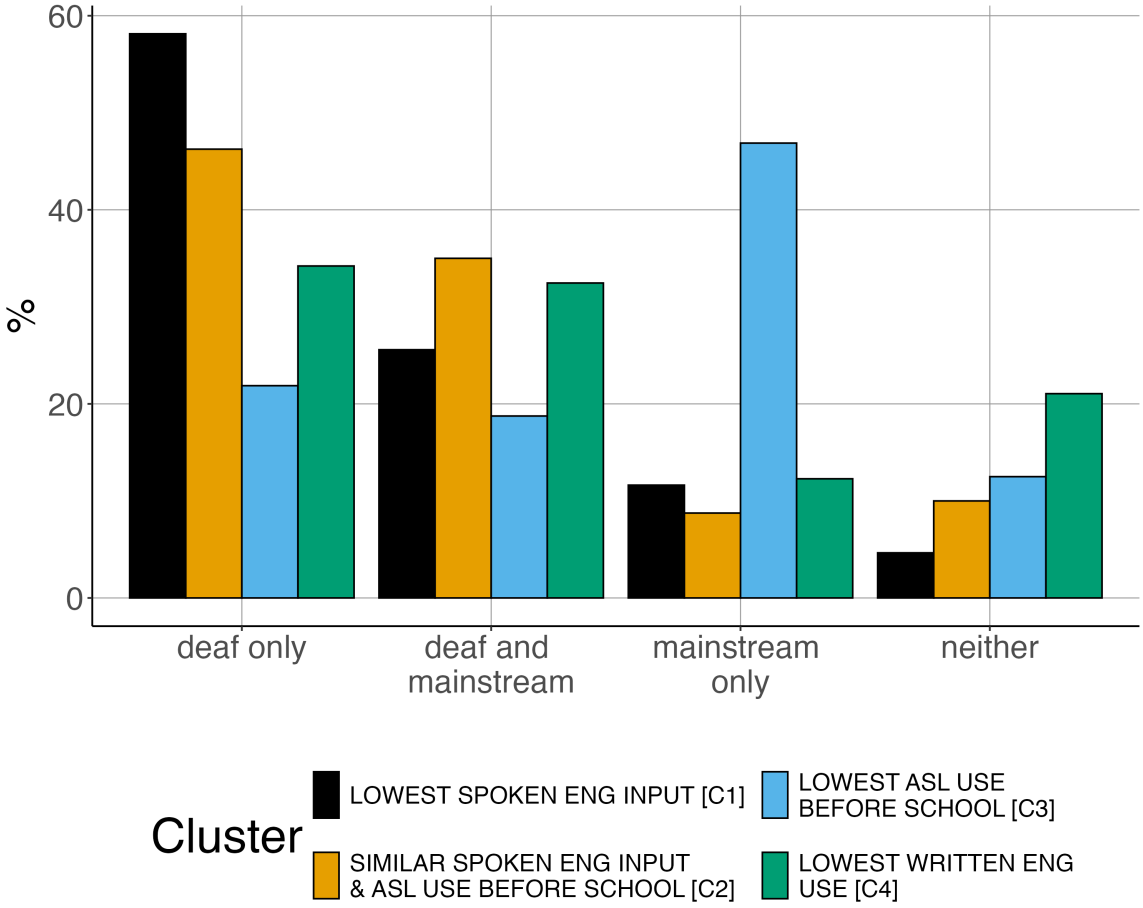


Figure 3.8: Comparison of SCHOOL across clusters

Cluster	Deaf	Mainstream	Both	Neither
LOWEST SPOKEN ENG INPUT [C1]	$+8$	-2	-2	-4
SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2]	$+5$	-5	$+4$	-3
LOWEST ASL USE BEFORE SCHOOL [C3]	-6	$+10$	-4	-1
LOWEST WRITTEN ENG USE [C4]	-7	-3	$+2$	$+8$

Table 3.21: Difference in observed and expected frequency of SCHOOL categories

3.5.6.4 Highest degree (DEGREE)

Across the sample, 103 participants report a high school diploma (38%) as their highest degree, 132 a Bachelor's degree (49%), and 31 an advanced degree (Master's or PhD) (11%). Values for 3 participants are missing. LOWEST SPOKEN ENG INPUT [C1] have the greatest proportion of members reporting a high school degree as their highest degree, and the least reporting a bachelor's degree. LOWEST WRITTEN ENG USE [C4] show the opposite pattern, with the greatest proportion of members having a bachelor's degree as their highest degree and (almost) the lowest having a high school diploma (compare with SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2]). The greatest proportion of members reporting an advanced degree is found in SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2], closely followed by LOWEST SPOKEN ENG INPUT [C1]. The dependence between cluster and DEGREE appears to be driven by LOWEST SPOKEN ENG INPUT [C1] and LOWEST WRITTEN ENG USE [C4] ($X^2 = 19.62$, $df = 9$, $p = .02$). Members of the former report having a high school diploma as their highest degree to a greater extent than expected and fewer report having a Bachelor's degree, and vice versa in LOWEST WRITTEN ENG USE [C4] (see Table 3.22). Furthermore, LOWEST SPOKEN ENG INPUT [C1] and SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] are more likely to have advanced degrees. These patterns do not align with the predictions in Table 3.18 as SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] are predicted to have the highest proportion of members with a high school diploma as their highest degree i.e. to have the lowest level of education, and LOWEST ASL USE BEFORE SCHOOL [C3] are predicted to have the highest proportion of members with a Bachelor's degree i.e. the highest level of education.

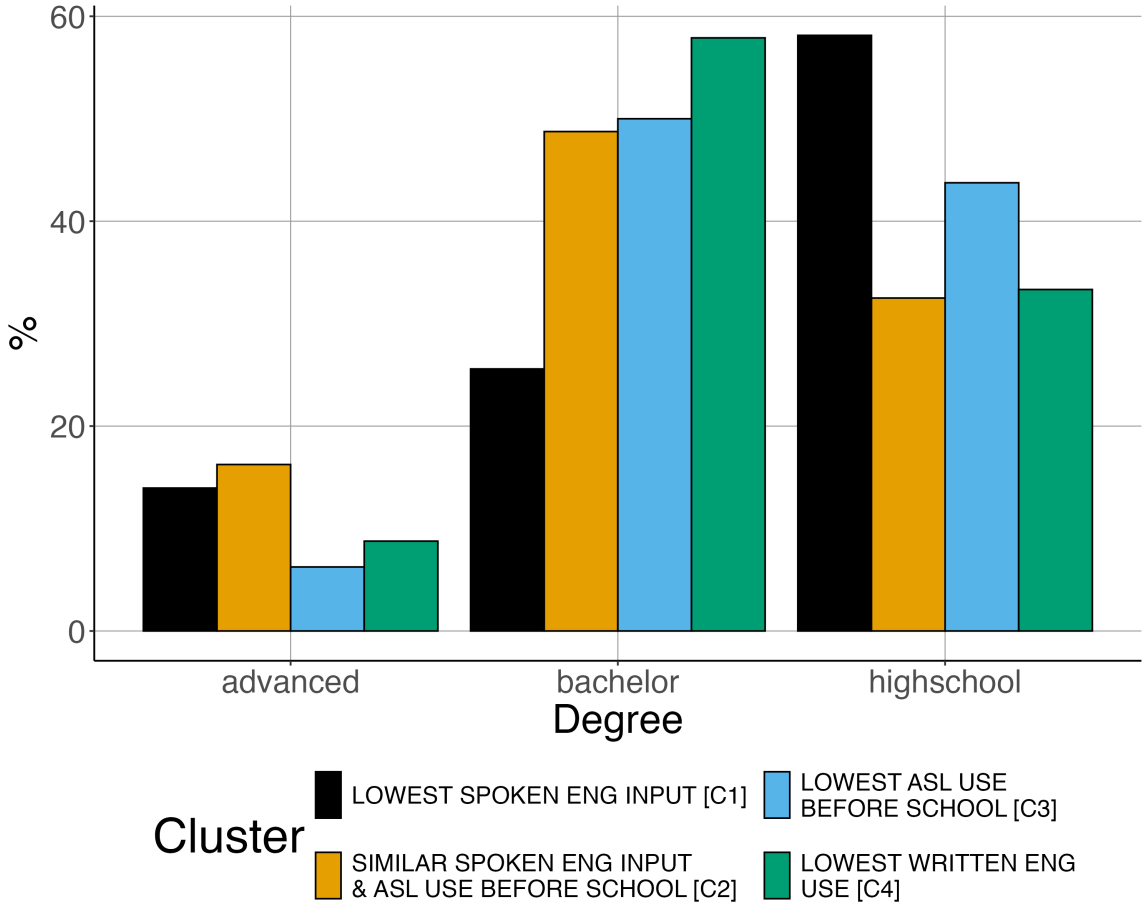


Figure 3.9: Comparison of DEGREE across clusters

Cluster	Advanced	Bachelor	Highschool
LOWEST SPOKEN ENG INPUT [C1]	$+1$	-10	$+9$
SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2]	$+4$	0	-5
LOWEST ASL USE BEFORE SCHOOL [C3]	-2	0	$+2$
LOWEST WRITTEN ENG USE [C4]	-3	$+10$	-6

Table 3.22: Difference in observed and expected frequency of DEGREE categories

3.5.6.5 Gender identity (GENDER-ID)

Across the entire sample, 99 participants identify as female (37%), 166 as male (62%), and 4 as non-binary or a third gender (1.5%). As shown in Table 3.17, GENDER-ID is not independent of cluster. The highest proportion of members identifying as male is found in LOWEST WRITTEN ENG USE [C4], and the highest proportion identifying as female is found in LOWEST ASL USE BEFORE SCHOOL [C3] (see Figure 3.10). Only LOWEST SPOKEN ENG INPUT [C1] and SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] identify as non-binary or a third gender. The dependence between cluster and GENDER-ID is likely to be primarily linked to LOWEST WRITTEN ENG USE [C4], as in this group members are more likely to identify as male and less likely to identify as female. However, SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] and LOWEST ASL USE BEFORE SCHOOL [C3] are also more likely to identify as female and less likely to identify as male, but to a lesser extent (see Table 3.23).

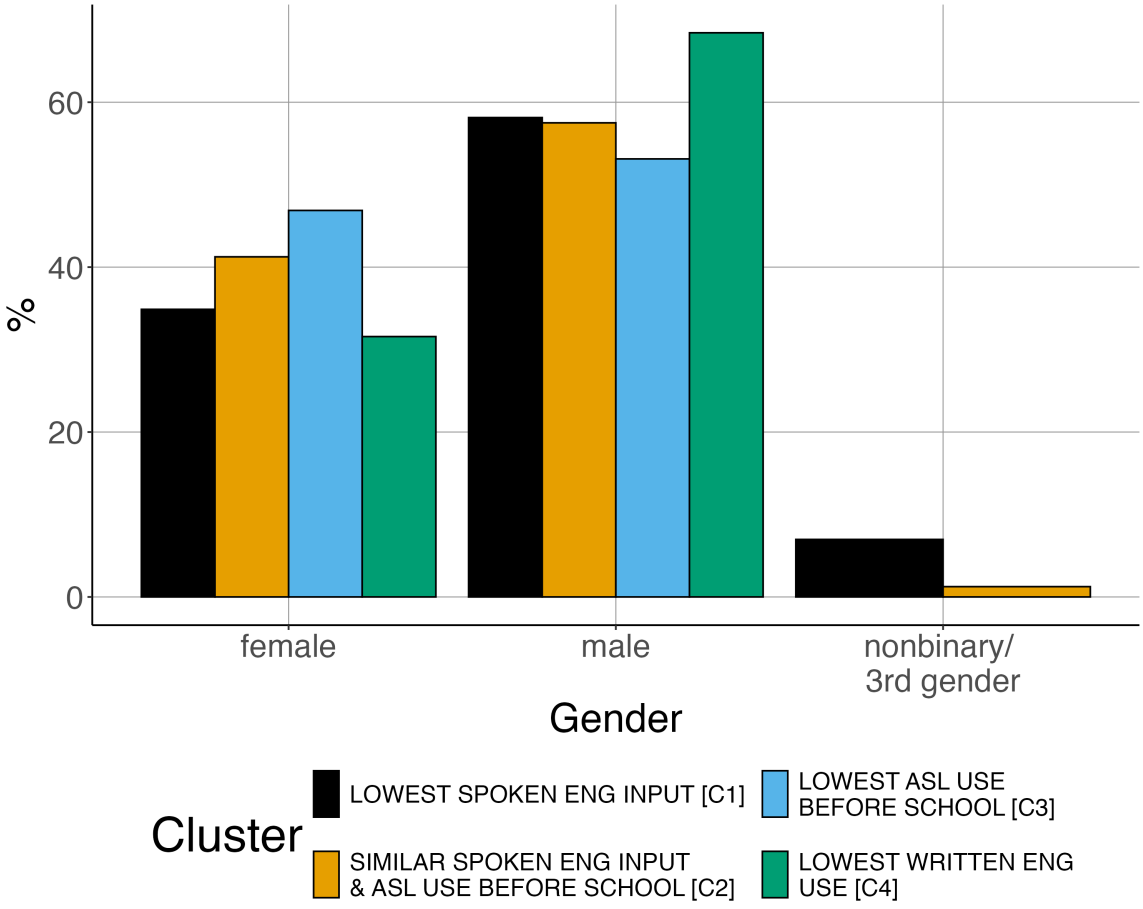


Figure 3.10: Comparison of GENDER-ID across clusters

Cluster	Male	Female	Third Gender
LOWEST SPOKEN ENG INPUT [C1]	-2	-1	$+2$
SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2]	-3	$+4$	0
LOWEST ASL USE BEFORE SCHOOL [C3]	-3	$+3$	0
LOWEST WRITTEN ENG USE [C4]	$+8$	-6	-2

Table 3.23: Difference in observed and expected frequency of GENDER-ID categories

3.5.6.6 Age (AGE)

The mean age in the sample is 30 (SD = 6, m = 30). The means within each cluster are shown in Figure 3.11. LOWEST SPOKEN ENG INPUT [C1], SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] and LOWEST WRITTEN ENG USE [C4] have a similar mean age, of about 30, while LOWEST ASL USE BEFORE SCHOOL [C3] are slightly younger, with a mean age of 27. When AGE is regressed on cluster, there is no significant effect (p = .12), indicating that language experience profile is not associated with a specific age (p = .04).

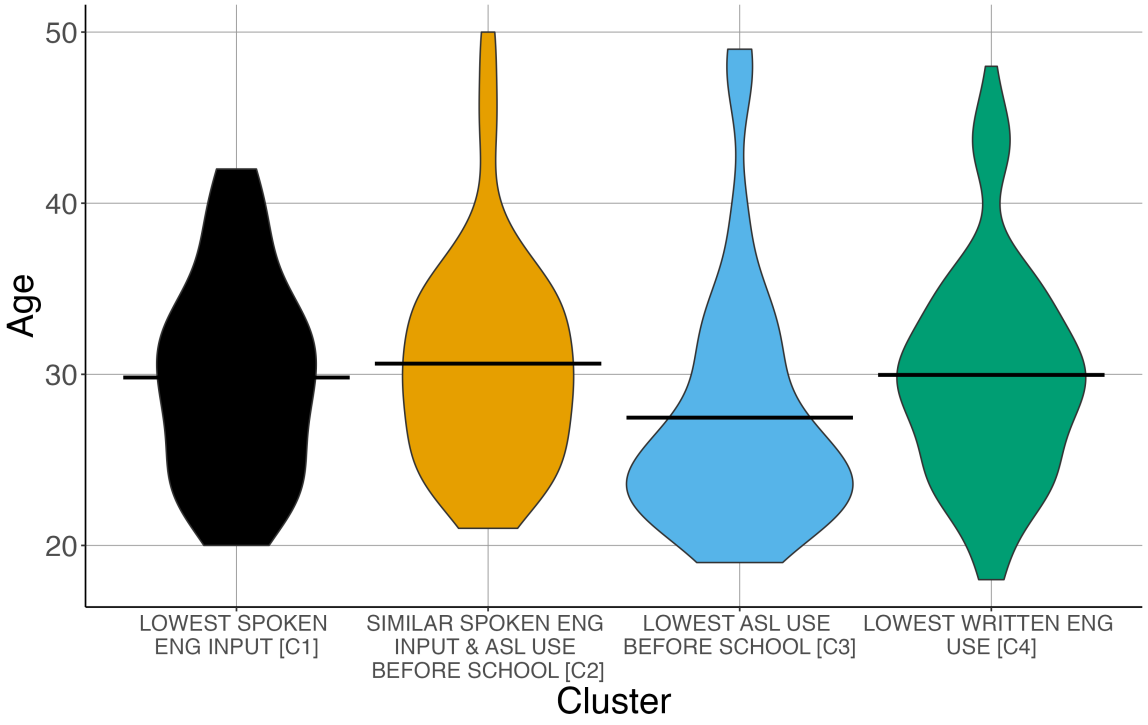


Figure 3.11: Comparison of AGE across clusters

3.5.6.7 Age-of-acquisition of ASL (AOA)

The mean AOA is 9 across the sample (SD = 5, m = 8). LOWEST SPOKEN ENG INPUT [C1] have the lowest AOA, and LOWEST ASL USE BEFORE SCHOOL [C3] the highest (see Figure 3.12). When AOA is regressed on cluster (R^2 = 0.09, p = 1.917e-05), there is a significant effect of SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] and LOWEST ASL USE BEFORE SCHOOL [C3]. The intercept, LOWEST SPOKEN ENG INPUT [C1], has a mean of seven, indicating that LOWEST SPOKEN ENG INPUT [C1] generally began acquiring ASL at age seven. SIMILAR SPOKEN

ENG INPUT & ASL USE BEFORE SCHOOL [C2] began acquiring ASL two years later (p=.0369), and LOWEST ASL USE BEFORE SCHOOL [C3] began acquiring ASL five years later LOWEST SPOKEN ENG INPUT [C1] (p = 7.45e-06). The mean age-of-acquisition of LOWEST WRITTEN ENG USE [C4] is approximately one year higher than LOWEST SPOKEN ENG INPUT [C1], but this effect is not significant.

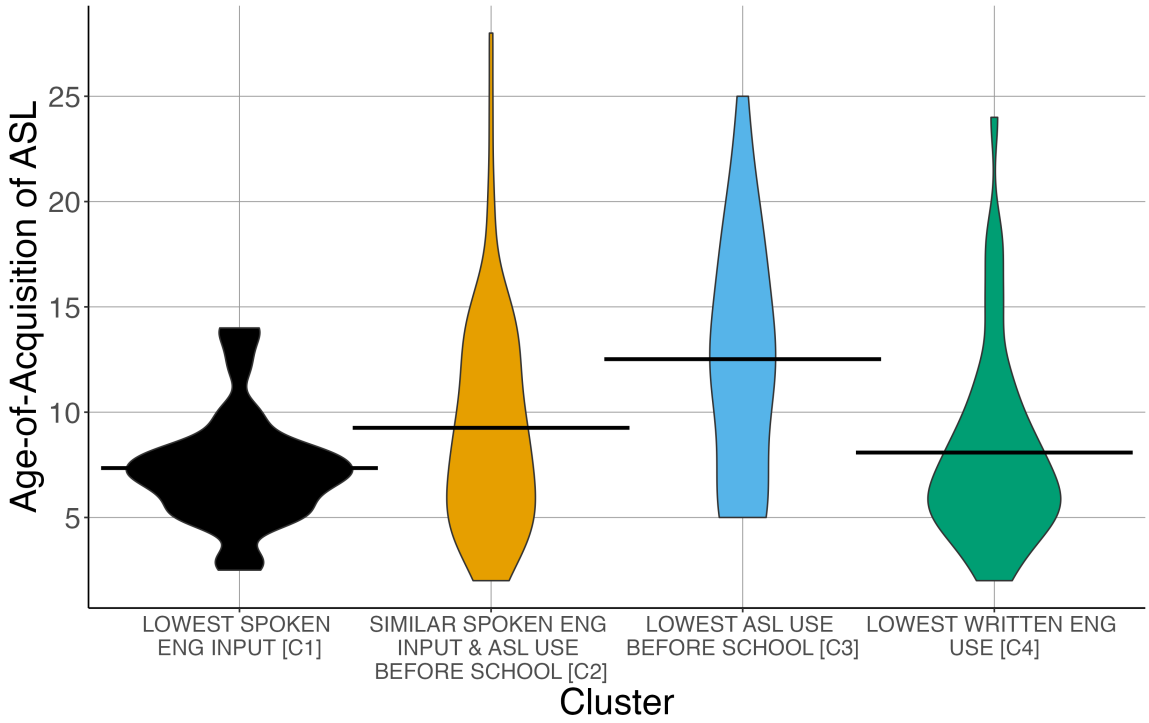


Figure 3.12: Comparison of AOA across clusters

3.5.6.8 Cultural identity (CULTURAL-ID)

Across the entire sample, 129 participants identify as white (48%) and 114 as Black/African American (42%). There are 14 participants who identify as American Indian/Alaska Native (5%), 5 who identify as Asian (2%), 4 who identify as other (1%), 2 who identify as Native Hawaiian/Other Pacific Islander (<1%) and 1 who identifies who Middle Eastern/North African (<1%). Chi-square testing shows that cluster and CULTURAL-ID are independent of each other (X^2 = 21.07, df = 18, p = 0.28). Figure 3.13 shows that most members of all clusters identify as white or Black/African American. The greatest proportion of members identifying as white is found in SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] and LOWEST ASL USE BEFORE SCHOOL [C3], while the greatest proportion identifying as Black/African American is found in LOWEST WRITTEN ENG USE [C4]. LOWEST SPOKEN ENG INPUT [C1] and SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] have the greatest proportion of members identifying as American Indian/Alaska Native and Asian.

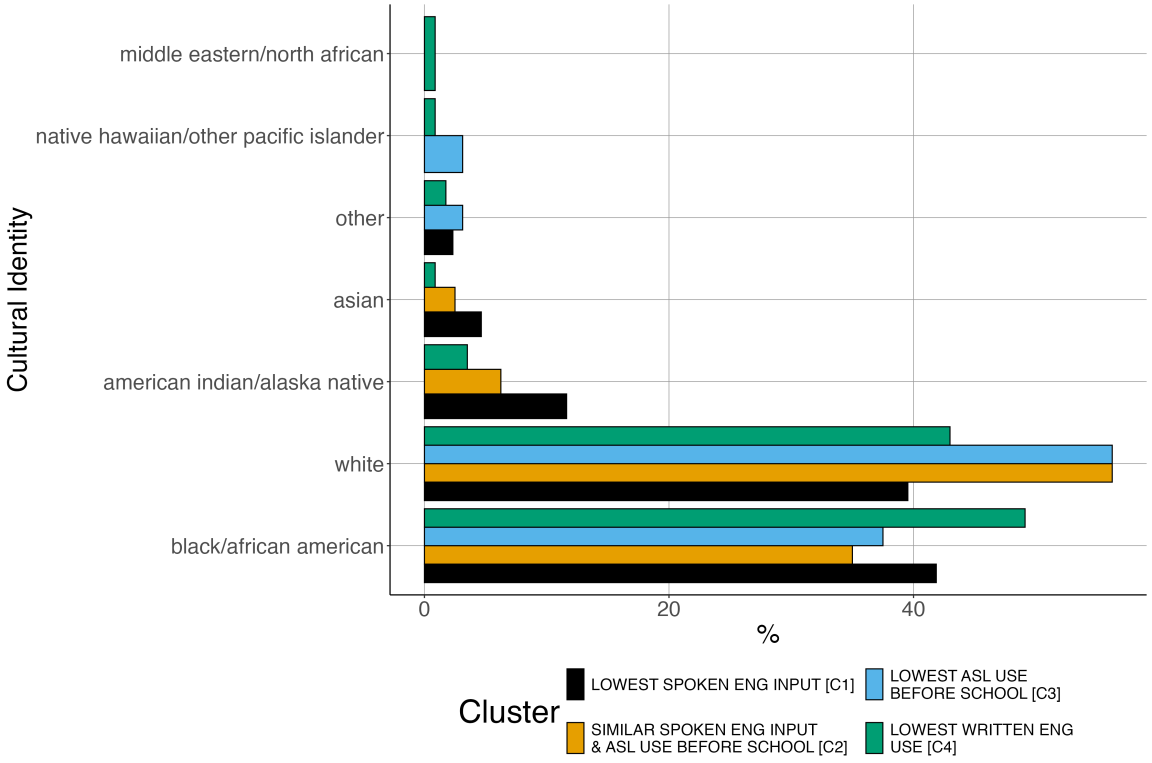


Figure 3.13: Comparison of CULTURAL-ID across clusters

The proportion of signers claiming Black/African American identity in this study is relatively high compared to other studies of ASL. I attribute this to the

Black deaf identity of my primary deaf collaborator, Sonya Carter, and a social media personality, David Player, who both distributed the data collection instrument to their networks. Both Sonya and David have a presence on social media that they use to discuss issues having to do with being Black and/or deaf in the United States. Given the topics they discuss, they may attract other Black deaf people in the United States, which may account for the high presence of such individuals in this study.

3.5.6.9 Region (REGION)

Across the entire sample, 57 participants are located in the northeast (21%), 66 in the midwest (25%), 64 in the west (24%) and 73 in the south (27%). There are missing values for 9 participants (3%). Chi-square testing shows that cluster and REGION are not dependent on each other (X^2 = 17.67, df = 12, p = .13). This can be seen visually in Figure 3.14, as there is no clear pattern in how regions are distributed across clusters. LOWEST SPOKEN ENG INPUT [C1] and LOWEST WRITTEN ENG USE [C4] show the highest proportions of members who were located in the midwest at the time of data collection. LOWEST ASL USE BEFORE SCHOOL [C3] have the highest proportion of members from the northeast. LOWEST ASL USE BEFORE SCHOOL [C3] has the highest proportion of members from the south; however, LOWEST SPOKEN ENG INPUT [C1] and SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] have show similar proportions too. Finally, the greatest proportion of members from the west are LOWEST SPOKEN ENG INPUT [C1].

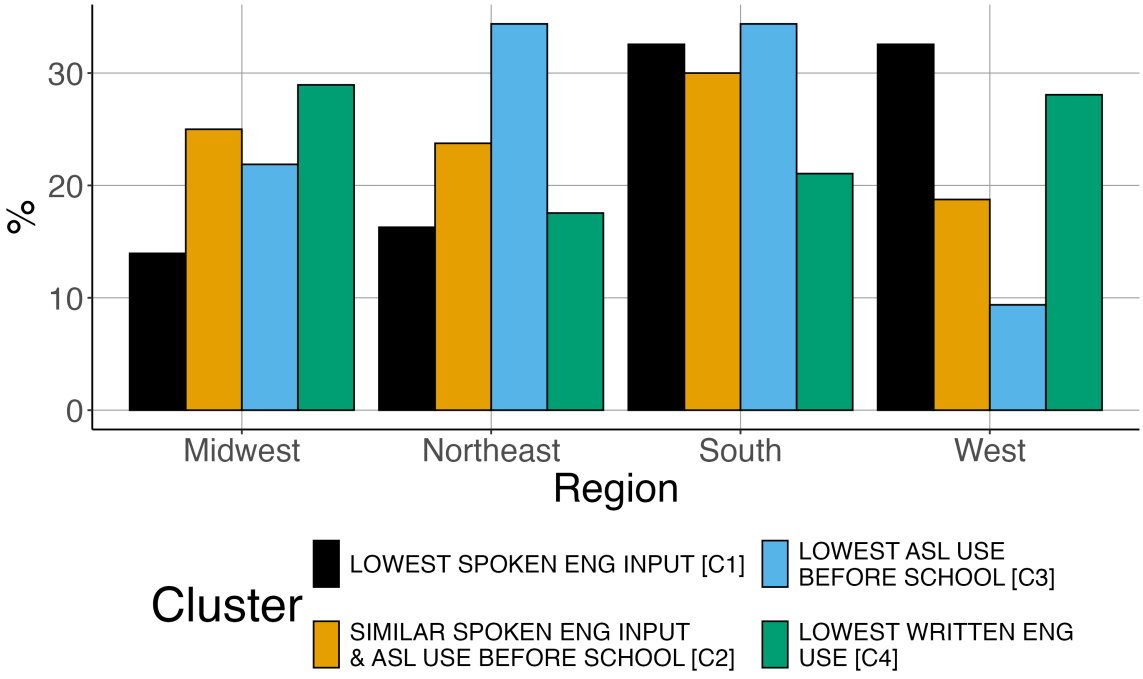


Figure 3.14: Comparison of REGION across clusters

3.6 On early signers

Recall the discussion in Section I that prioritisation of the linguistic behaviour of early signers, and particularly, their use of ASL, has obscured the heterogeneity in the language experiences of DHH people in the United States. In this section, the characteristics of signers who could be classed as "native" in the sample and clusters are discussed. Overall, this grouping represents a small proportion of all signers in the sample, differ in their self-reported language experience, and pattern with non-native signers, as evidenced by their presence in all clusters.

Two definitions of early signer are used that both require that a participant grew up with deaf family, and differ in the age at which ASL acquisition should have started by. The ages chosen are 3 and 5 years old. The proportions of signers who could be classed as "native" given these two characterisations are shown in Figures 3.15 and 3.16 respectively.

Only 7 participants in the 269-member sample fit the most restrictive characterisation of age-of-acquisition by age 3. This accounts for 3% of the sample. When age-of-acquisition is loosened to 5, there are 39 participants who would be classed as "native", which accounts for 14% of the sample. If the overall sample is taken as representative of the DHH population in the United States, these proportions provide empirical evidence that the focus on nativeness in the study of ASL excludes the vast majority of signers in the United States. Note also that the characterisation of an early signer as someone who grew up with deaf family is less restrictive than the more commonly used requirement for a deaf parent; therefore, the proportions reported here are likely to be smaller.

Figures 3.15 and 3.16 show how signers who could be classed as "native" are distributed across language experience clusters. When age-of-acquisition is by 3, early signers pattern with SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] (Section 3.5.1) and LOWEST WRITTEN ENG USE [C4] (Section 3.5.4) language experience. When age-of-acquisition is by 5, they are found across all clusters. Together this shows that the experience of participants who could be classed as "native" is not homogeneous, and patterns with the experience of signers who would not be classed as "native".

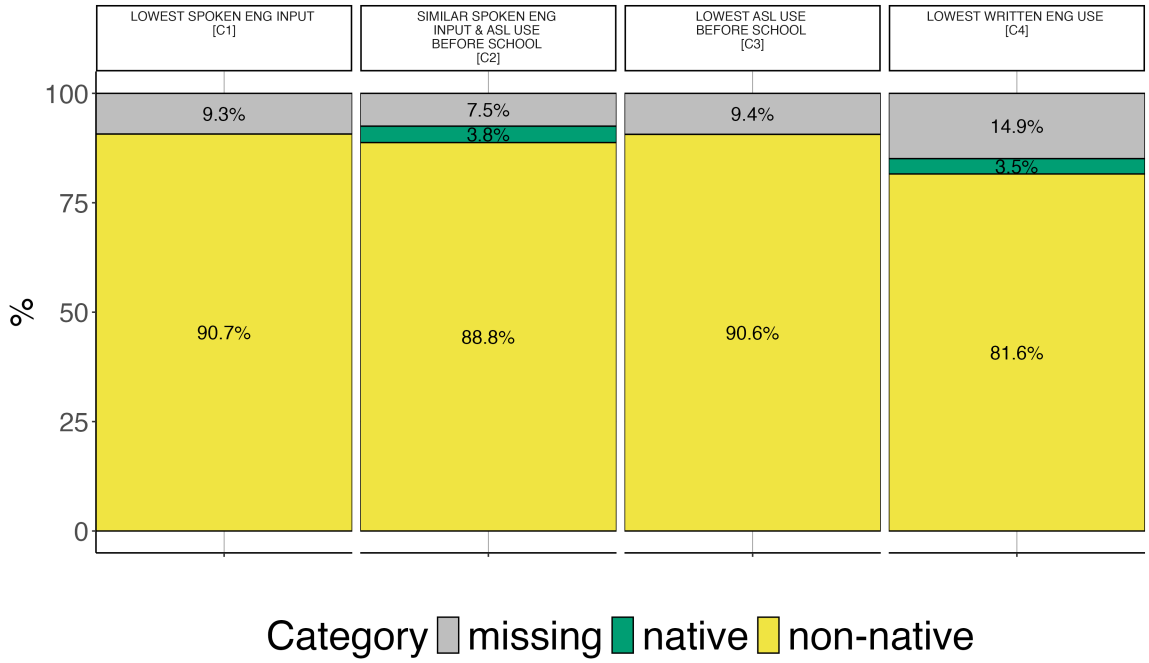


Figure 3.15: "Native" categorisation when AOA cut-off is 3

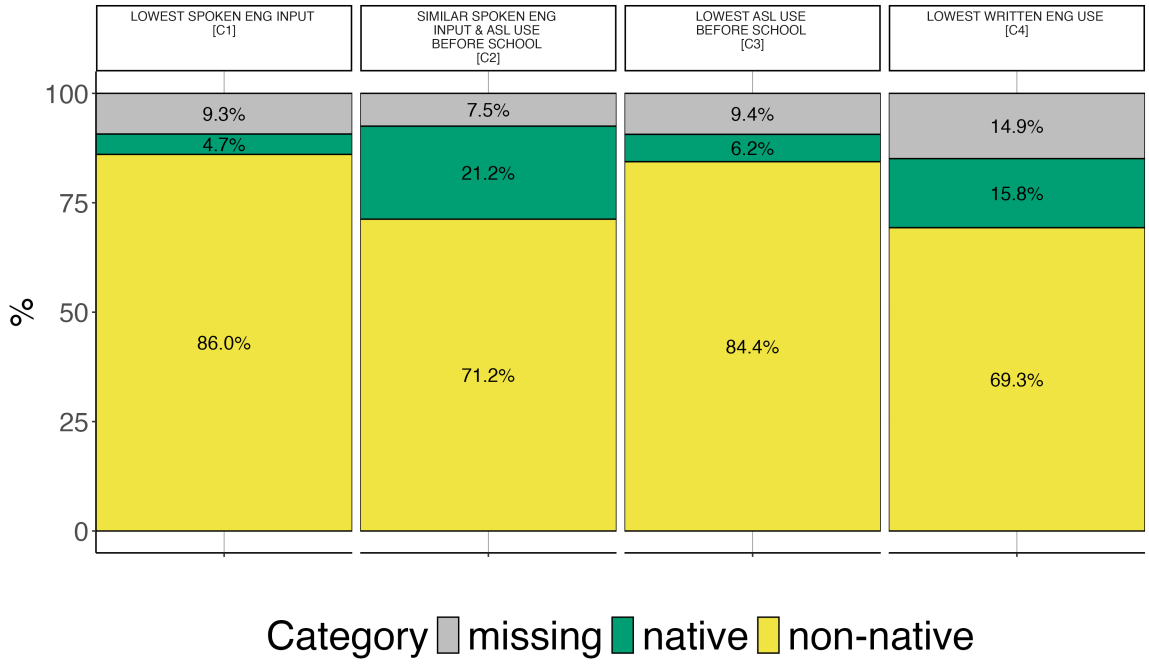


Figure 3.16: "Native" categorisation when AOA cut-off is 5

3.7 Discussion

This chapter characterises variation in experiences with ASL and English of DHH users of ASL using an emergent means of identifying language experience variables (Principal Components Analysis), and an emergent means of categorising language users (cluster analysis). Emergent categorisation with cluster analysis is chosen because this study assumes that language experience, particularly for DHH individuals, is multilingual, multimodal, and multidimensional. This perspective has not been foregrounded in research about ASL signers (however see Lindeberg, 2022) due to a focus on identifying a "pure" ASL free of contact from English and relatedly, the language use of early learners of ASL.

3.7.1 Given the variable nature of language experience, cluster analysis is used as opposed to pre-defined categories

Any characterisation of language experience depends on the aspects of experience that researchers target, and how they do so. This study's focus on English, ASL, and ASL-English mixing excludes other potentially relevant named and unnamed languages in the United States like African American Vernacular English (AAVE) or Spanish. Use of AAVE among participants is likely, as about half of the sample identifies as Black. English and ASL were primarily targeted because of interest in English-linked mouthing in ASL and it was also feasible to target them in the static survey format used as they are recognisable constructs in the DHH community and in research on ASL – it is not clear that terms like AAVE or African American Language are similarly recognisable. More importantly, no efforts were made to ensure consistency in what participants understood ASL and English to be. The intention was to allow participants to draw on their own boundaries between the two, as a driving assumption of this dissertation is that users of a language like ASL, that is in constant contact with English, will differ in how they separate the two. It is likely that targeting English and ASL separately may have temporarily invoked boundaries that may not have necessarily been there but this was tempered by explicitly asking about ASL-English mixing.

3.7.2 DHH users of ASL primarily vary in their experience with English, as opposed to ASL

The characterisation of language contact experiences that emerges through Principal Components Analysis shows that variation in experience with English and ASL is best captured by: [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK, [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME, [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK, [4] EXPERIENCE WITH ASL BEFORE SCHOOL, and [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME (in descending order) (see Section 3.2.0.4 for full description). The nature of these components suggests that for DHH users of ASL in the United States, variation in language experience primarily lies in their use of English, not ASL. This aligns with Lindeberg (2022) who reports that five members of his 100-member sample reported using ASL less than daily, while approximately half used spoken English or English signing. It is also expected, as DHH individuals have varying educational experiences, and access to spoken English. An implication of this is that DHH individuals differ in how much they experience English language contact, and that the components extracted are a means of explicitly characterising such. This characterisation could be useful in explaining variation in English-linked phenomena in ASL, like language entropy (Lindeberg, 2022).

Experience with ASL before entering school emerges as its own component, pointing at the variation that is excluded when early signers are prioritised in sign language research. This component aligns with the known heterogeneity of DHH early language acquisition (Hall & De Anda, 2021), and differences that have been found in the signing of "native" and non-"native" signers It indicates that much of the variation that exists among signers is lost by prioritising early signers and conflating signers into groups like "native" *vs.* non-"native" or early *vs.* late signer. Attempting to temper the effects of variation might be a rationale for defining narrow target groups; however, researchers should then argue for why they choose certain signers over others, particularly in light of bilingualism research that finds that current language use characterises bilingualism better than language learning history (Kałamała et al., 2023).

Methodological choices may explain why ASL use on its own does not figure more strongly in the principal components extracted. First, the sample was limited to participants that self-identify ASL as one of their languages which suggests that such signers do not differ much in how they report their use of ASL. Second, seven variables were removed in the input to the final PCA because they were

not clearly linked to a *single* principal component, making the interpretation of all components difficult. There were two scenarios: a variable loaded *below* the threshold level on more than one component or loaded *above* the threshold level. For variables targeting ASL, the first scenario is easier to rationalise, because it can be interpreted as indicating that ASL production is influencing all aspects of language experience, but to a level that is negligible and can thus be safely ignored. The second scenario is more difficult to explain away. Experience signing ASL in a typical week patterned with use of ASL and ASL-English mixing (0.52 loading) and reading and writing of English during school (0.38 loading) and in a typical week. In both cases, experience signing ASL in a typical week contributed the least to the two possible components that could be interpreted compared to other variables. Intuitively it is easier to see why ASL signing in a typical week would correlate with ASL-English mixing, as they both could occur in the same modality; however, it is more difficult to see why it would pattern with reading and writing English as they are different named languages used in modalities that do not overlap. Lastly, more questions were asked about English than ASL to collect information about different ways of producing and perceiving English, like writing and lipreading. Asking about different forms of English introduces additional variation in the data that would require explanation, and could potentially be uncorrelated with ASL production. The overall effect of this could produce a picture of DHH experience that backgrounds ASL use; however, this perspective also shows that DHH language experience and variation goes beyond ASL. A more improved version of the survey used to collect this data could ask more specific questions about exposure to ASL in different media, e.g. social media videos, to prompt participants to think broadly about their linguistic exposure.

3.7.3 Language experience profiles pattern with social characteristics

Cluster analysis identified four interpretable profiles of language experience with English and ASL in the DHH community of ASL users, and that these profiles are more or less associated with DEAF-ID, AOA, DEAF-FAM, SCHOOL, DEGREE and/or GENDER. Cluster analysis will necessarily find clusters, and so the interpretability of clusters is more important than their mere existence. Interpretability here means that the clusters that emerge pattern with social variables in ways that appear plausible. For instance, LOWEST SPOKEN ENG INPUT [C1] and LOWEST ASL USE BEFORE SCHOOL [C3] are associated with claiming DHH identity respectively, and with attending deaf and mainstream schools respectively. This aligns

with expectations, as attendance at deaf schools is associated with developing deaf identity.

The emergent clusters characterise how DHH individuals' *overall* experience with ASL and English semiotic resources by showing patterns in relative experience with semiotic resources. This is separate from the Principal Components which identify where variation occurs most, and quantifies this variation. Recall that a key part of the clustering is that it is done based on pattern, rather than magnitude; therefore, groupings are not made based on extremes of individual language experience variables. This also means that participants in the same cluster can report different absolute language experience. This approach is descriptively valuable in that it assumes all aspects of language experience are equally important to an individual. This aligns with the assumptions of this study, that DHH experience is multimodal and multidimensional. However, it may not predict language use, like a language entropy measure might, as ASL and English orientation and use will vary based on the individual and the interactional context they are in.

As mentioned above, targeting DHH heterogeneity is motivated by the focus on "native" signers found in ASL linguistics. In the strictest definition used, "native" signers are categorised into two different language experiences, namely SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] and LOWEST WRITTEN ENG USE [C4]. The presence of such signers in these clusters shows that "native" signers vary in how they report their experiences with English language contact. LOWEST WRITTEN ENG USE [C4] report having the same levels of experience with [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME and [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK, while SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] report having more experience with the former than the latter. Both groups also report having the same relative experiences with [4] EXPERIENCE WITH ASL BEFORE SCHOOL and [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME. The latter is relevant, as "native" characterisation implicitly targets language acquisition before entering school.

3.8 Conclusion

This chapter captures some of the heterogeneity in experience with English and ASL in the deaf and hard-of-hearing community in the United States. This heterogeneity is well-known, but is not typically the focus in ASL linguistics, due to the

widespread use of the "native" signer construct. It shows that community members vary most in their experiences with written English, oral forms of English like lipreading, mixing ASL and English, ASL before entering school, and speaking English. It also shows that there are at least four major profiles of language experiences within the community, that are differentially associated with social characteristics like deaf identity.

CHAPTER IV

Exploring how Perceiver Background Influences Evaluation of ASL

4.1 Introduction

This chapter asks how the experiences of perceivers influence evaluation of congruent English mouthing in ASL. As defined in Chapter I, mouthings are mouth patterns articulated alongside manual signing that are recognisable as associated with a spoken language, and which may or may not be produced with vocalisation (Bisnath, 2024). Congruent mouthing is mouthing that would be glossed in the same way as the manual sign it accompanies (Bisnath, 2024). English mouthing in ASL is targeted because it is the most prevalent visual form of English in ASL (as opposed to other spoken languages), and because of the dominance of English in the United States. As a contact phenomenon, English mouthing may mark orientation away from deaf identity in the context of the United States. Furthermore, mouthing[1] may be particularly indicative of such an orientation than other contact phenomena like fingerspelling, as it more visibly resembles speaking/hearing linguistic behaviour. Understanding the relationship between social characteristics of DHH individuals in the United States and their evaluation of English language contact phenomena in ASL is relevant for understanding how the experiences of minoritised groups are related to their orientation to more dominant languages. The findings of this study create a foundation for developing and testing more specific predictions about the relationship between perceivers and attitudes in the DHH community in the United States.

Two core assumptions are:

[1]Different forms of mouthing may differ in how noticeable they are to signers.

- that knowledge of and access to variation jointly arise from the interaction between social characteristics and language experience
- that evaluation of language is conditioned by the experiences of perceivers

As mouthing is an English contact phenomenon, five composite language experience variables that characterise experience with various forms of ASL and English are targeted (refer to Section 3.2.0.4). The social characteristics targeted are deaf identity, growing up with deaf family, school type attended, highest degree, gender identity, regional location, cultural identity, age and age-of-acquisition of ASL (described in Section 2.5). These characteristics are motivated by previous work on sociolinguistic variation in general, and specifically in DHH communities in the United States. Cluster membership is also targeted, as it brings together language experience and social characteristics in a data-driven manner, and clusters are differentially associated with social characteristics.

4.1.1 Terminology and Organisation

Two aspects of signing are evaluated, signing aesthetics and deaf identity. When discussing these concepts as they are measured in this study, they are referred to as AESTHETICS RATING and DEAF IDENTITY RATING respectively. The focus on aesthetics and deaf identity are motivated in Section 4.2, followed by a review of the social nature of language perception and production in Section 4.3.

4.2 The intersection of deaf identity, "real" ASL, and mouthing

This section argues that authentic ASL use and sociocultural deaf identity are oriented away from practices linked to English contact, like mouthing, as a means of motivating evaluation of mouthing in ASL in terms of signing aesthetics and deaf identity. Deaf identity manifests in multiple ways (Bat-Chava, 2000; Leigh, 2009), and in the United States is associated with use of ASL (Reagan, 2002). The construction of a standard ASL in turn is intimately connected to the signing produced by deaf individuals who began acquiring ASL early from deaf parents or the signing produced in deaf only settings (Hill, 2012). The importance of early acquisition *and* vertical transmission is illustrated in Jane K. Fernandes' claim that opposition to her being president of Gallaudet University was due to her not being "deaf" enough, in spite of coming from a multi-generational deaf family. She used

a mixed form of ASL and English, and did not learn ASL until she went to graduate school (Davis, 2007; Boswell, 2007). In linguistics too, signers who acquired ASL early and from deaf parents are reified in the "native" signer construct. The focus on these signers and contexts in linguistics is meant to reduce the effects of late(r) acquisition of ASL, English contact, and accommodation to hearing individuals, which are all historically linked to the need to legitimise ASL by positioning it as independent of English.

Use of English mouthing in ASL is held apart from the behaviour and experiences of signers who would have acquired ASL early in life and received less formal exposure to English. Mouthing is reported to not be part of "real" or "fluent" ASL and can be considered "annoying". Some forms of ASL may also be viewed as involving "too much" mouthing (Marschark et al., 1998; Nadolske & Rosenstock, 2007; Hill, 2012). There is also a suggestion that mouthing arises out of interaction with hearing people, marking it with the transience of accommodation strategies. This belief is not supported by production data, as mouthing does occur among deaf interlocutors using ASL (Lucas & Valli, 1990), but this does not preclude it from being a belief within the community that can influence perception. Similar associations between mouthing and spoken language contact are echoed in interviews with DHH community members. A signer judged to be using a mixed form of ASL is thought to be doing so because of late acquisition of ASL, and a second signer's use of mouthing in signing judged to be ASL is assumed to be doing so because of a history of a speech therapy (Hill, 2012). The first case can be straightforwardly interpreted as flagging lesser knowledge of ASL given the framing of early acquirers of ASL as "true" ASL users. The second case does not flag anything in particular about ASL use, but suggests orientation toward spoken language behaviours. Similarly, but in another context, that of Italian Sign Language (LIS), one signer's use of Italian mouthing is viewed as disconnected from LIS and so interpreted as indicating a lack of awareness of "sign language" (Fontana, 2022).

Despite the negative connotations, there is a sense of an appropriate way of using mouthing in ASL. One signer interviewed in Hill (2012, 119) found mouthing "nice and clear", and sign models and participants in linguistics experiments appear to find mouthing while fingerspelling "natural", producing them spontaneously while fingerspelling nonce words (Emmorey & Petrich, 2012; Caselli et al., 2021b). This sensibility may cut across sign languages, as signers of Italian Sign Language (LIS) find that Italian mouthing in LIS improves clarity of signing (Fontana, 2022). Note though that beliefs about mouthing will be different in different DHH

communities. Mouthing also contributes to the acceptability of sign language avatars, as signing without mouthing in German Sign Language (DGS) is considered disturbing (Kipp et al., 2011), and in Swiss-German Sign Language (DSGS) it is thought to be unnatural (Ebling & Glauert, 2016).

It appears then that the social characteristics associated with mouthing are oriented away from a canonical notion of deaf identity, but that there is variation in attitudes to mouthing in the DHH community. Implied in this too, is that mouthing is noticeable, and variable. These points together motivate the present experimental study, as they suggest that variation in evaluation of mouthing in ASL could be structured around characteristics associated with deaf identity and the context of sign language acquisition, like age-of-acquisition and growing up with deaf parents. Furthermore, they motivate targeting the aesthetics of signing and deaf identity in evaluation, as the two are associated with authentic ASL use. These axes of evaluation differ from typical targets of speaker evaluation studies, which, as their name implies, have not yet considered deaf experiences. They are more directly tied to deafness and use of ASL in the context of English and spoken language dominance and thus are more appropriate for understanding how an English contact phenomenon is viewed among DHH signers in the United States.

4.3 Social knowledge in perception and evaluation

Social knowledge in this study refers to what language users know about how language use varies socially, which includes both distributional knowledge and stereotypes. The accretion of this knowledge is theorised in the Exemplar Theoretic group of models (Pierrehumbert, 2001) targeting sociolinguistic variation (see Remirez, 2024, for one implementation), which are aligned with usage-based models of language (Docherty & Foulkes, 2014). In Exemplar Theoretic models, language users store their individual experiences with language as episodes, or exemplars. These exemplars contain rich linguistic detail indexed to information about the social context that they were experienced in (Drager & Kirtley, 2016). Language users build up traditionally linguistic and social categories, and associations among them, as they encounter this detail in exemplars. Thus, a perceiver who encounters a hearing signer with deaf parents who produces the sign PIZZA with mouthing corresponding to English "pizza" will store information about the articulatory properties of the sign and the mouthing used, and the identity of producer. When this same perceiver encounters a deaf signer who produces PIZZA

without mouthing, they will do the same. If this pattern of storage prevails over time, the perceiver may come to associate use of mouthing with hearing signers, and absence of mouthing with deaf signers. Information stored in this way gives language users knowledge of social variation and is influenced by frequency of exposure. However, the properties of experiences that perceivers store and how they do it is influenced by stereotypes, which may be personal and/or received, and by perceivers' experiences themselves.

In the remainder of this section, I illustrate use of social information in perception and motivate investigating how evaluation is socially-structured around perceivers by drawing on insights from the sociophonetics of spoken languages. I then review what is known about variation in mouthing in ASL.

Research on the sociophonetics of spoken languages clearly demonstrates the use of social information in perception of language. A classic illustration is that perception of Canadian raising can differ when perceivers from Michigan (USA) believe they are listening to a Canadian, as opposed to someone from Michigan. Canadian raising is the production of the /ɑu/ diphthong in words like *house* with the tongue higher than it would be if producing /ɑ/ on its own, resulting in a pronunciation like /huːs/ ("hoose"). It is not restricted to Canada, as it is also produced by speakers in northern states of the United States, but it is a stereotype about Canadian speech (Chambers, 2006). Detroit, Michigan listeners are more likely to perceive Canadian raising in Detroit speech when they are primed to believe that they are listening to a Canadian, as opposed to someone from Michigan (Niedzielski, 1999). Furthermore, undergraduates at the University of Michigan and University of California, Berkeley transcribe Chinese-accented sentences presented in noise more accurately when primed with a Chinese face, as opposed to a Caucasian one or a silhouette (McGowan, 2015) (see also Hanulíková, 2021). A similar observation is made without explicitly referencing speaker identity. When New Zealand English speakers are oriented to New Zealand *vs.* Australia using stuffed animals (a kangaroo and a kiwi respectively), their perception of variants of /ɪ/ aligns with how this vowel is produced in New Zealand *vs.* Australia (Hay & Drager, 2010) (see also Hurring et al., 2022). In Australian English /ɪ/ is raised and fronted while in New Zealand it is centralised and lowered. New Zealand English speakers who hear stimuli along this continuum produced by a New Zealand English speaker while in the same room as a stuffed kangaroo perceive /ɪ/ as more raised and fronted than when they are in a room with a kiwi.

This thread of research shows that socially-implicated information about speak-

ers and in the environment influences perception of language. The studies summarised above target national and ethnic identity of speakers (see Cheng, 2024, for critique of macro-social categories like "Asian"), and similar findings obtain with other typical social characteristics, like gender (Bouavichith et al., 2019; Lindvall-Östling et al., 2020) and social class (Koops, 2011), and "native" attribution (Lev-Ari & Keysar, 2010). Niedzielski (1999) further illustrates how a stereotype, invoked through national identity, can influence perception counter to what would be expected if only exposure was considered. That is, beliefs about the relationship between a linguistic form and who produces it influence perception. Related findings come from the study of personae, which are *"holistic, ideological social type[s] [...] recognisably linked to ways of being and speaking"*, like the Valley Girl (D'Onofrio, 2020, 4). TRAP-backing, the production of the vowel in "trap" further back in the oral cavity, is linked to California (USA) and the Valley Girl persona. The latter is a stereotypical Californian associated with whiteness, femininity, affluence, wealth, materialism and superficiality. Given the association between California in general and TRAP-backing, listeners might be equally expected to perceive TRAP-backing when they believe they are listening to a Californian and a Valley Girl. However, this only occurs when listeners believe they are hearing a Valley Girl, showing influence of stereotypes going beyond regional association (D'Onofrio, 2015).

Perception further varies with experiential and attitudinal characteristics of perceivers. In the previously discussed study of transcription of Chinese-accented English in noise, listeners categorised as having more experience with this variety of English, that is the listeners from Berkeley, made more accurate transcriptions than Michigan listeners who were categorised as having less experience (McGowan, 2015). However, for listeners (60 first year psychology students born in Australia) with the same experience with accents, vowel categorisation differed with attitude. That is, listeners with the same experience and expectation of hearing a Vietnamese accent are more accurate in categorising vowels in Australian- and Vietnamese-accented English when they are positively prejudiced to Asians, and less accurate when they are negatively prejudiced (Nguyen, 2017). Perceivers also appear to be less sensitive to variation at the neural level when they have negative attitudes Loudermilk (2015). Similarly, in imitation listeners who like a speaker more will imitate their extended VOT more (Yu et al., 2013). Patterns like this are also found in studies of evaluation. Differences in how perceivers from Montreal (Canada) and Gainseville, Florida (USA) judge the accentedness of speech associated with white *vs.* South Asian faces is argued to arise from dif-

ferences in the multilinguality of the areas perceivers are from. Those from Montreal do not judge speech linked to South Asians as being more accented while those from Gainseville do, perhaps because because Montreal is more multilingual than Gainseville (Kutlu et al., 2022). Similarly, the educational and employment background of perceivers directly influences their evaluation of intelligibility, comprehensibility, and accentedness, with those with more education rating Southern American English and Russian-accented English higher than those with less (Fuse et al., 2024). A similar effect is found at the level of phonetic detail – listeners with more formal education rate [ʧ] in Andalusian Spanish as indicative of higher socioeconomic level and urbanness, and vice versa for [ʃ], than listeners with less education (Regan, 2021).

4.3.1 Social variation in sign language production and perception

In an Exemplar Theoretic model, social variation in production of language is part of the knowledge that language users have. In ASL, production of mouthing is linked to the intersection of age, race, and region in the United States. Signers in the south (Alabama and Texas) have been observed not using any mouthing in a corpus of African American signers, and older Black signers were found to use mouthing less (Lucas et al., 2015). An anecdote reported in Lucas & Valli (Tabak (2006) 1990) also suggests that Black signers may may mouth less than white signers (Tabak (2006) Lucas & Valli, 1990). Similar variation is reported in other sign languages – in the British Sign Language (BSL) corpus (Schembri et al., 2013), production of mouthing varies by region, and signers identified as female mouth more than those identified as male (Proctor & Cormier, 2023). Variation based on age is not found in BSL, but in the related New Zealand Sign Language (NZSL), older signers are found to mouth more (McKee, 2007). Age-of-acquisition of ASL also correlates with quantity of mouthing production – as it increases, so does production of mouthing (Herbert & Pires, 2017). When age-of-acquisition is restricted ($\leq$8), signers who have a deaf parent are found to produce mouthing at a lower frequency than those who do not (Lindeberg, 2022). In more targeted measurement of language experience, daily use of spoken English and English signing are found to positively correlate with use of mouthing (Lindeberg, 2022, 93).

Social variation in perception of sign languages has not yet received much direct attention, but typical distinctions within language acquisition and psycholinguistics, like deaf *vs.* hearing signers, signers *vs.* non-signers, early *vs.* late signers, and "native" *vs.* "non-native" signers, are socially-implicated, as they have to do

with access to spoken and sign language, and conditions of language acquisition. This section highlights social explanations in studies of sign language perception that have to do with use of language and interaction.

Differences in language experience correlate with differences in how perceivers make use of mouthing. Signers who differ in experience signing ASL fixate on the face differently, with beginning signers fixating more on the mouth, perhaps to to see mouthing better (Emmorey et al., 2009). Bosworth et al. (2020) explain a difference in how much signers classified as acquiring ASL late (age-of-acquisition of ASL from 4–19, 13–34 years experience signing ASL) look at the mouth compared to those classified as acquiring ASL early (age-of-acquisition of ASL from 0–3, 21–57 years experience signing ASL) by referring to experience and interaction. They suggest that signers who acquired ASL later may use lipreading more *"either out of habit or necessity as an effect of later AoA"* (Bosworth et al., 2020, 290)[2]. Colour terms produced without mouthing in British Sign Language (BSL) are better recognised by signers with deaf parents as opposed to those without. The reason put forward for this is that signers with deaf parents might have greater knowledge of variation (Stamp, 2016), potentially because they might have more access to deaf culture and opportunities to socialise with different deaf people, resulting in greater knowledge of variation. Together, this research shows that the static categories currently in use in sign linguistics have utility, but the explanations for why they do so have to do with differences in the experiences of these groups. Thus, differences are not arising because, for example, a signer has deaf parents, but because of the experiences they might have had because they had a deaf parent. This suggests then that asking language users more directly about their language experience may be equally or more useful than extrapolating from categories like "native" *vs.* "non-native" etc.

Similar arguments can be made about how perception of other aspects of sign language form correlate with the social and experiential aspects of perceivers. Iconicity, for instance, is perceived differently based on specific language experience. Iconicity is a perceived relationship between a linguistic form and its meaning in which the meaning is directly represented in the form (Dingemanse, 2019).

[2]This contrasts with eye-tracking findings about Spanish Sign Language (LSE), in which no difference is found in where signers categorised as native *vs.* non-native direct their gaze (Mastrantuono et al., 2017). Note, however, that these differences might be due to Emmorey et al. (2009) measuring gaze behaviour in a face-to-face context compared to Mastrantuono et al. (2017) using video stimuli.

For instance, the sign OCTOPUS[3] in ASL visually represents the shape and tentacles of an octopus. Iconicity is often treated as a static structural property, particularly in sign languages, due to the visual possibilities afforded by the hands and body compared to the speech stream. If this were the case, one would expect the same signs to be rated the same for iconicity regardless of who perceivers are; however, signers evaluate the signs and manual alphabet handshapes of their own sign languages as more iconic than those of other sign languages (Occhino et al., 2017; Börstell, 2024). The findings of Börstell (2024) about fingerspelling are particularly illustrative, as manual alphabets draw on the shapes of letters, which can be argued to have an especially static visual representation. Perception of fingerspelling in ASL is also linked to world knowledge that accrues with age. Leannah et al. (2022) find that older signers recognise fingerspellings of real toponyms (as opposed to nonce names) more accurately than younger signers, and suggest that this might be because they know more about the world. Apart from fingerspelling, deaf educators use different attention-getting strategies with deaf preschoolers based on if the parents of these children were deaf or hearing Singleton & Crume (2022). This finding is interpreted as showing that children who grow up with deaf parents come to school already knowing how to direct their attention and eye gaze to receive visual input more than children who do not. Together, this body of research motivates an approach to evaluation of mouthing that directly targets DHH community members' experiences.

4.4 Orientation and research questions

The background material presented in the previous section shows that a broad range of socially-implicated characteristics of producers, perceivers, and the context of language use influence perception, and that much is left to be understood about evaluation of mouthing in sign languages. Existing literature on ASL does not provide exact predictions about the relationship between these characteristics and perception. However, research on the sociophonetics of spoken languages highlights the need for theorising the perceiver, and not assuming uniform behavior across perceivers, but heterogeneity explained by a potentially broad range of experience-implicated variables. This study aims to explore this domain with the goal of creating a foundation for future research on ASL and sign languages more generally.

[3]See sign here: `Mhttps://asl-lex.org/visualization/?sign=octopus`

1. How is mouthing evaluated for signing aesthetics and deaf identity by DHH signers of ASL in the United States?

2. How does evaluation of mouthing correlate with the social experiences of perceivers, and experience with ASL and/or forms of English?

Answering these questions will add quantitative experimental evidence to the qualitative reports about mouthing and its social correlates described in Sections 4.2 and 4.3, and identify predictors of evaluation.

4.5 Method

The method, hereafter referred to as the Evaluation of Mouthing Task, draws on the Matched Guise Task (Lambert et al., 1960), but is adapted for sign languages and the resources available to the researcher (refer to Section 2.4 for details about the task and its development). Eight evaluation terms, adapted from Hill (2012), were used: "pure", "smooth", "beautiful", "educated", "deaf", "hearing", "strong deaf person", and "deaf community leader". These terms were presented in written English as in Hill (2012), and also translated to ASL (see Figures 4.1 and 4.2 repeated from Chapter II for convenience). In Hill (2012), participants were asked to rate how much they agreed that the video(s) they had seen aligned with the evaluation terms on a 6-point evaluation scale. The present study takes a similar approach, but asks participants to provide ratings from 0–100 to allow for the possibility of more gradience. The following sections detail the stimuli, their development, and the experimental design.



Figure 4.1: Aesthetics evaluation terms in ASL



Figure 4.2: Deaf identity evaluation terms in ASL

4.5.1 Stimuli development and properties

The stimuli were developed with the primary deaf collaborator, Sonya Carter (SC). Two informational texts were developed on two topics that were relevant at the time of creation in 2022: COVID vaccines and Hurricane Ian (hereafter Hurricane). The researcher wrote the texts in English first as a starting point, and worked with SC over multiple sessions to convert them to ASL while fulfilling the criteria listed below. The goals in developing these texts were the following:

1. they have a similar length of about 30*s*
2. they have a similar discourse structure
3. they are balanced in containing forms that are expected to be more and less associated with mouthing

To meet goal 2, efforts were made to maintain a similar discourse structure across the stimuli (see Table 4.1). Highlighted rows show the sentential units that are repeated across the two texts. For example, all texts began as shown below, with items immediately following TOPIC depending on the text. The first line shows the ASL manual signs, and the second an English translation. Lowercase letters separated by hyphens mark fingerspelling. More conventionalised (lexicalised) fingerspellings, like that for NEWS, are not treated like less common ones.

HI EVERYONE NEWS TOPIC WHAT COVID b-i-v-a-l-e-n-t SHOT/HURRICANE i-a-n
"Hi everyone, the news topic today is the COVID bivalent vaccine/Hurricane Ian."

To meet goal 3, a coding system to assign an expectation of mouthing to grammatical categories based on the findings of Nadolske & Rosenstock (2007) and Herbert & Pires (2017), and my intuitions and those of collaborators based on our combined experience with sign language linguistics and ASL was developed. This approach had to be taken because there is no corpus or database of ASL that I knew of or had access to that could be used to generate these expectations (see Section 2.4.1.4 for other types of information that would be useful to know when developing experimental stimuli targeting mouthing). Table 4.2 shows how much each grammatical category is expected to appear with mouthing relative to other categories, and the frequency of each category type within the initial texts. In this table, 0 indicates low expectation of mouthing, and 2 a high expectation. Table 4.3 shows the frequency and percentage of grammatical categories with the same

Table 4.1: Properties of sentences within stimulus texts in order of appearance

No.	COVID	Hurricane
1	declarative	declarative
2	rhetorical polar question	rhetorical polar question
3	declarative	declarative
4	declarative	declarative
5	rhetorical polar question	declarative
6	declarative	declarative
7	declarative	declarative
8	instruction with classifier	declarative with classifier
9	instruction with classifier	rhetorical polar question
10	instruction	instruction
11	–	instruction
12	–	instruction

mouthing expectation within each text. Both texts are relatively balanced in the percentage of signs with the same assigned mouthing expectation within them.

The category of each sign used is determined by its meaning in its discourse environment and/or form. The meanings of verb, noun, adjective, classifier/depicting sign, pronoun, and point are interpreted as shown below. These definitions are not intended to define these categories in sign languages in general, but are strictly functional definitions particular to the stimulus texts in this study.

1. verb: *a manual sign that denotes an action*
2. noun: *a manual sign that denotes an object, person, or place*
3. adjective: *a manual sign that gives more information about a noun*
4. classifier/depicting sign: *a handshape that identifies a type of noun*
5. pronoun: *a manual sign, typically a point or location in space, that refers to a noun*
6. point: *a manual referential point that is not a pronoun*
7. functional item: wh-*words, and signs like* IF, *which are linked to English grammatical items*
8. fingerspelling/number: *items that are generated de novo, as opposed to being more conventional and/or frequent. This differentiation draws on Lepic (2019)'s identification of multiple degrees of conventionalisation in fingerspelling in ASL. Thus the*

fingerspelling of a word like "bivalent" which was relatively new addition to mainstream discourse at the time of stimulus development, is considered a fingerspelling, while the sign for NEWS*, which is the fingerspelling of "news", is considered to be its own sign, as it is more common and can be found in ASL news videos.*

Table 4.2: Frequency of mouthing expectation by category in initial stimuli

Category	**Mouthing expectation**	**COVID**	**Hurricane**
Verb	1	12	10
Noun	2	20	26
Adjective	2	12	6
Functional item	2	9	7
Classifier/Depicting sign	0	4	3
Pronoun	1	1	1
Fingerspelling/Number	2	7	5
Point	0	2	2
Total	*NA*	67	60

Table 4.3: Frequency and percentage of terms with the same mouthing expectation within texts

Mouthing expectation	**COVID**	**%**	**Hurricane**	**%**
0	6	8.96	5	8.33
1	13	19.40	11	18.33
2	48	71.64	44	73.33
1+2	61	91.04	55	91.67

Two mouthing conditions were created: a high condition where all signs appeared with mouthing, and a low condition where no sign appeared with mouthing. In the high condition, all mouthings were congruent (Bisnath, 2024), that is, they would be glossed in the same way as the manual sign they accompanied. Thus, the sign HURRICANE would be accompanied by mouthing of the English word "hurricane". After the texts were finalised, SC made sample videos signing each one in ASL with low (Video 1) and high (Video 2) mouthing. These videos were glossed in English along with non-manual markers and mouthing, and still images of classifier constructions.

Two additional deaf signers, Brennan Terhune-Cotter (BTC) and River Frank (RF), who were not part of stimuli development, produced the final stimuli. BTC and RF present similarly in age, race (white), and appearance (blonde, average body type, wearing black t-shirt), but could be perceived as differing in gender presentation. BTC recommended RF to me as a person who signed like him.

BTC and RF were sent the naturalistic video samples produced by SC, accompanying English glosses with no marking of mouthing, and marking of mouthing in the low and high conditions, and instructions in English. BTC and RF were asked to memorise the texts before producing them, and crucially to *not* read the glosses that were provided. The static forms of ASL that were sent were meant to aid memorisation. BTC and RF produced these texts with their own naturalistic mouthing, low mouthing, and high mouthing; therefore, they produced 9 videos each (for which they were compensated). The instructions provided along with the glosses of low and high mouthing are shown below. Keeping the videos as naturalistic as possible was prioritised over BTC and RF producing exactly the same signing. This choice was made because it was not feasible to aim for exactly the same mouthing.

- low mouthing: *Do not mouth on classifier constructions (pictures). Mouth in what way you think is appropriate and naturalistic for low mouthing as shown in Video 1 for all other signs.*
- high mouthing: *Mouth in what way you think is appropriate and naturalistic for high mouthing as shown in Video 2 for all other signs. DO mouth on classifier constructions (see next slide for mouthings to use). Mouthing in high mouthing condition should be more than in low mouthing condition.*

Links to the stimulus videos are listed below[4]. All audio was removed from the

[4]The video titles include labels for signer, topic and mouthing which are added for the convenience of interested researchers but were not seen by participants.

videos, and so if the sign models produced any sounds, they could not be heard. These videos are not fully controlled, as BTC and RF differ in the backgrounds they used in their videos and in how they produced high and low mouthing. BTC's videos have a green background while RF's has a white background. Impressionistically, I would order BTC and RF's production of high and low mouthing as shown below, where RF produces low mouthing with less articulation than BTC, and high mouthing with more articulation. BTC's production of low mouthing did include some mouth movements, as he found this condition difficult to produce. In the final modelling discussed below, differences based on signer did not show up. Viewers will also see that mouthing was ultimately *not* produced with classifier constructions in the high mouthing condition, as the sign models found it too unnatural.

$$\text{RF, low} < \text{BTC, low} < \text{BTC, high} < \text{RF, high}$$

- high, BTC, COVID Mhttps://youtu.be/UhNGaADUtTA
- low, BTC, COVID: Mhttps://youtu.be/o0wwvxWBT4s
- high, BTC, Hurricane: Mhttps://youtu.be/7HeJL391kbo
- low, BTC, Hurricane: Mhttps://youtu.be/QgpoFjpoT9Q
- high, RF, COVID: Mhttps://youtu.be/c9GRdV_tSms
- low, RF, COVID: Mhttps://youtu.be/lYcQa8STTFU
- high, RF, Hurricane: Mhttps://youtu.be/z92wMnTmCRI
- low, RF, Hurricane: Mhttps://youtu.be/_mJqoSY6U8Q

There was a three second delay before each video began, and videos began playing automatically. Participants could not pause or stop the videos, and were not able to move past them to other parts of the survey before they played to completion. Participants also could not view any video more than once.

4.5.2 Design

Eight lists were created which were counterbalanced for signer, mouthing condition, topic, and the order in which the mouthing conditions are presented (view list stimuli here: Mhttps://osf.io/truqk/?view_only=c4cddba12838

43e7af071867235aba63). The goal was to ensure that no participant saw the same signer, topic, or condition twice. This type of counterbalancing was implemented because RF and BTC could not produce exactly the same stimuli in terms of mouthing. Lists 1 to 4 and 5 to 8 are the same apart from the order in which mouthing condition is seen. The properties of each list are shown in Table 4.4. Each participant saw one list only.

After each video, participants were asked the questions shown in Table 4.5, always in the order shown. Note that the 0–100 scale also had three qualitative markings in English at the leftmost, middle and rightmost points.

No.	**Order**	**Condition**	**Signer**	**Topic**
1	highlow	high	BTC	COVID
		low	RF	Hurricane
2	highlow	high	BTC	Hurricane
		low	RF	COVID
3	highlow	high	RF	Hurricane
		low	BTC	COVID
4	highlow	high	RF	COVID
		low	BTC	Hurricane
5	lowhigh	low	RF	Hurricane
		high	BTC	COVID
6	lowhigh	low	BTC	Hurricane
		high	RF	COVID
7	lowhigh	low	RF	Hurricane
		high	BTC	COVID
8	lowhigh	low	RF	COVID
		high	BTC	Hurricane

Table 4.4: Properties of lists

No.	English Translation of Question	Measurement
q21	*How well did you understand the video you just saw?*	continuous 0-100 scale
q22	*What languages are being used in the video you just saw? You can select more than one answer.*	ASL/Black ASL/English/SEE/Other (open response)
q23	*The signing in the video you just saw looks pure. How much do you agree?*	continuous 0-100 scale
q24	*The signing in the video you just saw looks beautiful. How much do you agree?*	continuous 0-100 scale
q25	*The signing in the video you just saw looks smooth. How much do you agree?*	continuous 0-100 scale
q26	*The signing in the video you just saw looks educated. How much do you agree?*	continuous 0-100 scale
q27	*The signer in the video you just saw looks like a leader in the deaf community. How much do you agree?*	continuous 0-100 scale
q28	*The signer in the video you just saw looks like a strong deaf person. How much do you agree?*	continuous 0-100 scale
q29	*The signer in the video you just saw looks deaf. How much do you agree?*	continuous 0-100 scale
q30	*The signer in the video you just saw looks hearing. How much do you agree?*	continuous 0-100 scale
q31	*Do you have any comments about the signing in the video you just saw? Please type below.*	open response
q32	*What do you think about the signer in the video you just saw? Please type below.*	open response
q33	*How much mixing between English and ASL is in the video you just saw?*	continuous 0-100 scale
q34	*Do you have any comments about the signing in the video you just saw? Please type below.*	open response
q35	*Do you know the person in the video you just saw?*	yes/no

Table 4.5: Questions asked per video

4.6 Expectations

The broad expectation is that low mouthing will be rated higher for signing aesthetics and deaf identity properties than high mouthing. Regarding social characteristics, I expect that groups will differ in how they rate high *vs.* low mouthing; however it is difficult to make more specific predictions because the literature is sparse. Given the argument put forward in Section 4.2 that use of English mouthing is oriented away from authentic ASL and thus deaf identity, I expect differences in levels within DEAF-ID, DEAF-FAM, SCHOOL and CLUSTER will show differences, as well as AOA and [4] EXPERIENCE WITH ASL BEFORE SCHOOL. However, given the exploratory nature of the present study, the direction of differences cannot be predicted at this point.

4.7 Participants

The sample consists of 127 unique participants who indicated that they did not know the sign models and who were not missing any information about their social characteristics[5]. Refer to Table 4.6 for description.

[5]Readers of Chapter V will note that more participants are included ($n = 183$) as there was no need to remove participants who were missing information

Table 4.6: Description of participants who do not know the sign models, BTC and RF (*n=127*)

Category	**Characteristics of sample**
DEAF-ID	*deaf only* (43%), *hoh only* (36%), *both* (11%), missing (10%)
DEAF-FAM	*yes* (45%), *no* (55%)
SCHOOL	*deaf only* (49%), *mainstream only* (19%), *both* (24%), *neither* (8%)
DEGREE	*high school* (47%), *bachelor's* (43%), *advanced* (9%), missing (1%)
GENDER-ID	*male* (65%), *female* (32%), *non-binary/third* (2%)
REGION	*west* (24%), *midwest* (20%), *south* (35%), *northeast* (20%), missing (2%)
CULTURAL-ID	*white* (48%), *Black/African American* (42%), *other* (10%)
CLUSTER	*1* (23%), *2* (34%), *3* (18%), *4* (25%)
AGE	$M = 29 (SD = 6, Mdn = 28)$
AOA	$M = 9 (SD = 5, Mdn = 8)$
[1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK	$M = 0.04 (SD = 0.89, Mdn = 0.05)$
[2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME	$M = 0.16 (SD = 0.77, Mdn = 0.14)$
[3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK	$M = 0.11 (SD = 0.83, Mdn = 0.16)$
[4] EXPERIENCE WITH ASL BEFORE SCHOOL	$M = -0.02 (SD = 0.92, Mdn = 0.05)$
[5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME	$M = 0.13 (SD = 0.82, Mdn = 0.14)$

4.8 Analysis

Robust linear mixed effect models in `robustlmm` were used to model the data (Koller, 2016). A robust method was used because the data does not meet the assumptions of normality – that is, it is heteroscedastic (the difference between expected values and observed values is not the same across measurements) and contains influential observations (observations that are so different from other observations that they can skew the entire dataset) (assessed using `performance` Lüdecke et al. (2021)). This is not unexpected, as most data of a similar type are not distributed normally (but are often treated as if they do) (Field & Wilcox, 2017), and because this study builds in the assumption that the population has heterogeneous language experiences. As this study aims to create a foundation for future predictive work, robust methods are used to model the data conservatively. Model comparison is not a priority, and in fact AIC (Akaike Information Criterion) and other metrics that rely on log-likelihood, which are typically used to compare models, cannot be calculated when `robustlmm` is used (Koller, 2016). As such, in this study, significance is assessed using 95% confidence intervals calculated using bootstrapping with `confintROB` (Mason et al., 2024) (no. of simulations = 5000), and is primarily used to narrow down which social variables to prioritise in discussion. The rule of thumb for using confidence intervals in this way is that if the interval does not contain 0, the effect is significant. Reporting confidence intervals as opposed to *p*-values is also a better option when doing exploratory research as *p*-values are more appropriate for hypothesis testing. All confidence intervals are reported at 95% confidence indicating that there is a 95% chance that estimates fall within the interval.

The analysis is separated by rating type – one in which AESTHETICS RATING is the dependent variable (Section 4.9), and a second where DEAF IDENTITY RATING is dependent (Section 4.10). Models are specified as shown in (1) and (2), with the dependent variable, either AESTHETICS RATING or DEAF IDENTITY RATING, and the independent variable an interaction between mouthing and a social characteristic/language experience. The models are initially specified as shown in (1) with list and participant as random variables. In cases when a singular fit is returned, it is specified as shown in (2) without list as a random effect. Singular fits were returned for all models with AESTHETICS RATING specified as the dependent variable, and for one with DEAF IDENTITY RATING as the dependent variable ([5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME as the independent

variable). Therefore, all AESTHETICS RATING models follow (2) and all DEAF IDENTITY RATING models but one follow (1). Models are fit with each social characteristic separately, so 15 separate models are fitted for each type of rating (30 total). An interaction is specified because the social characteristic of a participant is expected to influence rating of high *vs.* low mouthing. Categorical social characteristics are dummy coded. Default specification of the intercept by alphabetical order was used; therefore, the reference point for mouthing is "high", and the group that appears first alphabetically for the social characteristic being tested. Thus, the reference point for DEAF-FAM, which has two levels – "yes" and "no" – is "no".

(1) `evaluation ~ mouthing*social characteristic + (1|list) + (1|list:participant)`

(2) `evaluation ~ mouthing*social characteristic + (1|participant)`

Before the final modelling, effects of each rating term ("pure", "smooth", "beautiful", "deaf", "strong deaf person, "deaf community leader"), signer (BTC or RF), topic (COVID, Hurricane and order of presentation (high before low and vice versa) were checked for. There were no effects of signer, topic and order. Effects on rating terms are discussed separately in Sections 4.9 and 4.10.

4.9 Results: AESTHETICS RATING

AESTHETICS RATING is comprised of the ratings for questions asking if the signing is "pure", "smooth", and "beautiful" (see Figure 4.3 for distribution). These terms are grouped together in the model after testing that there was no effect of individual rating terms. This was checked by specifying rating term in an interaction with mouthing in a variation of model (1) shown below.

(3) `AESTHETICS RATING ~ mouthing*social characteristic + (1|list) + (1|list:participant)`

The presence or absence of a significant interaction for all models is shown in Table 4.7, and the interaction terms and their coefficients are shown in Table 4.8. Significant interactions occur for groups within DEAF-FAM, SCHOOL, GENDER-ID, CLUSTER, AGE and [4] EXPERIENCE WITH ASL BEFORE SCHOOL, experience with

ASL before entering school. Note that the interaction term for SCHOOL, GENDER-ID and CLUSTER involves the group with very small numbers of observations, and so the confidence intervals are larger. The models of these social characteristics are visualised in Figures 4.4 to 4.7 and 4.8. The coefficients are all positive, apart from AGE. Significant interactions are not observed for DEAF-ID, DEGREE, REGION, CULTURAL-ID, AOA, [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK, [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME, [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK and [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME.

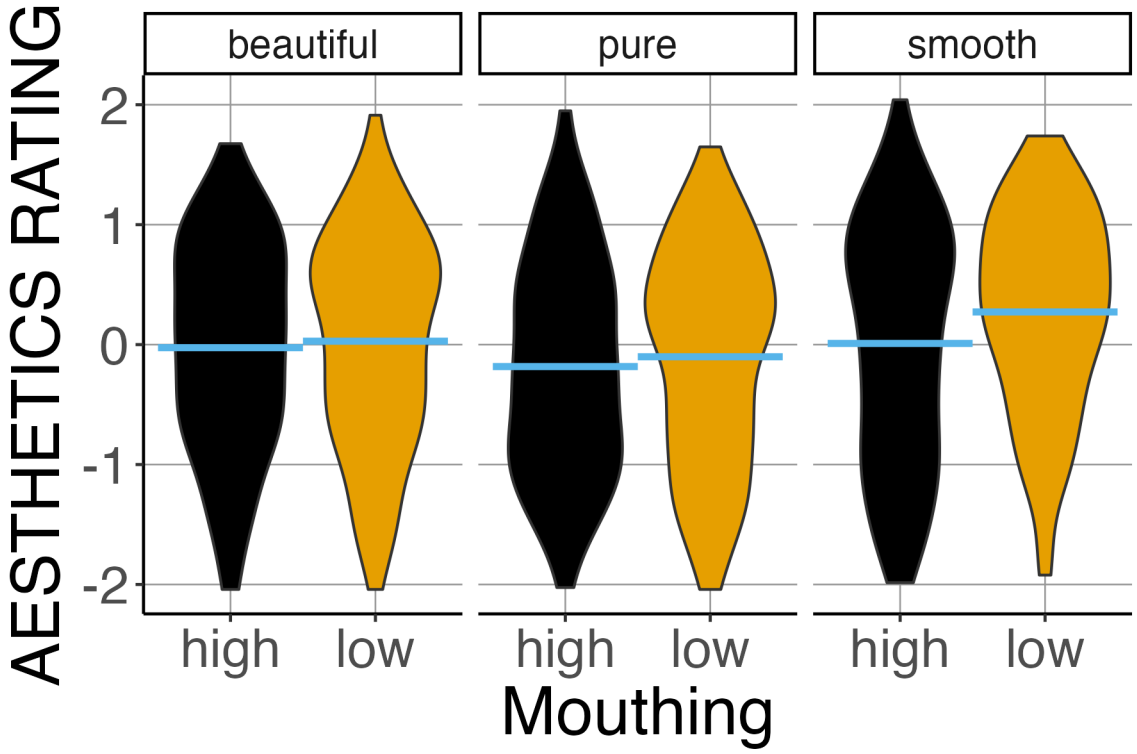


Figure 4.3: *z*-scored AESTHETICS RATING by mouthing

Table 4.7: Presence of a significant interaction between social characteristic and mouthing

Social Characteristic	**Significant Interaction**
DEAF-ID	no
DEAF-FAM	yes
SCHOOL	yes
DEGREE	no
GENDER-ID	yes
REGION	no
CULTURAL-ID	no
CLUSTER	yes
AGE	yes
AOA	no
[1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK	no
[2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME	no
[3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK	no
[4] EXPERIENCE WITH ASL BEFORE SCHOOL	yes
[5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME	no

Table 4.8: Estimates of significant coefficients and confidence intervals

Social characteristic	**Interaction**	**Estimate**	**95% CI**
DEAF-FAM	mouthing[low]*deaf-fam[yes]	3.7	[1.4, 6.03]
SCHOOL	mouthing[low]*school[neither]	7.4	[2.62 12.08]
GENDER-ID	mouthing[low]*gender-id[third]	12.3	[4.50, 20.01]
CLUSTER	mouthing[low]*cluster[cluster3]	4.1	[0.28, 7.74]
AGE	mouthing[low]*age	-0.3	$[-0.44, -0.08]$
[4] EXPERIENCE WITH ASL BEFORE SCHOOL	mouthing[low]*[4] EXPERIENCE WITH ASL BEFORE SCHOOL	1.3	[0.04, 2.62]

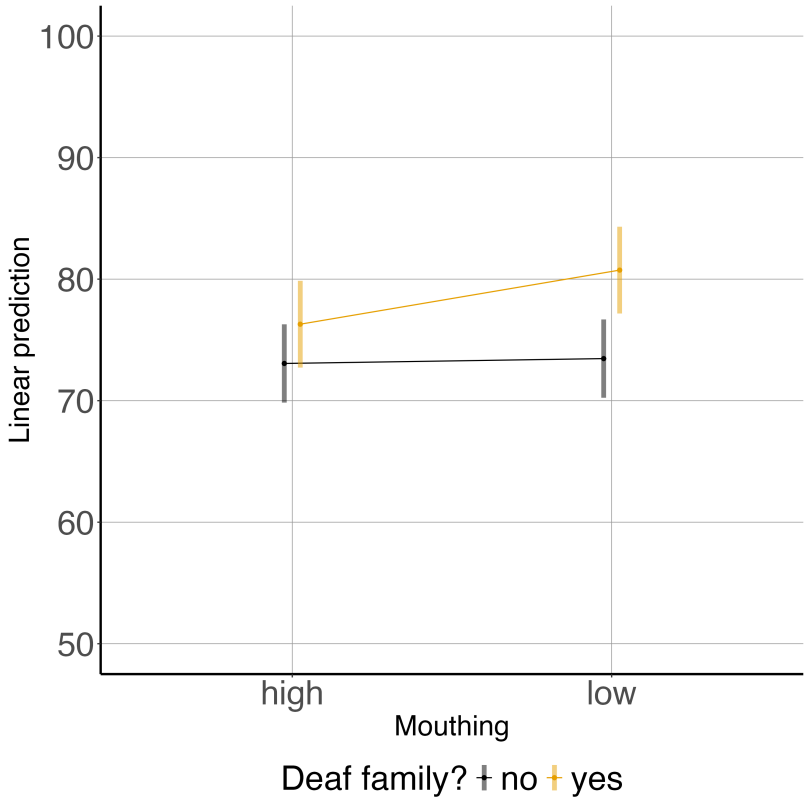


Figure 4.4: Visualisation of predicted interaction between DEAF-FAM and mouthing

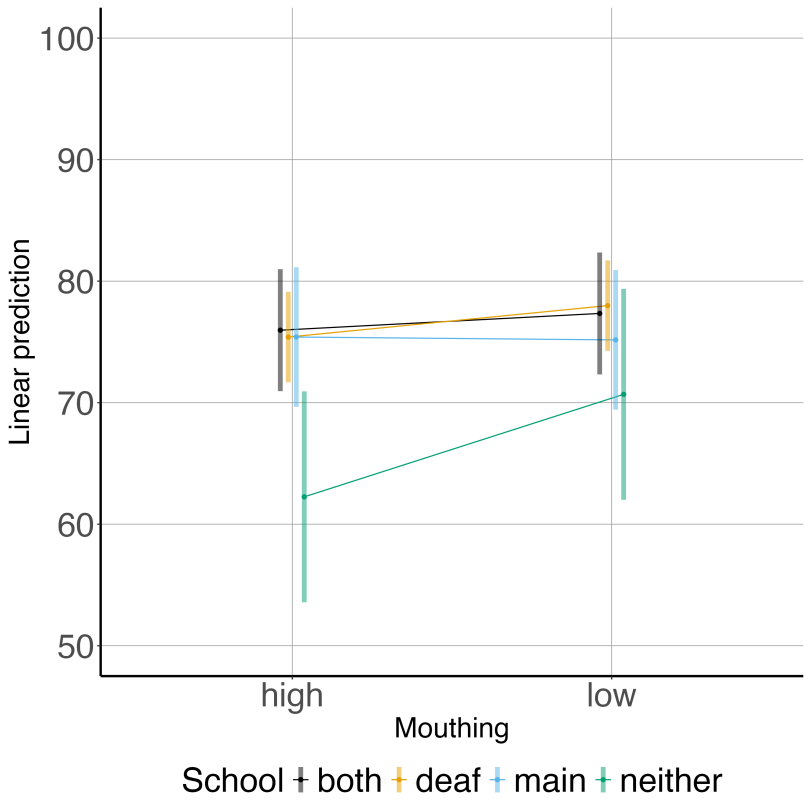


Figure 4.5: Visualisation of predicted interaction between SCHOOL and mouthing

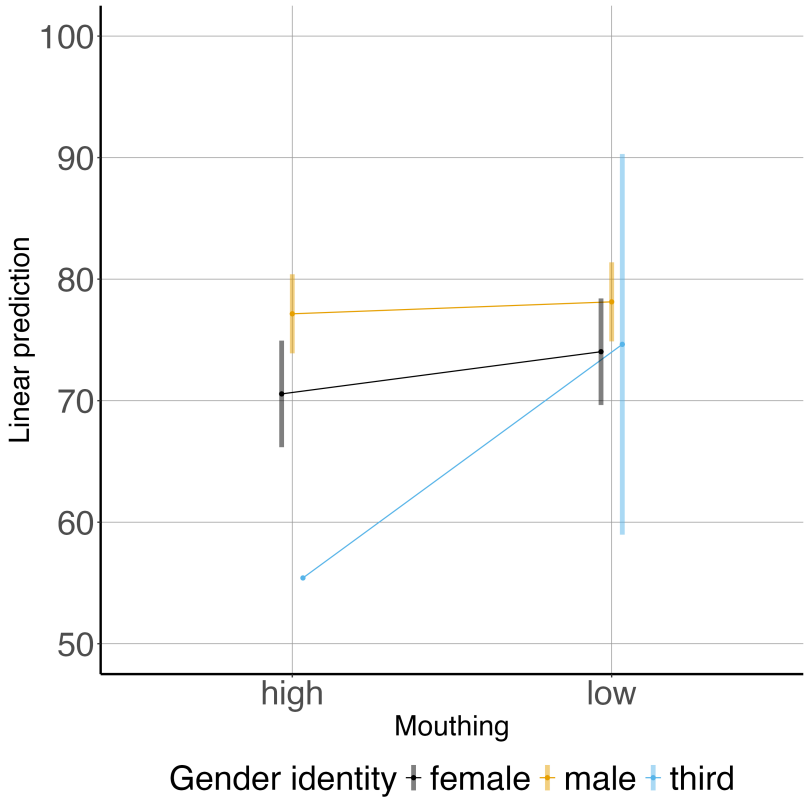


Figure 4.6: Visualisation of predicted interaction between GENDER and mouthing

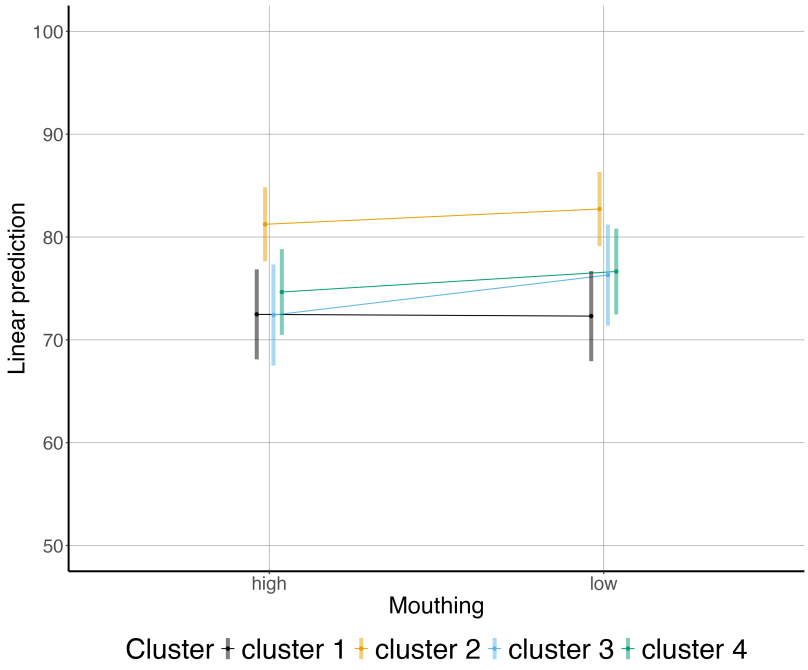


Figure 4.7: Visualisation of predicted interaction between CLUSTER and mouthing

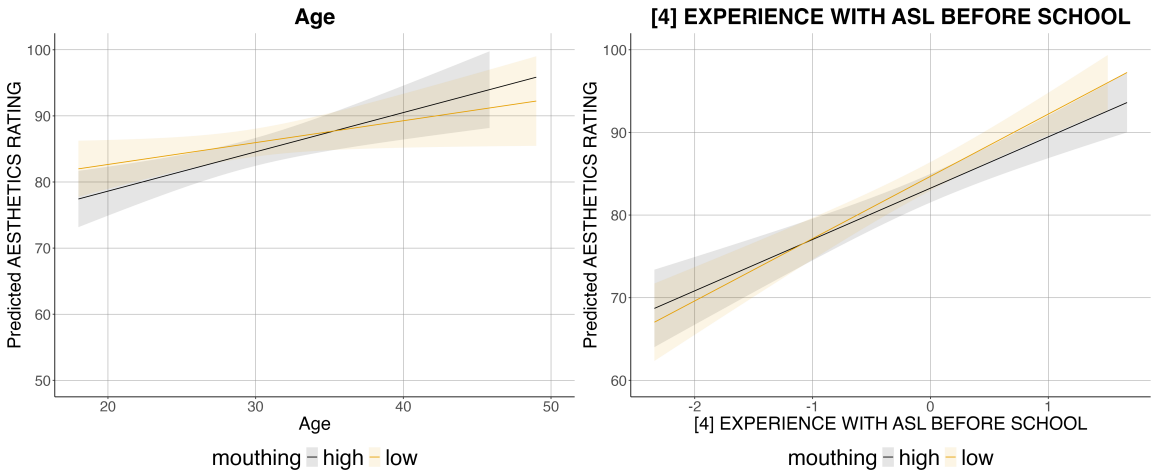


Figure 4.8: Visualisation of models of continuous independent variables of AESTHETICS RATING, AGE and [4] EXPERIENCE WITH ASL BEFORE SCHOOL

Pairwise comparisons for social characteristics were done using `emmeans` to more precisely identify the comparisons in which differences occurred (Lenth, 2023). Those combinations for which $p < .05$ can be found in Table 4.9. Comparisons in which the same mouthing condition (high or low) is being rated differently by different groups are highlighted. These comparisons show that low mouthing is rated differently by participants who grew up with deaf family *vs.* those who did not, and by members of LOWEST SPOKEN ENG INPUT [C1] *vs.* SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2].

Table 4.9: Predicted pairwise comparisons of mouthing*social characteristic where $p < .05$

Category	Comparison	Estimate	SE	z	p
DEAF-FAM	no high *vs.* yes low	−6.5	2.17	−3.01	0.02
DEAF-FAM	yes high *vs.* yes low	−3.6	0.90	−3.94	0.00
DEAF-FAM	no low *vs.* yes low	−6.7	2.17	−3.07	0.01
CLUSTER	[C1] high *vs.* [C2] low	−10.2	2.89	−3.54	0.01
CLUSTER	[C3] high *vs.* [C2] low	−10.3	3.11	−3.32	0.03
CLUSTER	[C1] low *vs.* [C2] low	−10.4	2.89	−3.60	0.01
SCHOOL	neither high *vs.* neither low	−6.9	2.18	−3.20	0.04
GENDER	female high *vs.* male low	−6.9	2.29	−3.02	0.04
GENDER	third high *vs.* third low	−14.2	3.99	−3.56	0.01

Overall the modelling suggests that:

1. AESTHETICS RATING rating is not influenced by aspects of DEAF-ID, DEGREE, GENDER, SCHOOL, REGION, CULTURAL-ID, AOA, [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK, [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME, [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK, and [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME
2. participants who grew up with deaf family rate low mouthing higher than those who did not grow up with deaf family
3. members of SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] rate low mouthing higher than members of LOWEST SPOKEN ENG INPUT [C1]
4. as age increases, rating of low mouthing decreases
5. as [4] EXPERIENCE WITH ASL BEFORE SCHOOL increases, rating of low mouthing increases

4.10 Results: DEAF IDENTITY RATING

DEAF IDENTITY RATING is comprised of the ratings for questions asking how much the sign model reflects a "strong deaf person" and a "deaf community leader" (see Figure 4.9 for distributions). Initially the term "deaf" was also included, but after fitting model (4), it was removed because it behaved differently from the other terms. This aligns with the difference between sociocultural and audiological deafness as the term "deaf" is likely to be more evocative of audiological deafness than "strong deaf person" and "deaf community leader".

(4) `DEAF IDENTITY RATING ~ mouthing*social characteristic + (1|list) + (1|list:participant)`

The presence or absence of a significant interaction for all models is shown in Table 4.10, and the interaction terms and their coefficients are shown in Table 4.11. Significant interactions are present for REGION, CLUSTER and [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK. The models for these social characteristics are visualised in Figures 4.10 to 4.12. The coefficients are all positive. Significant interactions are not observed for DEAF-ID, DEAF-FAM, SCHOOL, DEGREE, GENDER-ID, CULTURAL-ID, AOA, [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK, [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK, [4] EXPERIENCE WITH ASL BEFORE SCHOOL, and [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME.

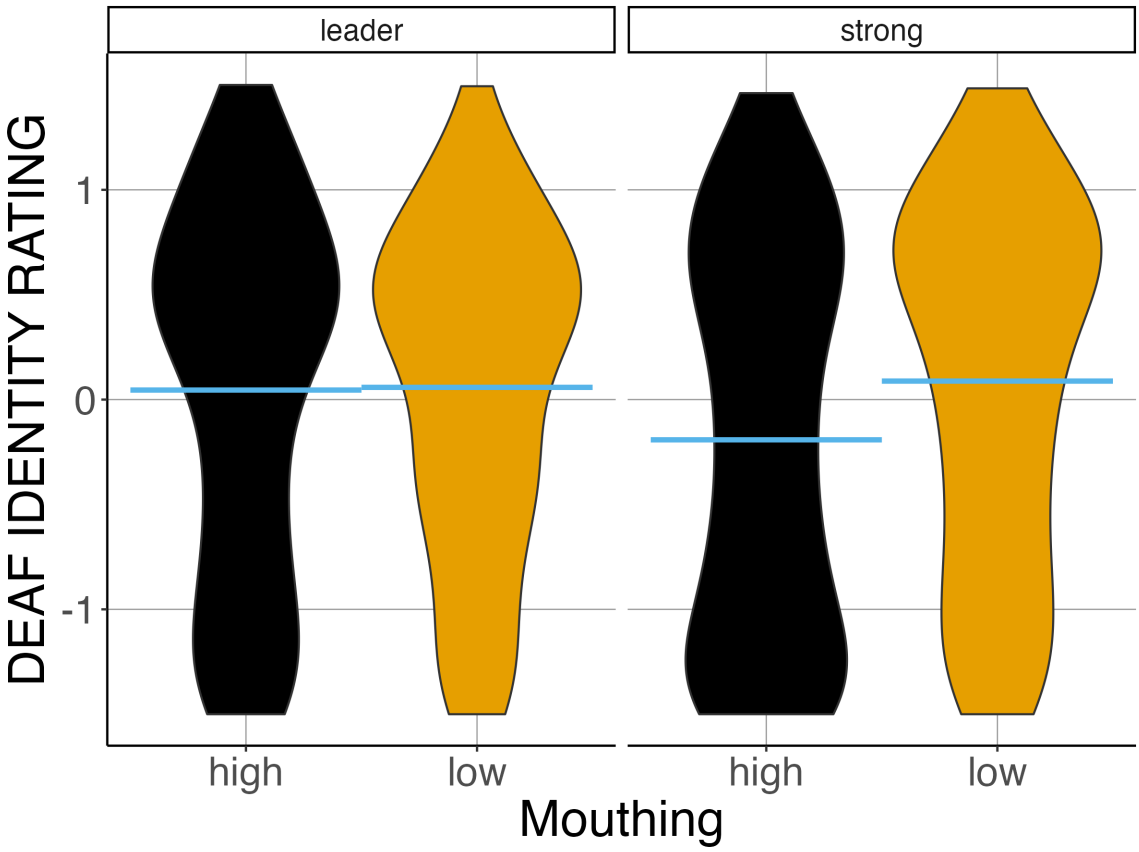


Figure 4.9: DEAF IDENTITY RATING by mouthing

Table 4.10: Presence of a significant interaction between social characteristic and mouthing

Social Characteristic	**Significant Interaction**
DEAF-ID	no
DEAF-FAM	no
SCHOOL	no
DEGREE	no
GENDER-ID	no
REGION	yes
CULTURAL-ID	no
CLUSTER	yes
AGE	no
AOA	no
[1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK	no
[2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME	no
[3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK	yes
[4] EXPERIENCE WITH ASL BEFORE SCHOOL	no
[5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME	no

Table 4.11: Estimates of significant coefficients

Social Characteristic	Interaction	Estimate	95% CI
REGION	mouthing[low]*region[northeast]	6.5	[0.69, 12.24]
REGION	mouthing[low]*region[south]	5.9	[0.68, 10.87]
CLUSTER	mouthing[low]*cluster[C2]	6.4	[1.59, 11.17]
[3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK	mouthing[low]*[3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK	2.5	[0.29, 4.66]

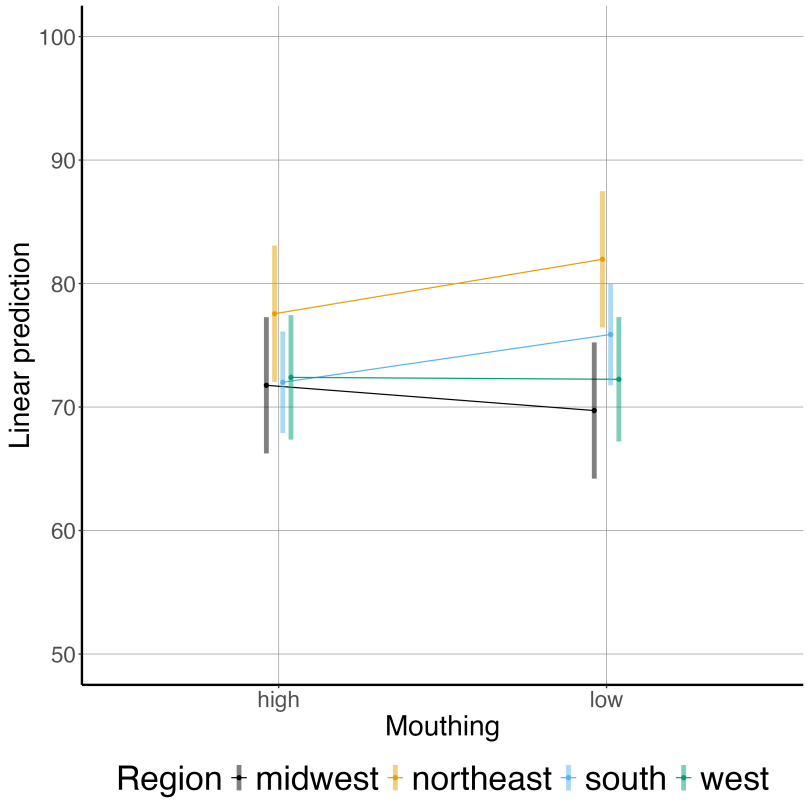


Figure 4.10: Visualisation of predicted interaction between REGION and mouthing

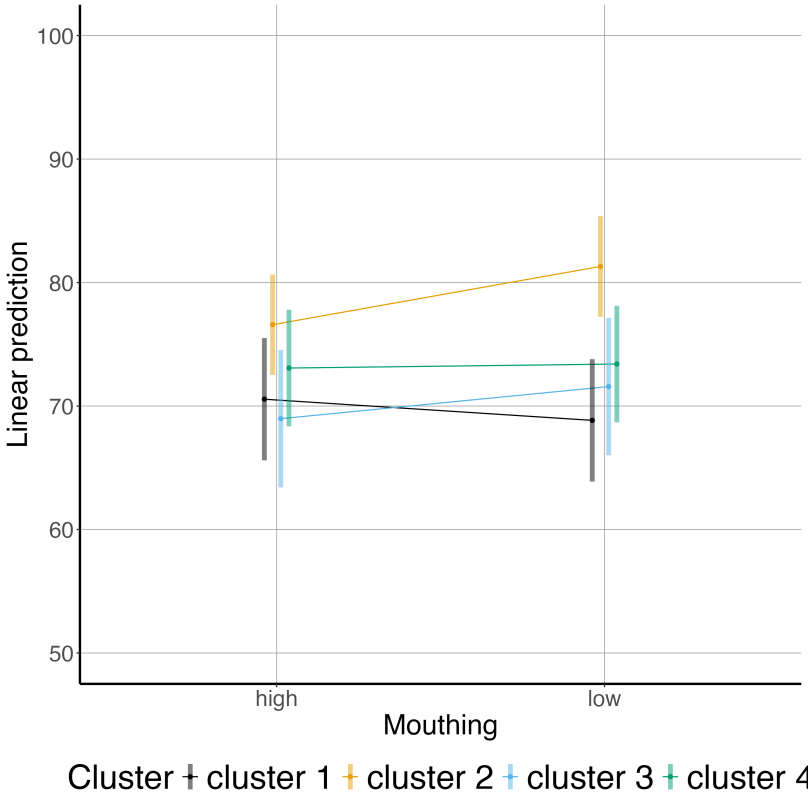


Figure 4.11: Visualisation of predicted interaction between CLUSTER and mouthing

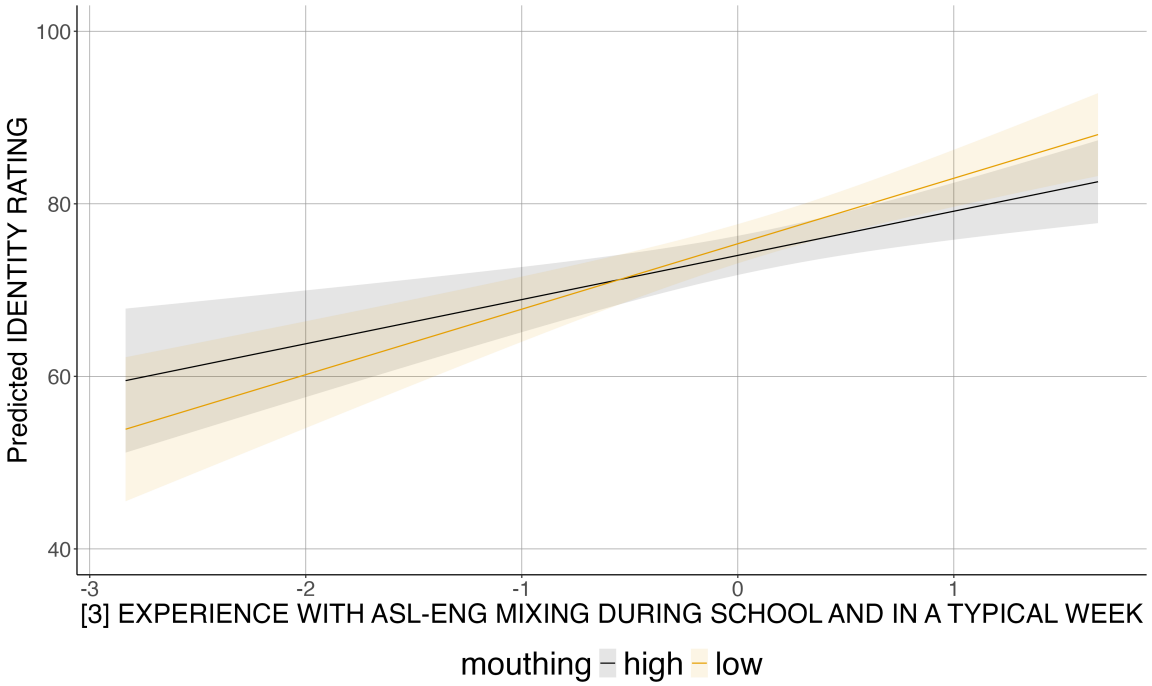


Figure 4.12: Visualisation of models of continuous predictor of DEAF IDENTITY RATING, [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK

Pairwise comparisons for CLUSTER and REGION were conducted. Those combinations for which $p < .05$ are listed below by social Characteristic, with interpretable comparisons highlighted. Only members of clusters 1 and 2 are shown to rate low mouthing differently.

Table 4.12: Predicted pairwise comparisons of mouthing*social characteristic where $p < .05$

Category	Comparison	Estimate	SE	z	p
CLUSTER	C1 high *vs.* C2 low	−10.8	3.27	−3.29	0.03
CLUSTER	C3 high *vs.* C2 low	−12.3	3.52	−3.51	0.01
CLUSTER	C1 low *vs.* C2 low	−12.5	3.27	−3.81	0.00

Overall the modelling suggests that:

1. DEAF IDENTITY RATING is not influenced by aspects of DEAF-ID, DEGREE, GENDER, SCHOOL, REGION, CULTURAL-ID, AOA, [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK, [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME, [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK, and [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME

2. members of SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] rate low mouthing higher than members of LOWEST SPOKEN ENG INPUT [C1]

3. as [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK increases, rating of low mouthing increases

4.11 Discussion

This section situates the findings within the research questions and discusses the implications that arise out of them.

4.11.1 The statistical utility of CLUSTER is theoretically aligned with holistic characterisations of language users

CLUSTER emerges as a key independent variable, correlating with both AESTHETICS RATING and DEAF IDENTITY RATING. In both cases, the interaction arises from differences between LOWEST SPOKEN ENG INPUT [C1] and SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2]. In terms of social characteristics,

key differences between LOWEST SPOKEN ENG INPUT [C1] and SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] are: (i) members of LOWEST SPOKEN ENG INPUT [C1] are more likely to have attended deaf schools only while members of SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] are more likely to have attended deaf schools and other schools and (ii) members of LOWEST SPOKEN ENG INPUT [C1] are more likely to not have pursued education beyond a high school diploma, while members of SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] are more likely to have done so, and (iii) members of LOWEST SPOKEN ENG INPUT [C1] report the greatest experience with forms of English that are not necessarily aural, while SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] report the least. Apart from this, members of LOWEST SPOKEN ENG INPUT [C1] are more likely to identify as deaf and to have grown up with deaf family, while members of SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] are more likely to identify as female. These patterns suggest that school types attended and amount of formal education may *together* correlate with evaluation, as, on their own they do not show a significant interaction with mouthing for neither AESTHETICS RATING nor DEAF IDENTITY RATING.

Given the caveat that there is variation within clusters, the findings suggest that attitude may correlate more strongly with the confluence of multiple social characteristics and language experience. Theoretical starting points are intersectionality and personae approaches to variation, though they more directly target identity than CLUSTER. Recall that clusters were solely defined on language experience (see Section 3.4), and are not necessarily social types recognisable within the DHH community in the United States. Intersectionality arose as a theoretical lens in legal studies, with Kimberlé Crenshaw showing that unidimensional analysis of race and gender erases the experiences of multiply-marginalised groups, namely black women (Crenshaw, 2013). A core idea is that macro-social categories like gender or cultural identity do not exist on their own, but arise out of their existence with other macro-social characteristics; however, in linguistics intersectionality is more aligned with general multidimensionality (Levon, 2015; Calder & King, 2020)[6]. Personae have been framed as a means of operationalising intersectionality (King, 2021). They are multidimensional but explicitly linked to ideology and idiosyncratically bring together multiple social characteristics that may align more or less with macro-social categories. Recall that the Valley Girl persona

[6]See also Tripp (2023) on intersectionality as a means of achieving justice in applied psycholinguistics.

brings together region, gender, race, and socio-economic status, as well as being associated with materialism and superficiality (D'Onofrio, 2015, 243).

That CLUSTER correlates with evaluation, but individual variables that are significantly associated with clusters do not, suggests that CLUSTER may identify useful social profiles that mark more than the simple combinations of their parts. That is, the clustering approach might be oriented to intersectionality in its original sense, and not simply multidimensionality. Note that the clusters themselves do not necessarily map on to recognisable profiles or stereotypes within the DHH community in the United States. Similar thinking is found in the quantitative study of health inequity where clustering methods are used in studies that invoke intersectionality (Bauer et al., 2022). Latent variable analysis like latent class analysis and latent profile analysis are also used in studying health inequity, which suggests that they may also be useful in studies like this one. A notable difference in health inequity studies reviewed in Bauer et al. (2022) and the present study is the former base their analyses on social characteristics *and* experiences of stigmatisation, while the present study made groupings based on language experience only. Future analysis then should more explicitly include social characteristics in cluster identification, and should consider experiences of oppression more directly (Tripp, 2023). Questions that can collect information about social power among DHH signers in the United States should also be identified for inclusion in analysis.

Additional research, particularly of the ethnographic or qualitative kind would be crucial to identifying such profiles, as they are better suited to identifying ideologically constructed categories. Looking to media representations of DHH heterogeneity may be useful way of identifying behaviours that are metapragmatically salient. An example would be the sketch comedy YouTube channel "Deafies in Drag", and videos like "5 Types of Deaf People" (`Mhttps://youtu.be/UcbJk0D3TIc?si=aJJCsyr1PIfsjtd0`) that identify and linguistically represent profiles of DHH community members.

4.11.2 Less English mouthing is slightly preferred in ASL signing

A core implication of the modelling is that it shows that low mouthing is rated significantly higher for AESTHETICS RATING and DEAF IDENTITY RATING. This finding provides quantitative evidence for the intuition that mouthing is viewed slightly more negatively among DHH ASL signers in the United States, reported in qualitative ASL research, and supports the argument that mouthing marks a less

authentic ASL (Section 4.2). This adds crucial evaluative context to production studies that report differences in use of mouthing based on age-of-acquisition of ASL and having a deaf parent (Herbert & Pires, 2017; Lindeberg, 2022). It suggests that differences in production of mouthing do not map straightforwardly on to attitudes about mouthing. Stated differently, individuals who produce different quantities of mouthing may have similar attitudes about mouthing, and vice versa.

Despite the significant difference in rating of high *vs.* low mouthing, it is crucial to note that high mouthing is still rated relatively positively for AESTHETICS RATING and DEAF IDENTITY RATING. Mean ratings fall between 70 and 75 on a 0–100 scale, and effect sizes are small ($<$ 10 unit differences) (recall Tables 4.8 and 4.11). The effect sizes are especially interesting as perceivers of sign language stimuli in video format tend to fixate on the lower face/mouth (Mastrantuono et al., 2017). If region of fixation is assumed to mean greater attention, then one might expect that perceivers would have been particularly attuned to mouthing differences, resulting in larger differences between high *vs.* low mouthing. However, this is not the case. It appears then that there is a preference for less mouthing, but that mouthing is generally acceptable in ASL signing in the United States. This nuances discussions of orientation to mouthing in sign languages not found in overviews like Bisnath (2024) – specifically that preferences may emerge in comparison, but that this does not mean that less preferred structures are unacceptable.

Two potential methodological explanations for the small effect sizes observed is the artificiality of high and low mouthing stimuli, and the difficulty that the stimulus models had in producing it. Recall that in the high mouthing stimuli, mouthing occurs on all signs while in the low mouthing stimuli, the intention was for mouthing to not appear with any sign, but some mouth movement did still occur. In more naturalistic signing, mouthing would be differentially associated with grammatical properties, like grammatical category or discourse context (Nadolske & Rosenstock, 2007), and would also vary based on assumptions made about interlocutors. Low mouthing might have been down-rated, thus pushing it closer to the ratings of high mouthing, though this explanation does not account for why the ratings appear on the higher end of the evaluation scale.

The interpretable pairwise comparisons suggest that groups vary in how they rate low mouthing, and not high mouthing. This suggests that there is greater agreement across the sample in AESTHETICS RATING and DEAF IDENTITY RATING of high mouthing compared to low. Why might this be? A potential explanation is the dominance of English in the United States and the minoritised nature of

deafness. Signers may be more used to seeing ASL produced with mouthing, as opposed to without, which may result in more stable evaluation of high contact ASL, as opposed to a more unusual ASL without any mouthing. If this is the case, then this suggests that frequency/familiarity on its own does not correlate with evaluation and/or that such effects work differently for members of minoritised groups perceiving a form associated with a majoritised variety. One potential way of getting at this notion in future studies is to measure the forms of ASL that participants encounter the most.

4.11.3 Evaluation of mouthing correlates with some but not all social characteristics of perceivers

This study assumes that evaluation of language is mediated by social characteristics of perceivers, that is their macro-social characteristics and language experience. Robust regression modelling shows that this is the case for mouthing in ASL – evaluation of high *vs.* low mouthing correlates with age, experience with ASL before entering school, experience with ASL-English mixing during school and in a typical week, growing up with deaf family or not, and cluster membership. However, these characteristics do not equally correlate with AESTHETICS RATING and DEAF IDENTITY RATING. Groups within CLUSTER are the only ones that show differences in evaluation of signing aesthetics and deaf identity – members of SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] rate low mouthing higher than members of LOWEST SPOKEN ENG INPUT [C1]. Differences in growing up with deaf family correlate with AESTHETICS RATING, as does age, and experience with ASL before entering school, while experience with ASL-English mixing only correlates with DEAF IDENTITY RATING. All independent variables correlate positively with evaluation of low mouthing, apart from age, thus the older a signer is, the lower they rate low mouthing.

4.11.4 AESTHETICS RATING correlates with early language experiences and age

AESTHETICS RATING appears to be driven by experiences during early life as growing up with deaf family and experience of ASL correlate with it. Participants who grew up with deaf family evaluate low mouthing higher than those who do not, and as experience with ASL increases, so does rating of low mouthing. These findings are compatible with each other as one might expect that individuals who have deaf family would have been exposed to ASL earlier, and thus report greater

experience with ASL. This account is also consistent with ASL being disassociated from features that index spoken language, argued for in Section 4.2, and that such ideas may come from people who are more aligned with deaf cultural identity. Interestingly, age-of-acquisition does not correlate with AESTHETICS RATING; however, this might be because the sample did not include many participants who had begun acquiring ASL before age three or five. Such participants are not common in DHH communities, and so oversampling would have been necessary.

The importance of aspects of early acquisition suggests that studies of ASL perception that make comparisons that involve these axes are invoking evaluation. This implies that orientation toward linguistic forms should be explicitly included in studies of sign language perception. This clearly applies to mouthing, and may also extend to other phenomena that mark orientation toward or away from authentic deafness and/or ASL use. A second implication is that participants who differ in deaf family and experience with ASL before entering school may differ in how sensitive they are to variation. This expectation is motivated by the social nature of perception discussed in Section 4.3, and Loudermilk (2015)'s suggestion that perceivers with more negative attitudes to a form may be less sensitive to variation in that form at the neural level.

Age also correlates with AESTHETICS RATING, with participants below 35 rating low mouthing higher than high mouthing, and vice versa for participants above 35. Taking the Apparent Time construct (Labov, 1963), which takes older and younger community members as representations of earlier and later stages of a language respectively, this kind of change could be interpreted as suggesting that attitudinal change, potentially driven by changes in deaf education and efforts at promoting ASL, is underway. However, given the nature of the data, it could also be that individuals' attitudes change over time, referred to as age grading in sociolinguistics literature (Wagner, 2012) – that is people are less tolerant of mouthing when they are younger but become more so as they become older. To distinguish between the two, it would be necessary to compare evidence from the present with that from the past, which could be done with longitudinal studies (Wagner, 2012).

4.11.5 DEAF IDENTITY RATING correlates with self-reported experience with ASL-English mixing

Outside of cluster membership, DEAF IDENTITY RATING only correlates with experience with ASL-English mixing – as participants report more experience mixing, rating of low mouthing increases. Questions about mixing do not specifically

pinpoint mouthing, and thus it is likely that participants did not only think of mouthing when answering; however the findings suggest that English mouthing is emblematic of ASL-English mixing in the DHH community in the United States, and that there is variation in how emblematic it might be. Correlations with the notion of mixing further suggest that authentic deaf identity is marked by lower use of English mouthing and more generally, lower use of English contact features. This is tested and discussed in more detail in Chapter V.

4.11.6 Insignificant independent variables may need to be examined at a more granular level

The analysis shows that the majority of independent variables tested do not correlate with evaluation. This can be explained in two ways: that the variables tested do not correlate with evaluation, or that the levels within each variable are not the right ones. The latter position is more conservative and likely given previous literature (recall Section 2.5) and the contrasts tested in this study. For instance, this study did not make a late deaf category explicitly available for selection (though participants could have identified themselves as such using the "other" category). The same can be said about the school categories that were made available. Even for characteristics that did show significant interactions like DEAF-FAM, more nuance could have been allowed for. The DEAF-FAM characteristic was identified using a yes/no question that asked if the participant had grown up with deaf family. However, Mitchell & Karchmer (2004b) finds differences in deaf children's linguistic behaviour based on if their parents are deaf *vs.* hard-of-hearing. It would also be useful to ask directly about siblings, as older deaf siblings can provide sign language input to younger ones Power & Meier (2023) (see also German, 2021, on differences in use of Zinacantec Family Homesign among siblings).

4.12 Conclusion

This chapter set out to quantitatively characterise evaluation of mouthing in ASL in terms of aesthetics and deaf identity, and to investigate how evaluation varies with the social characteristics and language experience of perceivers. These goals are motivated by the limited research done on evaluation of English mouthing in ASL, and by the spoken language sociophonetics literature that shows that perception of language varies with characteristics of the perceiver. Characterisation of the data using robust regression modelling suggests that mouthing may be viewed

negatively in ASL and oriented away from deaf identity, as higher mouthing is rated lower compared to signing aesthetics and sociocultural deaf identity. However, the difference in rating of high *vs.* low mouthing is small, and ratings are overall high, indicating that high levels of mouthing may be acceptable in ASL. The results also show that evaluation of mouthing varies with perceiver characteristics. Specifically, experiences in early childhood and age correlate with evaluation of aesthetics, and self-reported experience mixing ASL and English correlate with evaluation of deaf identity. This variation in evaluation along perceiver characteristics suggests that studies of sign language perception should account for signer beliefs about linguistic forms under consideration, and consider differences among signer in a more gradient way, as opposed to contrasting narrowly-defined categories. Language experience profile, as characterised by cluster membership, emerges as a potentially key correlate of evaluation generally, as it correlates with both aesthetics and deaf identity ratings above and beyond individual social characteristics and measures of language experience. This suggests that CLUSTER may be a starting point for a holistic, intersectional approach to sign language perception that could be more statistically useful than uni-dimensional variables.

CHAPTER V

Measuring English-ASL Mixing and its Correlation with Evaluation

5.1 Introduction

The previous chapter examined how English mouthing is evaluated in ASL, and if and how social experiences of perceivers correlate with this evaluation. The principal component that targeted language mixing, hereafter [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK, emerged as correlating with deaf identity rating – as self-reported experience with mixing increases, preference for low mouthing over high increases. Recall that [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK is a composite variable comprised of self-reported experience of producing ASL-English mixing in a typical week and during school and being exposed to the same, and being exposed to signed ASL (Table 3.5). The findings of Chapter IV support the argument made in Section 4.2, that authentic use of ASL and deaf identity are tied to each other, and use of English mouthing marks orientation away from both. That experience of language mixing correlates with evaluation of deaf identity (DEAF IDENTITY RATING) and *not* aesthetics (AESTHETICS RATING) opens up the research questions listed below. These questions are examined in terms of participants' perception of the feelings of authority figures about mixing ASL and English, their own orientation, and language experience with mixing.

1. How does AESTHETICS RATING correlate with language mixing measured in different ways?

2. How does DEAF IDENTITY RATING correlate with language mixing beyond [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK?

5.1.1 Organisation

This chapter begins by situating language mixing in linguistic purism, thus motivating why a relationship between beliefs about and use of mixing, and evaluation might be expected (Section 5.2). The section that follows identifies and motivates how mixing is targeted. Expectations about relationships between AESTHETICS RATING and DEAF IDENTITY RATING and mixing variables are then discussed (Section 5.4). A review of the method follows (Section 5.5), with the analysis and results (Section 5.6), discussion (Section 5.7), and conclusion (Section 5.8) respectively coming next. The analysis and results begin by showing that participant beliefs about mouthing and mixing align with this study's.

5.2 Correlating orientation to language mixing and attitude

This section motivates examination of beliefs about language mixing in relation to evaluation of mouthing in ASL. The reasons for targeting language contact through the concept of mixing in survey questions are explained in Section 5.2.1. Section 5.2.2 briefly overviews linguistic purism, shows that beliefs about language mixing are linked to purism, and exemplifies how the aforementioned beliefs correlate with behaviour.

5.2.1 Terminological motivation

When discussing language mixing during survey development, Sonya Carter (SC) suggested that the term for "Simultaneous Communication (Sim-Com)" be used instead of more general English-ASL mixing, but this was not pursued ultimately. Sim-Com, like English mouthing in ASL, is the simultaneous use of English and ASL resources, but differs from how I wanted to conceptualise the stimuli in this study. My aim was to avoid potential shibboleths of English influence in the manual component to better focus on mouthing as the locus of contact. Sim-Com is characterised as following English word order at the manual level, and specifically that associated with Pidgin Sign English (PSE),[1] or a manually-coded form of English like Signed Exact English (SEE) (Coryell & Holcomb, 1997). Some signers do not perceive themselves as fully understanding Sim-Com – in a group of 38

[1] "PSE is a nebulous category and a misnomer based on the definition of pidgin... [but] is a popular term used in the American deaf community to refer to someone who signs more English" (Joseph C. Hill, Juy 6th 2024, personal communication).

individuals at Gallaudet University, 11 believed that they understood more than 50% of a message conveyed in Sim-Com, 14 believed they understood 50%, and 11 25% of the message (Tevenal & Villanueva, 2009).

A more typical term associated with language contact in spoken languages like "code-switching" was not used because the "switching" component might suggest linear, non-overlapping alternation that does not align with the simultaneous nature of (congruent) mouthing. Recall that congruent mouthing is mouthing that can be glossed in the same way as the manual sign that it is being articulated over (Bisnath, 2024). In more naturalistic signing, this kind of mouthing may appear in transitions between manual signs; however, the mouthing in the stimuli created for this study was not designed to do this (refer to Chapters II and IV). Code-switching was also not used to avoid eliciting its folk conception. This conception, though primarily referring to language, may also include a more generalised change in persona towards behaviour that might be considered more or less professional or proper (Harrington et al., 2022), which are not the explicit targets of this study. "Code-blending" is another option that has been used to mark the simultaneity of mouthing as in Emmorey et al. (2005) and Herbert & Pires (2020); however, it is unlikely to be known outside of sign language linguistics.

5.2.2 Language mixing and linguistic purism

Orientation to language mixing has ties to linguistic purism, which is an ideology of actively keeping languages free of certain elements. Purism can be directed at removing any forms that are unwanted or perceived as foreign. It may also be aimed at returning a language to an "original" state, which may be represented by a time before perceived contamination or with the language use of community elder (Dorian, 1994; Langer & Nesse, 2012). In Section 4.2, I argue that true ASL is linked to the linguistic behaviour of "native" users.

Ideas of foreignness are straightforwardly linked to language contact, with negativity to code-switching reflecting purism. Among Spanish-English bilinguals in Texas, USA border towns, switching between English and Spanish receives lower ratings than English and Spanish on their own (Rangel et al., 2015). Increasing contact is also viewed as increasingly worse. Monolingual Spanish, for example, is evaluated most positively followed by lexical insertions of specialised English vocabulary, and lastly insertions of core English vocabulary among Spanish-English bilinguals in the United States (Anderson & Toribio, 2007). This negativity correlates with behavioural measures. Spanish-English biliguals classified

as viewing code-switching very positively rate code-switched sentences higher than those classified as having mildly positive or very negative attitudes. Those with more positive attitudes also rated *some* forms of code-switching significantly higher than those who were less positive (Badiola et al., 2018, 15–16) (see also Toribio, 2002). In contrast to this, Dutch-Papiamentu bilinguals in the Netherlands and Curaçao attitudes' to code-switching do *not* correlate with their accuracy on an auditorily-presented sentence-matching task, but participants with negative attitudes showed slower response times, which might indicate slower processing (cf. Loudermilk, 2015).

For minoritised languages, purism may be favoured by language activists but can have deleterious effects on language maintenance and the perception of users perceived as inauthentic. Daniel (2023) argues that purism is necessary in maintenance. However, when authentic use of a language is tied to elders in indigenous communities, younger users might be discouraged from using the language (Loether, 2009; Scheller, 2013) or restrict their use to interactions with elders (Meek, 2007; Gomashie, 2020). This can thwart maintenance efforts as younger users are needed to ensure that languages persist in time.

In sign language communities, purism is motivated by a desire to maintain languages by excising contact phenomena with links to other modalities (Moriarty, 2020) (see Kusters, 2020, for a discussion of purism ideologies between sign languages). This arises from the general minoritisation of deafness and sign languages in broader society and the stigmatisation of sign languages in deaf education (Keating, 2003; Moriarty, 2020). In sign language linguistics, purism is linked to legitimising sign languages by showing that they are not simply manual forms of spoken languages (Brentari & Padden, 2001). It may also be linked to the connection between authentic ASL use and deaf identity argued for in Section 4.2 and the related finding that lower mouthing is rated higher for deaf identity than more mouthing.

For DHH individuals who face sign language deprivation, reification of purity is stigmatising, as it can frame certain sign language users as without language (Moriarty, 2020)[2]. It can also stigmatise certain forms, like initialisations in ASL, which have been explicitly identified as "foreign" or "non-native" (Brentari & Padden, 2001) and a target of linguistic purism (Moriarty, 2020)[3]. For instance,

[2]This is also the case for ideologies of languagelessness ascribed to the bilingual practices of racially minoritised groups, like the use of Spanglish by Latino/as in the United States being framed as a lack of competence in *any* language (Rosa, 2016).

[3]Initialisation is the use of manual alphabet handshapes derived from English spelling in signs,

Keating (2003) describes teachers at Gallaudet University aiming to eliminate initialisations perceived as unnecessary. English mouthing is expected to be viewed similarly, and perhaps to a greater extent as evidenced by negative commentary about English mouthing in ASL, and other sign languages, and in the general lack of discussion of mouthing (Bisnath, 2024).

5.3 Targeting beliefs about mixing

The list below identifies and categorises how participant beliefs about mixing are targeted in this study. Recall from Chapter II that a methodological design goal was to center language contact, which motivated asking about experiences with ASL-English mixing. The list below does not reflect the order in which questions were asked (refer to Section 2.1 for full chronological order). Relative to the questions analysed in this chapter, participants would have responded to those about comfort first, followed by feelings of authority figures at home, feelings of authority figures at school, and finally use of mouthing. When participants gave a response about the latter, they had been given a definition of what mouthing was. Each question analysed in this chapter was embedded in a larger set of questions that were thematically-related. Thus, participants were asked multiple questions about their comfort with ASL and English, about authority figures in their home, and so forth (refer to Chapter II).

Questions asked about beliefs differ in how explicitly they might target feelings about language. Those about perceived beliefs of adult authority figures explicitly ask about feelings, while those targeting use of mouthing do not. Questions about comfort are viewed as simultaneously and inseparably evoking language use and feelings. The motivations for targeting beliefs in this way are detailed in sections 5.3.1 and 5.3.2.

1. Perceived beliefs of authority figures (Table 5.1)
    - feelings of authority figures at home
    - feelings of authority figures at school
2. Participant beliefs (Table 5.2)
    - use of mouthing

like the use of the F-handshape in the ASL sign FAMILY.

- comfort mixing English and ASL
- comfort understanding a mix of English and ASL

5.3.1 Perceived beliefs of adult authority figures

Perceived beliefs of authority figures in this study are those that have to do with the beliefs of authority figures in the home and school (see Table 5.1). The orientation of these authority figures may be a proxy for language attitude and experience – if these figures are positively oriented to mixing, they are expected to create environments that promote mixing, and minimally to not actively discourage mixed language use. Parents and teachers are discussed as reference points for adult authority figures in the home and school respectively, but note that these terms were not explicitly used in survey questions. The more general "adults in charge"/ADULT HEAD-IN-CHARGE in ASL was used as parents and teachers are not necessarily the only influential actors at home and school.

No.	English translation of question	Measurement
q79	*How did the adults in charge at home feel about you mixing English and ASL?*. View ASL here: `Mhttps://youtu.be/VCxUMeXpxkg?si=d_xspy_8geTEn72B`	continuous 0–100 scale, qualitative: not happy, neutral, happy
q99	*Think about all the schools you went to. How did the people in charge feel about you mixing English and ASL?* View ASL here: `Mhttps://www.youtube.com/watch?v=YY9gHb9jxsE`	continuous 0–100 scale, qualitative: not happy, neutral, happy

Table 5.1: Survey questions about the perceived beliefs of adult authority figures

This section provides a rationale for targeting adult authority figures in the home and school as potential sources of beliefs about language. It also identifies multiple intervening complexities that may make finding statistical support for relationships between authority figure orientation and participant orientation difficult.

5.3.1.1 Experiences linked to parental figures

Authority figures in the home, like parents, influence child language outcomes (see also German, 2024, on referencing authority figures in navigating sign language use). Parents who are users of marginalised languages, like African Ameri-

can English in the United States or Creoles in the Caribbean, are known to encourage their children to speak "properly" (Harrington et al., 2022) or to align with dominant languages (Paugh, 2001). The following quote about use of Kwéyòl/Patwa *vs.* English in Dominica shows a father requiring use of English in the home to the extent that even in adulthood his son does not feel comfortable using Patwa with his father.

> "we couldn't speak Patwa at home. Because my father would see to it that we speak English in the home and then up to now as big - as I am married, I cannot look at - and he's old! He's 83, yes, and I cannot look at him and converse with him in Patwa. I find its difficult for me to do because that was not customary." (Paugh, 2001, p.178)

The situation for DHH children has some parallels with language learning in migrant groups and for new speakers; however, there are additional complicating factors. New speakers are "individuals with little or no home or community exposure to a minority language and instead acquire it through immersion or bilingual education programs, revitalization projects or as adult language learners" (O'Rourke et al., 2015, 1). Like immigrant children, DHH children may be culturally different from their parents, and like new speakers, their acquisition of a certain languages may be tied to access to resources outside the home. For DHH children, there are additional complications arising (minimally) from the deaf status of parents, awareness of deafness and deaf culture, and interaction with healthcare. It is also important to consider the parents' and child's access to aural information, as deafness can be inherited (Mitchell & Karchmer, 2004a), and access influences decision making (Li et al., 2003). These differences create multiple sources of variation in how parental attitudes might relate to child language outcomes and attitude not present in the hearing population[4]. Children who grow up with at least one deaf parent are more likely to be born with lower access to aural information, and to be exposed to more signing in the home, while children who grow up with hard-of-hearing parents are more likely to be born with greater access to aural information, and lower exposure to signing at home (Mitchell & Karchmer, 2004a). Within hearing parents, there are differences in orientation to deafness and use of manual language (Nash, 1975). Hearing parents may not be able to fully grasp the deaf condition according to Nash (1975), but if they are positively oriented toward

[4]This is also linked to the heterogeneity of DHH language acquisition and experience that is captured to an extent in Chapter IV.

sign language use enough to learn a sign language themselves, their children can meet the same developmental milestones as those growing up with deaf signing parents (Caselli et al., 2021a; Berger et al., 2024). Positive orientation on its own is not enough though, as access to information and resources like language classes for parents do influence linguistic outcomes, and are not equally accessible (Allen, 2002; Lieberman et al., 2014; Cioè-Peña, 2020).

5.3.1.2 Experiences during school

Experiences during school are particularly important for DHH individuals, as schools may be the first place that they may learn a sign language, develop connections to deaf communities, and meet deaf adults. Teachers are responsible for carrying out the educational goals of schools, and the means in which they do so can directly influence their students' language practices and beliefs. Lee & Cole (2024) conceive of teachers as "street-level bureaucrats", who are the mediators of public policy, and whose ideologies influence how policy is manifested. A powerful illustration of this can be found in the following description of student experiences at an oral school, the Mary E. Bennett School for the Deaf (MEB), in California, USA from 1950–1959.

> "Howard shared his first experience at MEB as a first-grader: 'I entered the classroom and I signed, HELLO! The teacher walked to me and she slammed my hand with a ruler. She said, "Never sign HELLO". She told me to vocally speak HELLO.' Ruben described a similar situation in his first few days at MEB. He signed during recess and was caught. A teacher took him into a classroom and used a ruler to hit the back of his hands. Baffled, he said nothing until later when he asked other students and learned this was a common occurrence. He said, 'I realised we weren't allowed to sign. So I accepted it, I accepted it. Days went by. I went outside and played. It was quiet. Quiet. It was always the ORAL method.'" (Macias, 2018, 281)

This quote identifies teachers as a potential source of language-related trauma, as students experienced physical punishment and confusion around signing[5]. Such experiences can result in the development of negative associations with spoken and/or sign language use. This is also found in more contemporary educational

[5]Note that physical violence in the context of the United States is more likely to have been experienced by older signers.

contexts inside and outside of the United States. Signers of the ASL variety used in New Mexico came to believe that it was inferior after attending Gallaudet University and being exposed to the more prestigious Gallaudet variety of ASL (Player, 2023). Similarly, migrants to Sweden learning Swedish Sign Language (STS) come to downgrade their view of the languages and communicative means they used before migration in part due to their teachers' apparent ideology that STS is the only legitimate sign language (Duggan & Holmström, 2022).

Crucially, the beliefs of teachers may be directly referenced in linguistics studies targeting linguistic variation. This is found in a perceptual dialectology study of New Mexico, USA in which a participant reflected the beliefs of their teachers as in: "The participant recalled that white school officials perceived NMSD [New Mexico School for the Deaf] as having the best signing model, whereas Western and Southern regions of New Mexico did not provide good signing models for NMSD students" (Player, 2023, 41) (see also lower rating of singular "they" linked to prescriptiveness (Bradley, 2020)).

The orientation of teachers toward linguistic varieties may also be more informative than the broad school type attended. Recall from the previous chapter that the deaf *vs.* mainstream contrast did not predict evaluation of mouthing. A potential reason is that teachers of deaf students will differ in their deaf identity, and in their commitment to schools' educational policy. For instance, the quote above shows teachers using physical means of enforcing spoken language use, but at the same school and time, other teachers covertly used sign language resources like fingerspelling with students (Macias, 2018). Note however, that clandestine sign language use itself is likely to contribute to beliefs about language use. For instance, it might signal that sign language use is something to hide or a last resort, or alternatively mark in-group membership.

5.3.2 Participant beliefs about language mixing

Table 5.2 identifies the questions used to target participant beliefs about mixing. These questions vary in how evocative of language ideology they are assumed to be, the specificity at which they identify language contact, and if they target language production or comprehension. All responses are expected to be mediated by language ideology; however, questions about comfort (q70 and q71) are viewed as more explicitly targeting affect than the question about use (q174). Q70 and 71 target language mixing in general while q174 targets mouthing specifically, and q70 and 174 target production while q71 targets comprehension.

No.	English translation of question	Measurement
q70	*How comfortable do you feel mixing English and ASL?*. View ASL here: `Mhttps://www.youtube.com/watch?v=D9FEoxjzGi4`	continuous 0–100 scale, qualitative: very uncomfortable, somewhat comfortable, very comfortable
q71	*How comfortable do you feel understanding a mix of English and ASL?* View ASL here: `Mhttps://youtu.be/ufV7qUKOr60?si=x2-gBvzPeMmWVB8f`	continuous 0–100 scale, qualitative: uncomfortable, somewhat comfortable, very comfortable
q174	*How much do you use mouthing in ASL?* View ASL here: `Mhttps://www.youtube.com/watch?v=T8SIDpAxMME`	continuous 0–100 scale, qualitative: never, sometimes, all the time

Table 5.2: Survey questions about participant beliefs

5.3.2.1 Why target comfort?

Comfort is targeted because of its utility in explicitly characterising users of multiple languages, as exemplified by the Language Experience and Proficiency Questionnaire (LEAP-Q) and the Bilingual Language Profile (BLP) (Marian et al., 2007; Gertken et al., 2014; Kaushanskaya et al., 2020). In the LEAP-Q, questions about comfort with language in various modalities are interpreted as contributing to L1 and L2 competence, late L2 learning, and media-based learning (Marian et al., 2007). Comfort understanding, writing, reading and speaking an L1 all contribute to L1 competence, which emerges as the composite variable explaining the most variance in the data from 52 multilinguals from the greater Chicago metropolitan area. These measures of comfort also correlate with aspects of proficiency, perceiver accent, cultural identification, and preference.

Comfort is also predictive outside of instruments like the LEAP-Q and Bilingual Language Proficiency (BLP). It positively correlates with self-rated proficiency in a second language among university students in the United States (Halsted, 2014). Similarly, Punjabi-English bilinguals in Canada who are more dominant in their L2, English, report being more comfortable using Punjabi with another Punjabi-English bilingual (Dhanoa & Nicoladis, 2021). This suggests then that comfort simultaneously captures aspects of language use and orientation. Comfort is also predictive of judgements about language structure – Cheng et al. (2022) find that comfort with Hindi-Urdu in Hindi-Urdu-English bilinguals predicts acceptability ratings of Hindi-Urdu sentences and Yim & Clément (2021) find that

comfort mixing predicts codeswitching in Cantonese-English bilinguals.

In studies of bilingualism, participants are asked about their comfort using forms of individual named languages. The present study slightly deviates from this approach in asking about comfort *mixing* two named languages.

5.3.2.2 The relationship between evaluation and self-reported use

This section shows that the link between language attitude and production is not straightforward, but that the latter could map on to language attitude in some contexts. This motivates targeting use of mouthing, and testing its correlation with evaluation. Self-reported production does pattern with actual production in Spanish-English bilinguals living in southeastern Pennsylvania with varied ethnolinguistic background (Cox et al., 2020). The relationship between orientation to a form and production is more complicated, but is found among Welsh-English bilinguals. Those who report that they keep Welsh and English separate in their language use, and believe that Welsh and English should be kept separate, produce mixed determiner phrases at a lower frequency (Couto et al., 2015). Liu (2018) complicates the relationship between usage and production however, finding that some forms of codeswitching correlate with attitude in Chinese-English bilinguals living in London. Specifically, orientation to English correlates with intra-clausal switching, but *not* inter-clausal switching.

5.4 Expectations

The previous section draws primarily on spoken language studies to motivate targeting the perceived beliefs of adult authority figures about language mixing, and participant beliefs as represented by their comfort with ASL-English mixing and their use of mouthing. Based on this discussion, I might expect that (i) as perception of adult authority figures' feelings about mixing become more positive, the difference in AESTHETICS RATING and DEAF IDENTITY RATING, that favours low mouthing over high, will decrease, and (ii) as comfort mixing ASL and English increases, the difference in AESTHETICS RATING and DEAF IDENTITY RATING, that favours low mouthing over high, will decrease. However, as the motivating studies are not about English mouthing or ASL in the United States, or self-reported language use in particular, other outcomes are equally possible. The mixed findings about the relationship between attitude and language use make it difficult to state a specific expectation about how self-reported use of mouthing might map on

to AESTHETICS RATING or DEAF IDENTITY RATING, particularly Liu (2018)'s finding that attitude maps on differently to different kinds of the same structure.

5.5 Method

This chapter is a re-analysis of the aesthetics and identity rating study described in the previous chapter but with mixing variables as independent variables. Recall that these ratings and will be referred to as AESTHETICS RATING and DEAF IDENTITY RATING respectively. In that study, participants saw two videos, that differed in level of mouthing (high *vs.* low), topic (COVID *vs.* Hurricane Ian), signer (RF *vs.* BTC), and order of presentation (high before low *vs.* low before high). After each video, participants were asked to rate how much they agreed that the signing in the video was pure, smooth, and beautiful (AESTHETICS RATING), and how much the signer looked like a strong deaf person and a deaf community leader (DEAF IDENTITY RATING). Participants used a slider control scale with a range from 0–100 to provide ratings.

5.5.1 Participants

The sample contains 183 participants who indicated that they did not know the models who produced the stimuli, and thus is smaller than sample used in cluster analysis ($n = 269$). The present sample is larger than the one used in Chapter IV ($n = 127$) as members of that sample were excluded if *any* of their social characteristics were missing. As the focus was not on social characteristics in this study, participants with missing information were not excluded. The social experiences of participants in the present study are shown in Table 5.3.

Table 5.3: Description of participants who do not know stimulus models (*n=183*)

Category	Characteristics of sample
DEAF-ID	*deaf only* (48%), *hoh only* (33%), *both* (13%), missing (6%)
DEAF-FAM	*yes* (39%), *no* (61%)
SCHOOL	*deaf only* (46%), *mainstream only* (22%), *both* (24%), *neither* (7%)
DEGREE	*high school* (40%), *bachelor's* (44%), *advanced* (13%), missing (2%)
GENDER-ID	*male* (57%), *female* (39%), *non-binary/third* (2%)
REGION	*west* (21%), *midwest* (21%), *south* (33%), *northeast* (22%), missing (3%)
CULTURAL-ID	*white* (47%), *Black/African American* (38%), *other* (15%)
AGE	$M = 31 (SD = 8, Mdn = 30)$
AOA	$M = 9 (SD = 5, Mdn = 8)$

5.6 Analysis & Results

Each section within this one describes the distribution of the data followed by the associated robust regression models. All models are fitted as before with the `robustlmm` R package (Koller, 2016), and 95% confidence intervals calculated with parametric bootstrapping using `confintROB` (Mason et al., 2024). All model coefficients are rounded up to one decimal place, while confidence intervals are reported up to two decimal places to maintain some distinction in the ranges. Note that estimates reported in tables come from `robustlmm` output, and thus may differ slightly from the plots made with `sjPlot`. All other plots are made with `ggplot2` (Wickham, 2016).

All models including mouthing (categorical variable with two levels, high and low) and a second independent variable were first fitted as interaction models and visualised with `sjPlot` (Lüdecke, 2024). An interaction was targeted because the primary interest is in how high *vs.* low mouthing is rated. If interactions were statistically insignificant, the relevant models were re-fit without an interaction and visualised. Significance is determined by examining confidence intervals calculated from parametric bootstrapping. The rule of thumb for *t*-tests is that an effect is significant if the confidence interval does not include 0 (Plonsky et al., 2015).

Section 5.6.1 describes how participants associate mouthing with English and ASL (Section 5.6.1.1), and how they think about mixing in the two mouthing conditions (Section 5.6.1.2). The sections following describe the comfort (Section 5.6.2),

use of mouthing (Section 5.6.3), and perceived feelings of caretakers (Section 5.6.4) variables.

5.6.1 Do participant beliefs align with the assumptions of this study?

This section covers pre-analyses done to check if participant beliefs align with the assumptions of this study, testing if mouthing is associated with English (Section 5.6.1.1) and if high and low mouthing stimuli are perceived as showing different levels of ASL-English mixing (Section 5.6.1.2). The pre-analyses show that participants do consider mouthing to be more associated with English than with ASL, and that they rate the low mouthing condition as showing less mixing than the high mouthing condition. This confirms then that participants are thinking about mouthing, ASL-English mixing, and the stimuli in a similar way as this study does, which makes it reasonable to move forward with regressing evaluations of high and low mouthing against the independent mixing variables listed in Section 5.3.2.

5.6.1.1 Mouthing is associated more with English than ASL

In terms of named languages, participants rate mouthing as belonging to English at a higher level than they rate it as belonging to ASL. Their ratings were provided in response to the questions shown in Table 5.4.

No.	English Translation of Question	Measurement
q176	*How much do you agree that mouthing belongs to ASL?* View ASL here: `Mhttps://youtu.be/I0NU53xzCD8?si=AmrFoe3D84I_B1pv`	continuous 0–100 scale, qualitative: strongly agree, neither agree nor disagree, strongly disagree
q177	*How much do you agree that mouthing belongs to English?* View ASL here: `Mhttps://youtu.be/I0NU53xzCD8?si=mTyQZUcDwSNUfKcG`	continuous 0–100 scale, qualitative: strongly agree, neither agree nor disagree, strongly disagree

Table 5.4: Survey questions about how much mouthing is thought to belong to English and ASL

Figure 5.1 visualises their responses comparatively. The mean belonging to ASL rating is 62.96 ($SD = 22.22, Mdn = 65.00$), while the mean belonging to English rating is 65.69 ($SD = 22.98, Mdn = 68.00$). The x-axis shows the languages

that participants were asked about, that is ASL and English. The y-axis shows the z-scored ratings of how much participants thought that mouthing belonged to either language. Responses are categorised by if the participant rated mouthing as belonging more to ASL (belonging to ASL rating $>$ than belonging to English rating), in yellow, or to English (belonging to English rating $>$ than belonging to ASL rating), in black.

A robust linear mixed effects model specified in (5) shows that there is a significant difference in how participants respond based on named language (see details of model in Table 5.5). They rate mouthing as belonging to English 1.9 units (95% CI [1.04, 2.83]) higher than they rate its belonging to ASL. However, the means for belonging to both languages are both approximately 60, indicating that participants do not see mouthing as being strongly associated with or dissociated from either English or ASL.

(5) `belonging rating ~ ASL/English + (1|participant)`

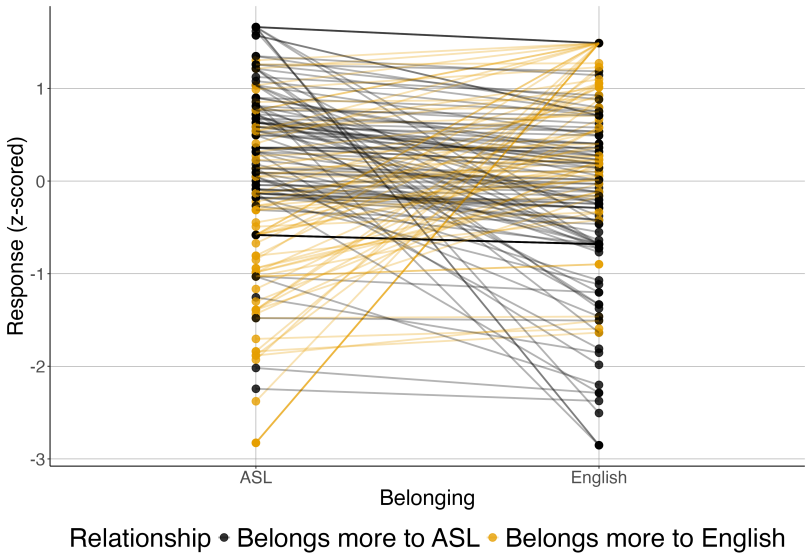


Figure 5.1: Comparison of participant ratings of how much mouthing belongs to ASL and English

	Estimate	SE	*t*-value	95% CI
belongs to ASL (intercept)	64.9	1.1	59.8	[63.89, 65.14]
belongs to English	1.9	0.5	4.2	[1.04, 2.83]

Table 5.5: Fixed effects of model (1) regressing belonging to a language against mouthing condition

5.6.1.2 Mixing rating differs with mouthing condition

At the level of mouthing condition, high *vs.* low mouthing are perceived as showing different qualities of mixing. Their ratings were provided in response to the question shown in Table 5.6, which was twice, once after they saw high mouthing and once after they saw low mouthing.

No.	English Translation of Question	Measurement
q34	*How much mixing between English and ASL is in the video you just saw?* View ASL here: `Mhttps://youtu.be/yf2sar6xRlg?si=ahIiJVP4k5r-yO_Y`	continuous 0–100 scale, qualitative: none, some, a lot

Table 5.6: Survey question targeting ASL-English mixing

Figure 5.2 shows the distribution of the *z*-scored mixing ratings for the high and low conditions. Each point represents a participant. The *x*-axis shows the two mouthing conditions, high and low, and The *y*-axis the rating of mixing in both conditions. The darkest horizontal line shows the median, which is similar in both conditions. The spread from the 25th to 75th percentile is roughly even in the high mouthing condition, but uneven in the low condition, with more ratings found below the median. Initial description of the raw scores shows that high mouthing ($M = 66.76$, $SD = 21.57$, $Mdn = 69.00$) is rated higher for mixing at the aggregate level than low mouthing ($M = 58.98$, $SD = 28.31$, $Mdn = 68.00$) for mixing, but that this difference is not stark.

A linear mixed effects model with mixing rating as the dependent variable, mouthing as the independent variable, and participant as a random effect was fitted (6) (see Table 5.7). This model shows that low mouthing is rated 4.2 units (95% CI $[-5.51, -3.01]$) lower for mixing than high mouthing.

(6) `mixing rating ~ mouthing + (1|participant)`

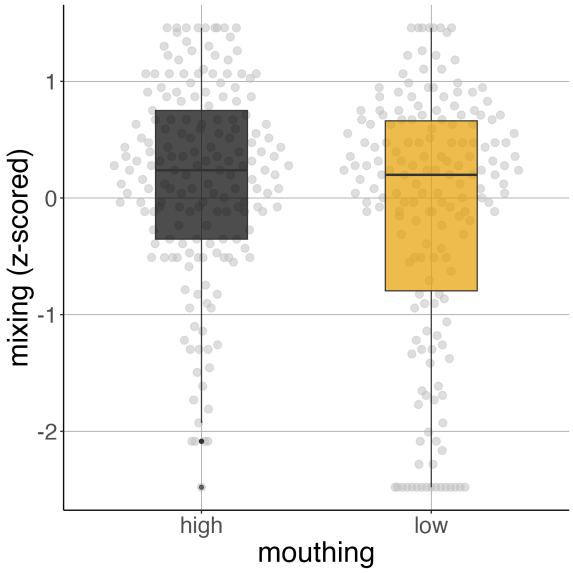


Figure 5.2: Distribution of mixing ratings by mouthing condition

	Estimate	SE	*t*-value	95% CI
high mouthing (intercept)	68.9	1.3	51.7	[65.77, 67.49]
low mouthing	−4.2	0.6	−6.5	[−5.51, −3.01]

Table 5.7: Fixed effects of model (6) regressing mixing against mouthing condition

5.6.2 Comfort

Figure 5.3 shows the distribution of comfort mixing ($M = 71.17$, $SD = 21.19$, $Mdn = 72.00$) and understanding ASL-English mixing ($M = 71.45$, $SD = 20.82$, $Mdn = 73.00$). These descriptive statistics show that at the aggregate level, participants report equal comfort producing and understanding mixing. In Figure 5.3, the x-axis shows the two targets of comfort rating – doing, or producing, mixing and understanding mixing. The y-axis shows the z-scored comfort rating. The darkest horizontal line shows the median, which is similar in both conditions. The spread from the 25th to 75th percentile is roughly the same for comfort doing and understanding mixing, with more scores falling between the 25th percentile and the median.

Comfort mixing and understanding mixing were fitted separately as independent variables of AESTHETICS RATING and DEAF IDENTITY RATING each, and participant as a random effect, thus four models were fit. An interaction between mouthing and the comfort term was specified as shown in (7).

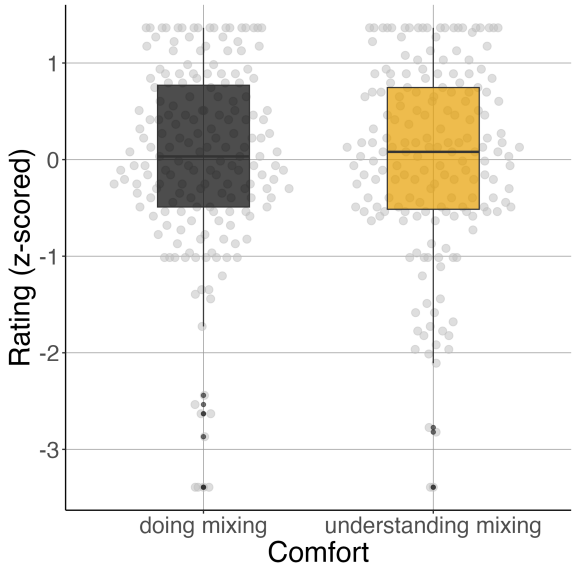


Figure 5.3: Distribution of comfort producing and understanding ASL-English mixing

(7) AESTHETICS/DEAF IDENTITY RATING ~ mouthing*comfort + (1|participant)

No interaction between comfort and AESTHETICS RATING or DEAF IDENTITY RATING was observed (refer to Figures 5.4 and 5.5), indicating that differences in self-reported comfort with mixing do not correlate with a difference in rating high vs. low mouthing for AESTHETICS RATING or DEAF IDENTITY RATING. As there was no significant interaction, these models were re-fit as shown in (8) to (11). The absence of an interaction does not align with the expectation identified in Section 5.4 that as comfort mixing ASL and English increases, the difference in AESTHETICS RATING and DEAF IDENTITY RATING that favours low mouthing over high would decrease.

(8) AESTHETICS RATING ~ mouthing + comfort mixing + (1|participant)

(9) DEAF IDENTITY RATING ~ mouthing + comfort mixing + (1|participant)

(10) AESTHETICS RATING ~ mouthing + comfort understanding mixing + (1|participant)

(11) `DEAF IDENTITY RATING ~ mouthing + comfort understanding mixing + (1|participant)`

The final models show main effects of mouthing, which are expected based on the previous chapter, and also of comfort mixing (visualised in Figure 5.4) and understanding mixing (visualised in Figure 5.5). All main effects are positive (see Table 5.8 for estimates and confidence intervals).

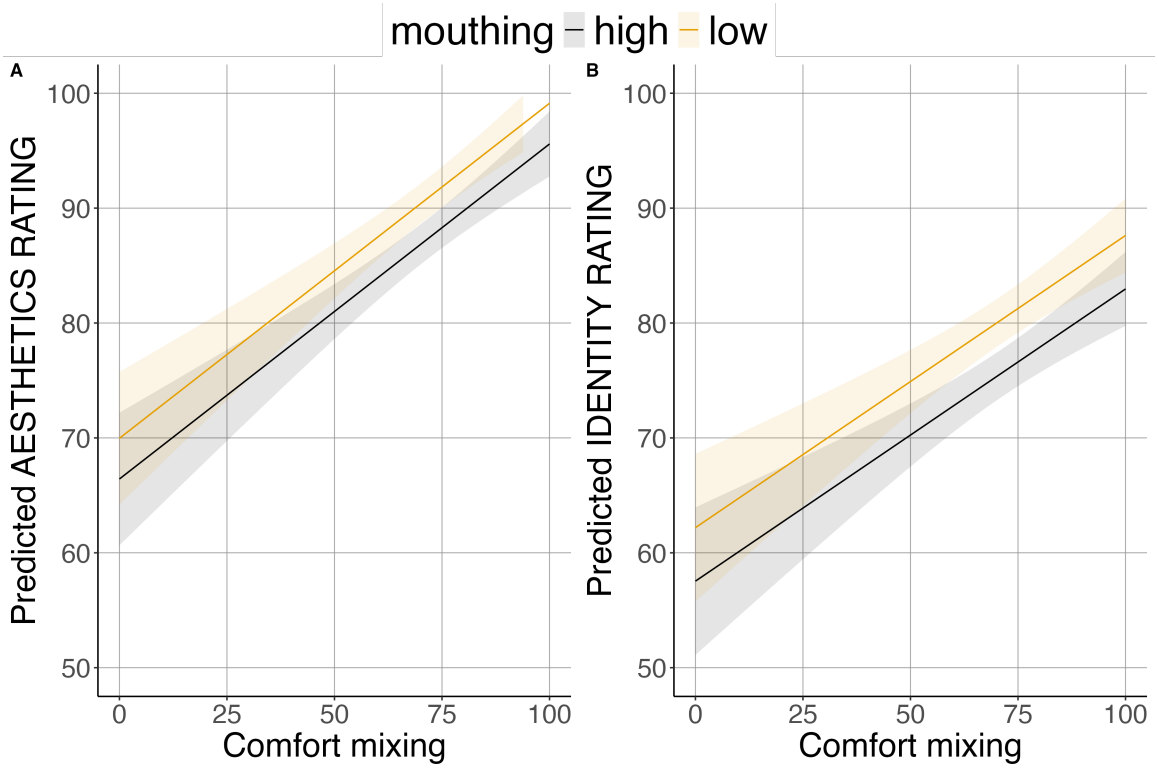


Figure 5.4: Visualisation of model (8) regressing AESTHETICS RATING on comfort mixing (A), and model (9) regressing DEAF IDENTITY RATING on comfort mixing (B)

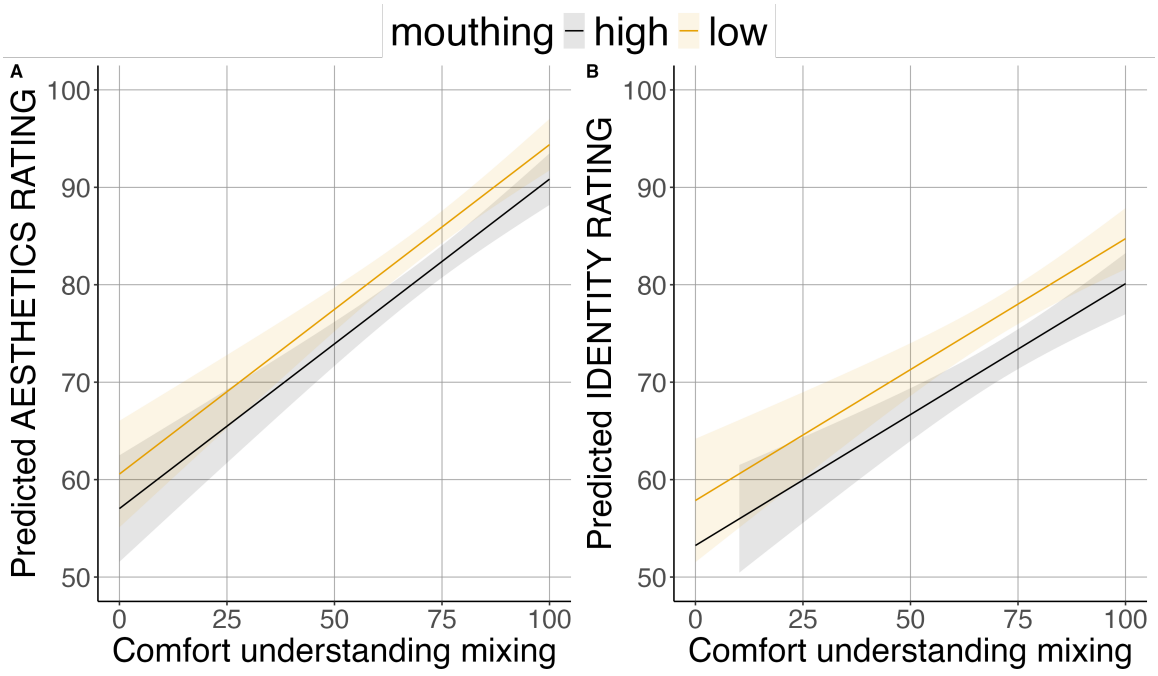


Figure 5.5: Visualisation of model (10) regressing AESTHETICS RATING on comfort understanding mixing (A), and model (11) regressing DEAF IDENTITY RATING on comfort understanding mixing (B)

	Estimate	SE	*t*-value	95% CI
Model (8)				
high mouthing (intercept)	55.1	2.9	18.7	[52.05, 56.16]
low mouthing	3.5	0.6	5.9	[2.42, 4.71]
comfort mixing	0.3	0.0	7.4	[0.27, 0.32]
Model (9)				
high mouthing (intercept)	52.2	3.3	15.9	[48.67, 55.85]
low mouthing	4.7	1.0	4.5	[2.70, 6.65]
comfort mixing	0.3	0.0	5.8	[0.19, 0.28]
Model (10)				
high mouthing (intercept)	51.6	2.8	18.5	[48.74. 53.02]
low mouthing	3.5	0.6	5.9	[2.37, 4.67]
comfort understanding	0.3	0.0	9.1	[0.31, 0.36]
Model (11)				
high mouthing (intercept)	51.3	3.22	15.9	[47.62, 54.98]
low mouthing	4.6	1.0	4.5	[2.62, 6.61]
comfort understanding	0.3	0.0	6.3	[0.20, 0.29]

Table 5.8: Fixed effects of models (8)–(11) regressing AESTHETICS RATING or DEAF IDENTITY RATING against comfort

5.6.3 Use of mouthing

Figure 5.6 shows the distribution of self-reported use of mouthing ($M = 68.85$, $SD = 20.27$, $Mdn = 70.00$). In this plot, the x-axis shows z-scored ratings for use of mouthing and ranges from approximately -4 to 2. 0 on the x-axis marks the mean and points above and below it mark the number of standard deviations away from the mean. The y-axis shows the number of participants and ranges from 0 to approximately 25. The majority of participants' scores fall one standard deviation above and below the mean, and there is a skew towards the left-tail of the distribution.

AESTHETICS RATING and DEAF IDENTITY RATING were individually regressed on use of mouthing as shown in (12) and (13) respectively. An interaction between AESTHETICS RATING and use of mouthing is observed in which as self-reported use of mouthing increases, AESTHETICS RATING of low mouthing decreases by 0.1 units (95% CI [0.07, 0.18]) (see Figure 5.7 (A)). No interaction is observed for DEAF IDENTITY RATING, and so this model was re-fit without an interaction term. The main effect of mouthing is that low mouthing condition is rated 4.6 units (95% CI [2.63, 6.58]) higher for DEAF IDENTITY RATING than high mouthing, and for every 1 unit increase in self-reported use of mouthing, DEAF IDENTITY RATING of the sign model increased by 0.2 units (95% CI [0.09, 0.19]).

(12) `AESTHETICS RATING ~ mouthing*use of mouthing + (1|participant)`

(13) `DEAF IDENTITY RATING ~ mouthing*use of mouthing + (1|participant)`

Figure 5.7 shows the model predictions for use of mouthing. The plot on the left shows how AESTHETICS RATING, shown on the y-axis, are expected to vary with use of mouthing (A), and the plot on the right shows the same for DEAF IDENTITY RATING (B). The x-axis ranges from 0–100 and the y-axis from 50–100. Each plot shows two lines, one for low mouthing ratings and a second for high mouthing ratings. In plot (A), the lines intersect, showing that as use of mouthing increases, AESTHETICS RATING of low mouthing increases more than it does for high mouthing. In plot (B), the lines do not intersect and are almost parallel, indicating that the rate of increase for low and high mouthing in terms of DEAF IDENTITY RATING is almost even. The line for low mouthing is higher than that for high mouthing, indicating that it is overall higher for DEAF IDENTITY RATING.

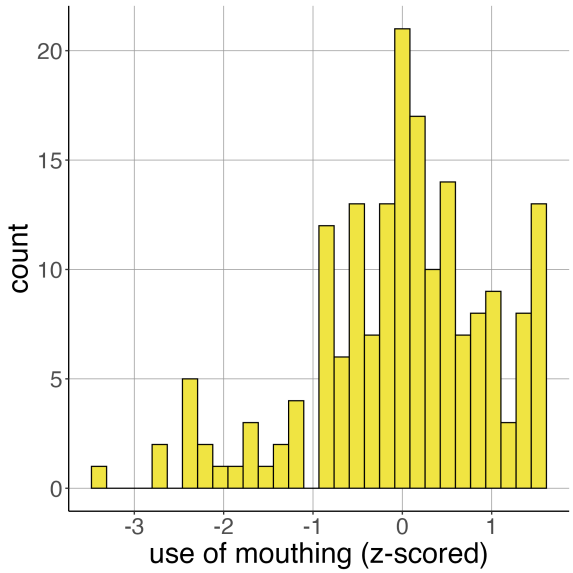


Figure 5.6: Distribution of z-scored use of mouthing ratings

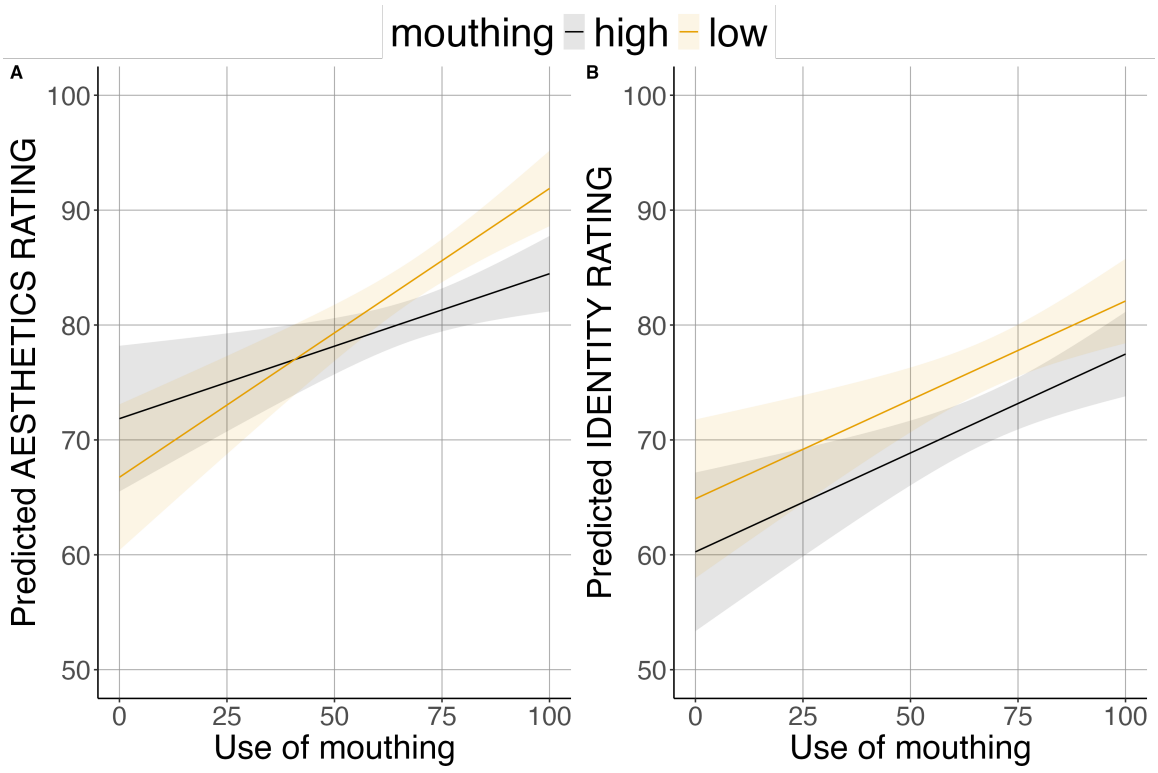


Figure 5.7: Visualisation of model (12) regressing AESTHETICS RATING on use of mouthing (A), and model (13) regressing DEAF IDENTITY RATING on use of mouthing (B)

	Estimate	SE	*t*-value	95% CI
Model (8)				
high mouthing (intercept)	67.4	3.2	20.8	[66.62, 72.42]
low mouthing	−5.1	2.1	−2.4	[−9.11, −1.06]
use of mouthing	0.1	0.0	2.8	[0.04, 0.12]
low mouthing*use of mouthing	0.1	0.0	4.3	[0.07, 0.18]
Model (9)				
high mouthing (intercept)	58.4	3.5	16.6	[55.94, 63.08]
low mouthing	4.6	1.0	4.5	[2.63, 6.58]
use of mouthing	0.2	0.0	3.5	[0.09, 0.19]

Table 5.9: Fixed effects of models (8) and (9) regressing AESTHETICS RATING (A) and identity (B) DEAF IDENTITY RATING against use of mouthing

5.6.4 Caretakers' feelings

Figure 5.8 shows the distribution of ratings of how participants perceived their caretakers' feelings about mixing at home ($M = 71.33$, $SD = 22.40$, $Mdn = 74.00$) and in school ($M = 66.72$, $SD = 22.44$, $Mdn = 70.00$). The x-axis shows the category of caretaker, those at home and those at school respectively. The y-axis shows the raw scores of how participants' perceived their caretakers' feelings about mixing z-scored by participant. The darkest horizontal line within the box-plots shows the median score, which is slightly higher for caretakers at home than those at school. A higher rating indicates that participants perceived their caretakers as having more positive feelings about mixing. On average, caretakers in the home are perceived as having slightly more positive feelings about mixing than those at school.

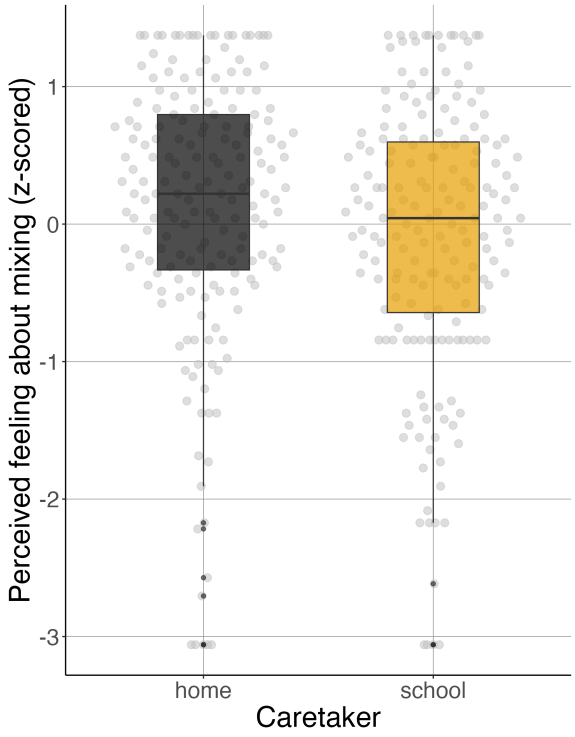


Figure 5.8: Perceived feelings about ASL-English mixing of caretakers

DEAF IDENTITY RATING and AESTHETICS RATING were regressed individually on caretaker feelings as shown in model (14); however, no interaction was observed. Thus, differences in how participants perceive the feelings of their caretakers do not correlate with differences in how they rate high vs. low mouthing. This finding does not align with expectation (i) that as perception of adult authority figures' feelings about mixing become more positive, the difference in AESTHETICS RATING and DEAF IDENTITY RATING, that favours low mouthing over high, would decrease (Section 5.4).

(14) `AESTHETICS/DEAF IDENTITY RATING ~ mouthing*perceived caretaker feeling + (1|participant)`

As no interaction was observed, the models were re-fit as shown in (15) to (18). All main effects are positive (see Table 5.10 for estimates and confidence intervals).

(15) `AESTHETICS RATING ~ mouthing + perceived caretaker at home feeling + (1|participant)`

(16) `DEAF IDENTITY RATING ~ mouthing + perceived caretaker at home feeling + (1|participant)`

(17) `AESTHETICS RATING ~ mouthing + perceived caretaker at school feeling + (1|participant)`

(18) `DEAF IDENTITY RATING ~ mouthing + perceived caretaker at school feeling + (1|participant)`

Figure 5.9 shows the model predictions for caretakers in the home, and Figure 5.10 for caretakers at school. The x-axis on all plots shows perception of caretakers' feelings and ranges from 0–100. The y-axis shows the expected aesthetics or identity ratings and ranges from 50–100. Each plot shows two non-intersecting lines representing the expectations for high mouthing and low mouthing. All plots show that as caretakers feelings about mixing increase, that is become more positive, rating of low and high mouthing increases at almost the same rate. The beginning point for low mouthing, however, is higher than high mouthing. Generally AESTHETICS RATING is higher than DEAF IDENTITY RATING.

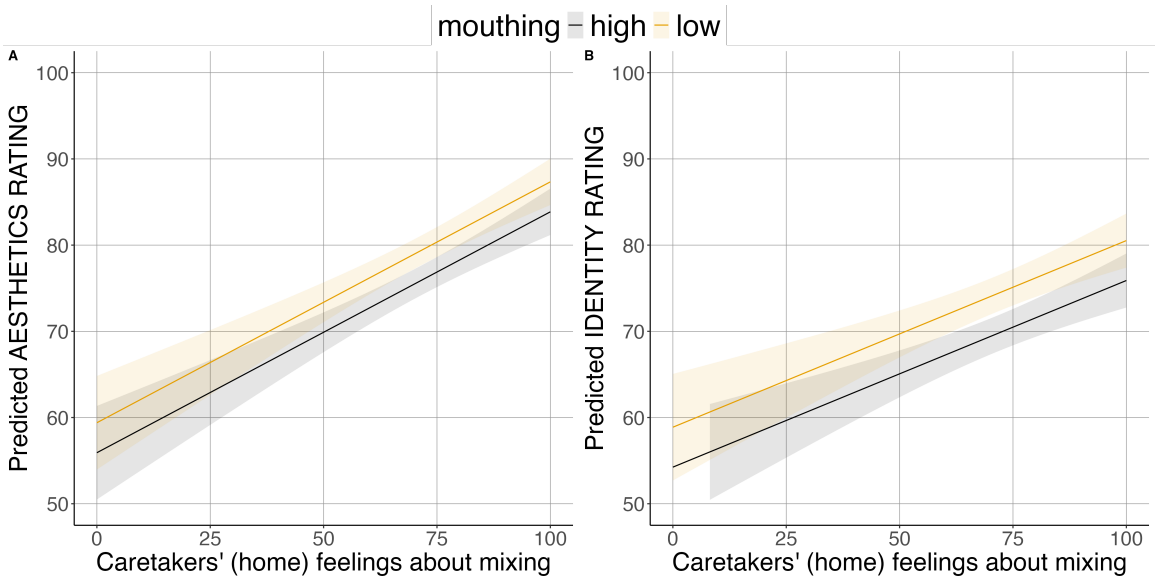


Figure 5.9: Visualisation of model (15) regressing AESTHETICS RATING on perceived feelings of caretakers at home (A), and model (16) regressing DEAF IDENTITY RATING on perceived feelings of caretakers at home (B)

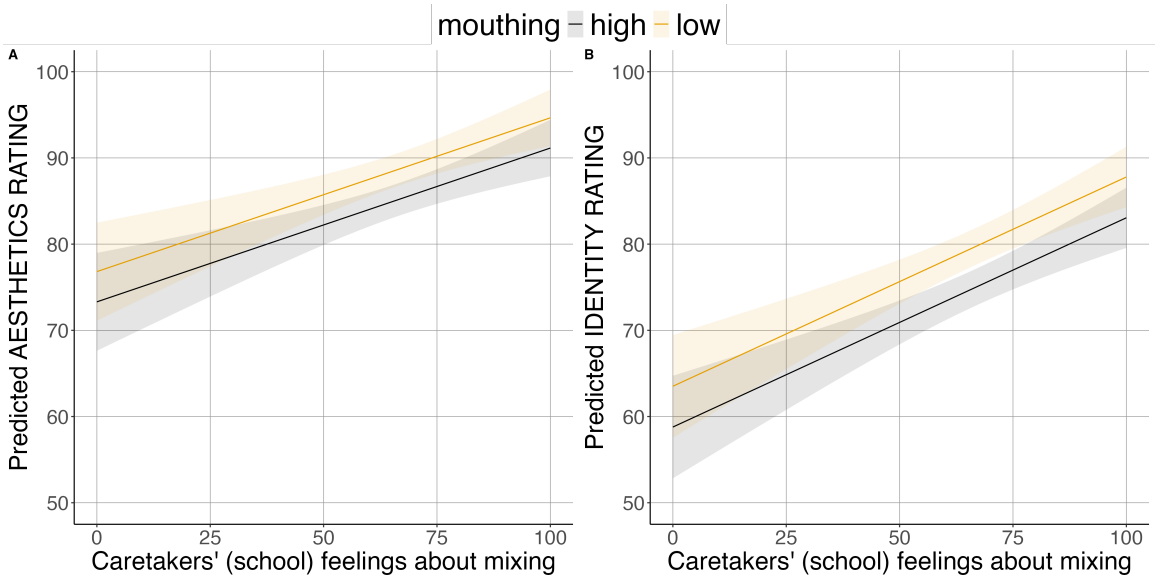


Figure 5.10: Visualisation of model (17) regressing AESTHETICS RATING on perceived feelings of caretakers at school (A), and model (18) regressing DEAF IDENTITY RATING on perceived feelings of caretakers at school (B)

	Estimate	SE	*t*-value	95% CI
Model (11)				
high mouthing (intercept)	55.7	2.8	20.1	[54.93, 58.88]
low mouthing	3.5	0.6	5.8	[2.32, 4.60]
perceived feelings	0.3	0.0	7.6	[0.23, 0.28]
Model (12)				
high mouthing (intercept)	54.9	3.2	17.4	[51.68, 58.62]
low mouthing	4.6	1.0	4.5	[2.62, 6.59]
perceived feelings	0.2	0.0	5.2	[0.15, 0.24]
Model (13)				
high mouthing (intercept)	64.0	2.9	22.1	[59.63, 63.39]
low mouthing	3.5	0.6	5.9	[2.39, 4.65]
perceived feelings	0.2	0.0	4.4	[0.17, 0.23]
Model (14)				
high mouthing (intercept)	53.7	3.0	17.7	[50.62, 57.14]
low mouthing	4.7	1.0	4.5	[2.77, 6.68]
perceived feelings	0.2	0.0	5.7	[0.18, 0.27]

Table 5.10: Fixed effects of models (11)–(14) regressing AESTHETICS or DEAF IDENTITY RATING against perceived caretaker feelings

5.6.5 Summary

Robust regression modelling shows high mouthing is rated significantly higher for ASL-English mixing than low mouthing, and is more associated with English as opposed to ASL. In terms of evaluation of high and low mouthing, the only significant interaction occurs when AESTHETICS RATING is modelled with the interaction of mouthing and self-reported use of mouthing as independent variables. Specifically, participants who report that they use mouthing more, rate low mouthing 0.1 units higher for AESTHETICS RATING. This means then that participants' perceptions of how adult caretakers felt about mixing, and their comfort producing and understanding mixing do not correlate with a difference in rating high vs. low mouthing.

5.7 Discussion

The research questions defined at the beginning of this chapter aimed to determine if and how additional beliefs and experiences with language mixing, outside of [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK, correlate with evaluation of signing aesthetics and deaf identity. Robust regression

modelling shows that self-reported use of mouthing is the only independent variable that significantly correlates with either aspect of evaluation – it correlates with AESTHETICS RATING (refer to Figure 5.7 (A)). This following sections contextualise the finding about use of mouthing in the heterogeneity of DHH language experiences in the United States described in Chapter IV, discusses issues in how the other tested independent variables were targeted, and suggests improvements for future work.

5.7.1 Greater self-reported experience with language contact does not mean greater preference for English mouthing in ASL

Self-reported use of mouthing and [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK differ in the aspects of evaluation they correlate with – aesthetics and deaf identity respectively – but are conceptually similar in the pattern they show. If use of mouthing and mixing are grouped as experience with language contact, the following generalisation is obtained: as self-reported experience with language contact becomes more positive, rating of ASL showing *less* English contact (the low mouthing condition) increases. Two possible implications arising from this that are not separable are:

- increased use of contact forms does not imply a greater preference for those forms
- self-reported usage of contact forms captures a negative orientation to contact, in which participants who view contact negatively are more likely to report greater use of contact forms

Note that a necessary assumption here would be that being a strong deaf person and/or being a deaf community leader is viewed positively, which are not necessarily be true. These implications are discussed in terms of the relationship between language attitude and actual and self-reported production.

The preference for mouthing, and use of contact forms aligns with what might be expected given the heterogeneity that DHH signers might encounter on a daily basis. DHH individuals are expected to modify their language use based on the interactional contexts they are in, which could lead to greater production of contact forms than they might prefer when asked to provide judgements. A similar pattern is generally found in studies of language attitude and the attitude-behaviour

relationship. For instance, McGowan & Babel (2020) find that the sounds that Bolivian Spanish users perceive differ from what they believe they perceive, and Kristiansen (2010) finds that attitudes differ based on if they collected using explicit vs. implicit means among Danish speakers in Copenhagen, Denmark (see also Licata, 2023). In terms of interaction, participants report fairly even frequency of interaction with the following groups (that overlap in some cases): deaf ($M = 74.32$), hearing non-signers ($M = 70.94$), and ASL signers ($M = 72.37$). Recall that four broad profiles of signers that differ in their self-reported experience with ASL and English were identified in Chapter III. If the participants in the present sample only interact with deaf ASL signers, they would be expected to encounter at least four different kinds of signers. They would have to modify use of their English and ASL resources to meet the communicative needs of these signers, which could explain the disjoint between language use and preference. Participants' ideas of what counts as ASL vs. English are also expected to differ based on the perceived social characteristics of who they encounter, like race (refer to Chapter IV).

At the outset, this study assumed that self-reporting is ideological, and that reporting of mixing in particular would draw on ideologies of purity. This appeared to be supported, as increased reporting of use of mouthing correlates with increased rating of the variety with less contact in the form of English mouthing i.e. the variety that might be considered the "purest" ASL. A similar relationship is echoed in Cox et al. (2020) who finds that Spanish-English bilinguals in the United States who report greater proficiency in English may perceive themselves as using English more when mixing Spanish and English. These findings together suggest that individuals who have greater experience mixing named languages may also associate certain features more strongly with or away from one language than another. In the context of the present study, this would mean that participants who report more ASL-English mixing may more strongly associate English mouthing away from ASL use, resulting in upgrading the low mouthing condition for aesthetic and deaf identity properties. This aligns with Enfield (2003)'s framing of individuals as the site of language contact and the agents who assign linguistic forms to named languages (see also Bisnath & Namboodiripad, under review).

5.7.2 Perceived feelings of adult caretakers

The lack of interaction between perceived feelings of authority figures, mouthing, and evaluation may be due to the aforementioned difficulties in correlating behaviour with attitude, and the study design. The discussion in Section 5.3.1.1

shows that the language ideologies of authority figures can influence those of individuals under their control. However, the actions arising from their ideologies may be more informative, and are limited by individual levels of access. The absence of a correlation is thus in line with this account (with the caveats associated with interpreting null findings). An implication then is that future studies should aim to ask more specific questions about the types of actions that authority figures take to support or deter language learning. This is not a trivial task as it would require collecting ethnographic, interview, and/or focus group data, and generalising across it. In terms of the general approach, the way that perceived feelings of authority figures was targeted was limited at the outset. They were measured with just two questions – one for figures in the home and one for those at school. Participants would have been required to generalise across multiple individuals, which is difficult and could have introduced inaccuracies. Future studies, that are more targeted than the present one could be, may benefit from asking participants to identify influential linguistic figures or role models in their lives, and center questioning around those figures.

5.7.3 Contextualising the numbers

The effects found in this study are very small relative to the scale used in data collection, and thus may be difficult to replicate in studies with smaller sample sizes. Recall that findings of this study are based on 183 participants. The scale used ranged from 0–100 and had a sensitivity of one unit – thus participants were unable to provide ratings that were not whole numbers. The estimates for the effects of the mixing variables listed in Section 5.3.2 are all below 1.0. Estimates for the effect of mouthing are higher, but are generally below 5.0. When the small sizes of the effects are put together with the relatively stark difference in mouthing between the high and low conditions, it is unlikely that studies with more fine-grained distinctions in levels of congruent mouthing and smaller sample sizes would obtain the patterns found in this study.

Participants generally rate high and low mouthing fairly high for all the target properties. As mentioned earlier, participants tended to use the higher half of the scale, and tended to provide high ratings with means around 70. It may be then that the effects reported here may only show up when high *vs.* low congruent mouthing are contrasted under experimental conditions.

5.7.4 Open questions

A remaining question is why would use of mouthing correlate with aesthetics rating and not identity rating, and use of mixing correlate with identity rating but not aesthetics rating? Part of an answer might be that the use of the term "mouthing" in the survey prompt might have directed focus toward formal properties of the stimuli. A second question is if reporting of mixing is ideological, why does no measure of *comfort* with mixing correlates with evaluation? Recall that self-reported comfort producing and understanding mixing did not correlate with AESTHETICS RATING or DEAF IDENTITY RATING. Self-reporting of comfort with mixing is expected to explicitly tap into affect associated with language. Given the dominance of spoken English and hearing culture in the United States, one might expect that a preference for less mouthing in ASL might be driven by potential feelings of discomfort around use of English. This may not have been found because of how the survey was distributed. A flyer in English was spread through sign language linguistics and educational networks, which may have introduced a bias towards recruiting participants used to ASL-English mixing. Some support for this comes from the somewhat high mean levels of comfort reported, which were above 70 for both understanding and producing ASL-English mixing. Apart from this, an implicit measure, like the Implicit Association Task (IAT) (Greenwald et al., 1998), may be a better way of probing affect as it relates to mixing (Callesano & Carter, 2023) (see also Licata, 2023; Rosseel et al., 2018, 2019). As mentioned in Chapter II, this task can collect automatic responses along semantic differentials, like good *vs.* bad, towards linguistic forms. The linguistic form in question would be presented with one of the two components of the semantic differential and participants would be asked to respond to the pairing. Participants are expected to respond faster to pairings that they perceive as matching, compared to those that they do not perceive as matching. A potential IAT on mouthing in ASL could include the following pairings:

1. ASL CAT with English mouthing "cat" + ASL GOOD
2. ASL CAT with English mouthing "cat" + ASL BAD
3. ASL CAT with no mouthing + ASL GOOD
4. ASL CAT with no mouthing + ASL BAD

If participants believe that ASL should be produced without mouthing, they would be expected to respond faster to items 2 and 3, and slower to items 1 and 4.

5.8 Conclusion

This chapter examined evaluation of English mouthing in ASL in terms of experience and beliefs about ASL-English mixing. This is motivated by the nature of mouthing as a contact phenomenon associated with spoken English that is a potential target for linguistic purism in ASL. Mixing was examined in terms of perceptions of the feelings of adult caretakers about mixing, comfort producing and understanding mixing, and use of mouthing. Robust regression modelling shows that only use of mouthing correlates with AESTHETICS RATING – as experience with use of mouthing increases, so especially does rating of low mouthing. The findings of this study sets the quantitative groundwork for testing more specific hypotheses about the relationship between attitudes to mixing and use of multimodal contact features in ASL. Future studies of a similar type may benefit from more directly asking about the actions of caretakers as independent variables, and from using other methods of identifying orientation to linguistic forms like the Implicit Association Test (IAT).

CHAPTER VI

Conclusions

This dissertation investigates the relationship between language attitude and language contact by studying variation in attitudes to English mouthing in ASL among DHH signers in the United States. It takes an interdisciplinary approach, bringing together insights from sign language linguistics, anthropology, and sociolinguistics. In this chapter, I discuss the major takeways of this dissertation along with limitations, suggestions for improvement, and future research possibilities.

6.1 Summary of research questions and findings

This section recapitulates the research goals and questions stated in Chapter I, and summarises the associated findings.

The first research goal was to collect and categorise some of the heterogeneity of DHH experience with ASL and English in the United States. This was targeted by asking how DHH users of ASL in the United States group together based on their experiences with ASL and English, and how their social characteristics are distributed within the groupings found. Experience was defined in terms of five principal components, [1] EXPERIENCE WITH WRITTEN ENG IN SCHOOL AND A TYPICAL WEEK, [2] EXPOSURE TO SPOKEN ENG OVER THE LIFETIME, [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK, [4] EXPERIENCE WITH ASL BEFORE SCHOOL, and [5] EXPERIENCE SPEAKING ENG OVER THE LIFETIME. Four broad types of DHH community members were identified using hierarchical cluster analysis: LOWEST SPOKEN ENG INPUT [C1] ($n = 43$), SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL[C2] ($n = 80$), LOWEST ASL USE BEFORE SCHOOL [C3] ($n = 32$), and LOWEST WRITTEN ENG USE [C4] ($n = 114$). These groupings are differentially associated with the social characteristics inves-

tigated, which were deaf identity, growing up with deaf family, school types attended, highest degree, gender identity, cultural identity, region, age and age-of-acquisition of ASL. For instance, LOWEST SPOKEN ENG INPUT [C1] is associated with deaf identity, SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] with having a degree higher than a high school diploma, LOWEST ASL USE BEFORE SCHOOL [C3] with hard-of-hearing identity, and LOWEST WRITTEN ENG USE [C4] with having a bachelor's degree.

The second research goal was to explore correlations between DHH experiences and attitude to mouthing by asking how mouthing is evaluated for signing aesthetics (AESTHETICS RATING) and deaf identity (DEAF IDENTITY RATING), and how these evaluations pattern with the social characteristics of participants. AESTHETICS RATING concretely refers to evaluation of purity, beauty, and smoothness, and DEAF IDENTITY RATING with strong deaf (sociocultural) identity and deaf community leadership. Low mouthing received higher AESTHETICS RATING and DEAF IDENTITY RATING compared to high mouthing overall, but participants with different social experiences (language experience, social characteristics, and cluster membership) rated low mouthing differently. Participants belonging to SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2] gave higher AESTHETICS RATING and DEAF IDENTITY RATING to low mouthing than those belonging to LOWEST SPOKEN ENG INPUT [C1]. Participants who grew up with deaf family gave higher AESTHETICS RATING to low mouthing than those who did not. As age increased, AESTHETICS RATING for high mouthing increased, and as [4] EXPERIENCE WITH ASL BEFORE SCHOOL increased, so did AESTHETICS RATING of low mouthing. In terms of DEAF IDENTITY RATING, as [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK increased, so did rating of low mouthing.

The third research goal aimed to explore how experiences with language mixing correlate with attitude, namely AESTHETICS RATING and DEAF IDENTITY RATING. This question is motivated by the correlation between [3] EXPERIENCE WITH ASL-ENG MIXING IN SCHOOL AND A TYPICAL WEEK and DEAF IDENTITY RATING observed in targeting the second research goal, and aligned with the placement of this dissertation in language contact. Experiences with language mixing were examined through participant perceptions of their caregivers' (in the home and school) feelings about ASL-English mixing, their own comfort producing and understanding this mixing, and their use of mouthing. Only use of mouthing was found to correlate with AESTHETICS RATING – as reporting of use of mouthing in-

creased, so did rating of low mouthing.

6.2 Moving towards a more holistic understanding of DHH experience and language use

This dissertation made a theoretical commitment to centering the subjectivities of DHH individuals in understanding ASL, and to centering language contact, specifically that between English and ASL. A core component of this is the use of emergent methods to characterise variation in language experience, and to group signers, namely Principal Components Analysis (PCA) and cluster analysis. Emergent here does not mean atheoretical, as these methods are, like all others, dependent on the kind of data used as input and the discretion of the researcher. Furthermore, all methodological design and interpretation is theoretical. This data-driven approach contrasts with the use of categories that primarily draw on essentialisations between language acquisition experience and authentic sign language use, like "native signer". In doing this, this dissertation was able to identify four groups of signers who differ in patterns of language experience and associated social characteristics. These clusters are useful statistically as they correlate with differences in social characteristics and evaluation. Specifically the distinction between LOWEST SPOKEN ENG INPUT [C1] and SIMILAR SPOKEN ENG INPUT & ASL USE BEFORE SCHOOL [C2], correlates with AESTHETICS RATING and DEAF IDENTITY RATING where individual aspects of language experience and singular social characteristics did not.

Holistic characterisation of experience using methods like cluster analysis is aligned with some interpretations of intersectionality (Crenshaw, 2013). In the study of stigmatisation in healthcare for instance, intersectionality motivates grouping participants by clustering based on social characteristics and experiences of stigmatisation (Bauer et al., 2022). The present study only formed clusters based on language experience, but it may be more useful to identify them based on language experience and social characteristics. This was not pursued due to cluster analysis not being particularly well-suited for dealing with both categorical and continuous data, but other approaches like latent profile analysis, latent class analysis (Williams & Kibowski, 2016) or structural equation modelling may be more appropriate. It would also be important to more directly target experiences of oppression, or account for oppression, if an intersectional lens is used (Tripp, 2023). A caveat is that the clusters identified in this study are not necessarily social profiles

recognisable within the DHH community, but they provide a starting point for exploring potential types using interviews and/or focus groups. The clusters also do not necessarily map on to how individuals may perceive themselves. For instance, a cluster could potentially group together individuals who are Latino/a/x and deaf, but this does not necessarily mean that individuals within that cluster may strongly identify with being Latino/a/x and deaf (Torres, 2019).

The experimental stimuli used in the Evaluation of Mouthing Task are not naturalistic in that they only included congruent mouthing. Recall that congruent mouthing is mouthing that would be glossed in the same way as the manual sign it accompanies. It may be the most frequent kind of mouthing, but may not be the most salient in terms of adding propositional content not found in the manual sign; however, understanding these properties requires focussed investigation that has not yet been done. The experimental stimuli potentially suffer from not using texts that contextualised congruent mouthing with other forms of mouthing, as the situatedness of individual grammatical structures with others can influence their evaluation. For instance, the social meaning of phonetic features in English used in the United Kingdom and Jamaica can differ based on the level of presence of other grammatical features (Wassink & Dyer, 2004). A similar idea is found in Hill (2012) who reports that a stretch of signing could be categorised as ASL, even if it included some mouthing, if it contained enough other features associated with more authentic ASL, such as classifier constructions/depicting signs. This suggests then, that future studies of attitude to mouthing should make attempts at including different forms of mouthing (the forms identified in Bisnath, 2024, would be a starting point).

6.3 Lower rates of congruent mouthing is preferable, but higher rates are acceptable

The findings of Chapter IV show that low congruent mouthing is more likely to be viewed as some combination of more pure, beautiful, and smooth, and evocative of strong sociocultural deaf identity and being a deaf community leader than high congruent mouthing; however, the effect sizes are relatively small given the 0–100 scale that was available to participants – they were all less than five units.

What does this mean for attitude to mouthing in ASL? As discussed in Section 1.5.3, ASL is often described as having less mouthing than other western sign languages in the global north. The findings of this dissertation do not directly bear on

frequency of mouthing, but the relatively high rating of high mouthing suggests that this kind of mouthing may be more prevalent than previously thought, which is already implied in Nadolske & Rosenstock (2007), and suggested by Lindeberg (2022). The results of this study suggest then that researchers should avoid repeating the truism that use of mouthing in ASL is exceptional compared to other sign languages and solidifying it in the literature. Instead, the prevalence of mouthing in ASL should be examined in a more direct way, perhaps by developing a corpus of ASL (Hochgesang et al., 2023).

In terms of attitudes within the DHH signing community, the small differences in evaluation of high *vs.* low mouthing is indicative of a broad range of attitudes for congruent English mouthing. I say congruent mouthing here, as this is what was modulated in the experimental stimuli, but this should not be understood as saying that participants viewed the mouthing they saw as belonging to a single type of mouthing. These findings align with the comments reported in Hill (2012) that show that mouthing is viewed positively and negatively across individuals. An implication of this for experimental studies of signing is that excluding mouthing across the board in stimuli where mouthing is not the direct target of study may not be representing signs accurately. This is usually done in an effort to control experimental stimuli; however, as signers seem to view mouthing positively, it may be that signs presented without mouthing are socially marked in a way that might be irrelevant to the research questions at hand. It may also be that across signs some are more typically associated with mouthing than others – treating all signs in the same way in terms of mouthing could introduce variation that is not accounted for in results. A potential way to proceed forward is to develop means of identifying the frequencies and forms of mouthing that typically occur with individual signs and using that information in stimulus development.

6.4 Methodological contributions and improvements

This dissertation contributes a means of collecting evaluation of mouthing, and a concise means of collecting information about experience with ASL and English.

The Evaluation of Mouthing Task builds on the Matched Guise Task (Lambert et al., 1960) and its variants while making modifications for sign languages. The main challenge in adapting this task to sign languages is the need to show the faces of sign models, which eliminates the possibility of obscuring their identity, and of allowing participants to assume that different varieties are being produced by

different people. Showing the face also risks participants recognising sign models, which is likely in smaller closely-knit communities that linguists may draw on in doing research. These issues were dealt with by using two sign models and counterbalancing across them, and by explicitly asking participants to indicate if they knew the models they saw. This approach appears to be successful, as no effect of signer or topic was found in the regression models; however, it may be less successful when sample sizes are more restricted than they happened to be in this study.

The Evaluation of Mouthing Task could be improved by collecting more observations per participant, including more naturalistic signing, and knowing more about how participants know sign models. First, including more naturalistic signing would be useful, as the two levels of mouthing tested represent extremes. Second, each participant only provided one rating per evaluation term for each level of mouthing due to limitations in the number of sign models available, and the need to try to limit the total time participants would need to complete the Evaluation of Mouthing Task and survey. To collect more observations using the Evaluation of Mouthing Task approach, one would simply need to increase the number of sign models and topics; however, as I found in this study, this is difficult. Increasing the number of models would also make it more difficult to keep aspects of their visual identity balanced, and would increase the chances of participants recognising models. Finally, knowing the extent to which participants know sign models in order to more accurately gauge how prior knowledge influences evaluation.

The second methodological contribution is a concise set of survey questions, based on a relatively large sample, that can be used to collect DHH experience with ASL and English in the context of the United States. Recall that language experience was collected using 27 questions about self-reported use of English and ASL in different modalities at three different points in life – before entering school, during school, and in a typical week. Principal Components Analysis (PCA) narrowed these questions down to 20, which were able to capture $\approx$70% of the variance in the data (see Tables 3.3 to 3.7 and Appendix 7.3). The number of questions could be reduced further by referring to the loadings (bracketed numbers in Tables 3.3 to 3.7), which show how much each question contributes to a principal component with higher loadings contributing more. A cut-off point for loadings could be selected to reduce the number of questions further, or the top two variables of each component could be chosen, which would reduce the number of questions to 10. In using this means of collecting language experience, future researchers should

consider if and how the sample of participants they have patterns with the sample used in this dissertation, as the loading patterns derived are tied to the variance within this particular sample.

Understanding of language experience would have been much improved by asking more specific questions and using interviews and/or focus groups. The exploration of language experience during school was particularly weak, as it asked participants to generalise across all of their school experiences. Given the age requirement of 18, participants are likely to have attended multiple schools, and types of schools. It would have been useful to ask more nuanced questions about different periods of schooling, and to allow participants to self-identify the types of schools they went to and answer the same questions about each. A survey method is not well-suited for collecting this kind of data – interviews or focus groups may be better, but this would significantly limit the number of individuals that could be reached. One option for this study would have been to do follow up interviews with a limited number of participants.

Apart from schooling, knowing about participants' job history, and their access to disability support and deaf community services could specify and nuance language experience further. The types of jobs that people have can determine the languages that they use and the kinds of interactions they have, which would influence their language experience and their expectations about how others use these languages. For instance, a deaf academic working in the United States at a hearing institution is likely to be exposed to formal written English quite regularly, while someone working a public-facing job in sales would be expected to have frequent short interactions with hearing people they are unfamiliar with. Information about the presence of disability support and deaf community services and DHH individuals' access to them over their lifetimes could explain potential disconnects between attitude and language use. Access here could minimally be about financial wherewithal and time availability. For instance, even if DHH children had hearing parents who were positive to their children learning and use a sign language, if sign language classes were not available in the region they lived in, or if they were too expensive or at inconvenient times, these children would still experience the effects of language deprivation in the home.

6.5 Looking forward

This dissertation gives an indication of whose language practices are being excluded in sign language linguistics research that prioritises a small group of DHH individuals who acquired a sign language early through vertical transmission. Sign language linguists must thus make greater efforts to engage with the language use of DHH communities overall, as opposed to ruling out signers who do not fit narrow acquisition criteria *a priori*. This is particularly relevant in psycholinguistics, and other sub-fields that rely on experimentation and group contrasts. The clusters identified in this dissertation and their concomitant social characteristics are alternative groupings founded on the actual experiences of DHH community members, and so may be more useful in explaining ASL perception and use than proxies like "nativeness" (Cheng et al., 2022).

Future research on mouthing in ASL should examine attitude to mouthing of languages other than English in the United States, like African American Language and Spanish. This would be an important means of including individuals who are under-represented in ASL research, as AAL and Spanish are markers of cultural identities that are minoritised in the United States. Given the influence of ASL across the world, it would be valuable to extend this study to varieties of ASL used outside of the United States. Signing in Trinidad and Tobago, and other Caribbean countries, shows influence of ASL (Braithwaite, 2018; Bisnath, 2021), but is in contact with local spoken languages that mark local identities. In the case of Trinidad and Tobago, this is primarily Trinidadian English Creole, and may come to be Venezuelan Spanish too given increasing numbers of Venezuelan migrants. The use of mouthing from local languages may be an important part of local ASL dialect formation. Indication of this is found in the identification of Flemish Sign Language (VGT) and French-Belgian Sign Language (LSFB) based on Dutch and French mouthing respectively (Sáfár et al., 2015). Comparative examination of this type, across varieties of ASL inside and outside of the United States, will contribute to understanding how linguistic resources are recruited in marking identity in sign languages.

This dissertation's exploration of language contact between ASL and English in the DHH community in the United States and attitudes toward it represents a means of engaging with sign language use that treats all DHH individuals equally while centering differences in social experience. This approach contributes to the general

understanding of variation in language attitude and to building an understanding of cross-modal language contact, and provides a foundation for making predictions about differences in ASL use that are grounded in the language experiences of DHH individuals.

CHAPTER VII

Appendix

7.1 Principal Components Analysis scree plot

Scree plots, also called elbow plots, are a heuristic used in PCA to select an appropriate number of components to extract. The number on the x-axis at at which the line begins to plateau, its ”elbow”, identifies the number of components to extract.

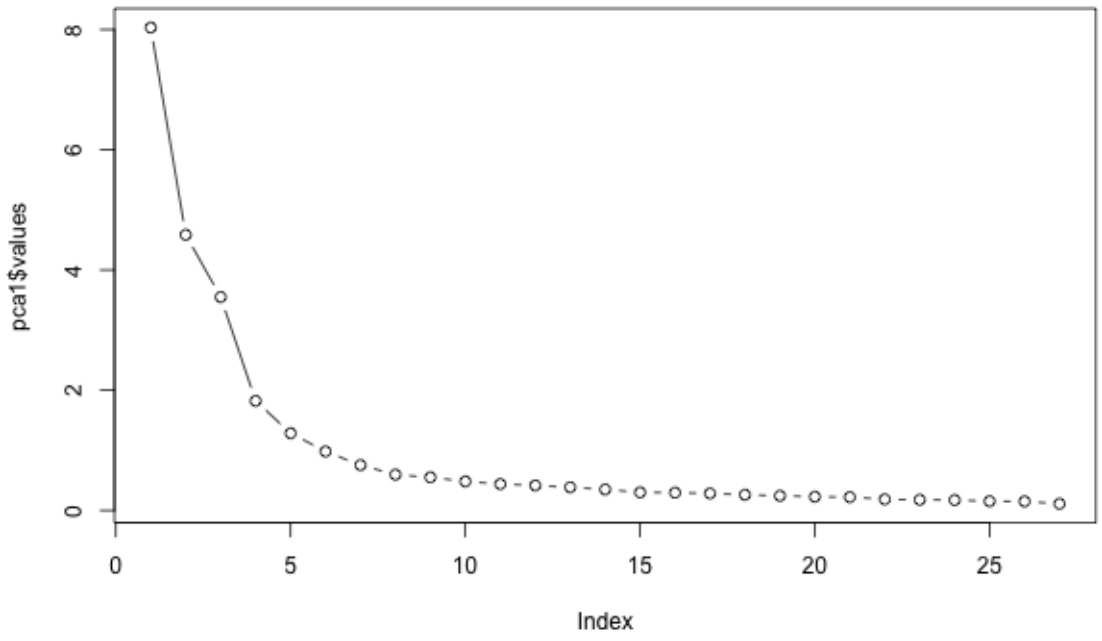


Figure 7.1: pca1 Scree Plot

7.2 Correlations among principal components

Table 7.1: Correlations among Components

	c1	**c2**	**c3**	**c4**	**c5**
c1	1.00	0.40	0.35	0.01	0.25
c2	0.40	1.00	0.35	0.23	0.43
c3	0.35	0.35	1.00	0.34	-0.04
c4	0.01	0.23	0.34	1.00	0.11
c5	0.25	0.43	-0.04	0.11	1.00

1. c1:cEXPERIENCE WITH WRITTEN ENGLISH IN SCHOOL AND A TYPICAL WEEK (Table 3.3)
2. c2: EXPOSURE TO SPOKEN ENGLISH OVER THE LIFETIME (Table 3.4)
3. c3: EXPERIENCE WITH ASL-ENGLISH MIXING IN SCHOOL AND A TYPICAL WEEK (Table 3.5)
4. c4: EXPERIENCE WITH ASL BEFORE SCHOOL (Table 3.6)
5. c5:EXPERIENCE SPEAKING ENGLISH OVER THE LIFETIME (Table 3.7)

7.3 Full experiment and survey in Qualtrics

Internet location of project materials including PDF of survey and links to ASL components: `Mhttps://osf.io/truqk/?view_only=c4cddba1283843e7af071867235aba63`

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