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SOCIOPHONETICS AND SIGNED LANGUAGES

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Introduction

Signed languages use components of the body, including the hands, arms, torso, head, and face, to implement physical manifestations of abstract representations—organized as handshape, movement, and location—in their mental grammar, just as spoken languages do. In other words, signed languages have phonetics. The introduction of this reality to academic linguists is attributed to the work of William Stokoe (1960) and Stokoe, Casterline & Croneberg (1965). Because signed languages are also used within social contexts where signers express not just lexical and grammatical meanings but also social meanings, identities, and stances, these types of meaning can become variables that correlate with phonetic realizations. Thus, as signed language phonetics and phonology have become fields of study, so has signed language sociophonetics. This chapter provides an overview of the sociophonetics of signed languages for those unfamiliar with signed language linguistics generally or for those who have studied other aspects of signed languages and wish to learn about the methods and findings of this particular subfield.

Because the authors study American Sign Language (ASL), as used in North America, and because findings from ASL are disproportionately represented in the field, this imbalance is reflected throughout this chapter. But we stress that signed languages are not a monolith. Glottolog (Hammarström et al. 2021) names 197–202 known signed languages throughout the world (depending on inclusion of auxiliary sign systems and International Sign Language). These languages, and doubtless the many other undocumented signed languages, differ from one another in myriad ways. Some of these differences have analogues in spoken language typology, such as phonological inventory distinctions. For example, Brentari & Eccarius (2010) conducted a cross-linguistic study of three-finger handshapes in ASL, Hong Kong Sign Language, and Swiss German Sign Language. They found four, five, and six three-finger handshapes in these languages, respectively. For categories which may be considered shared by multiple languages, their phonetic implementation will differ between languages, though investigation of these phonetic differences between signed languages is lacking.

Other concerns in signed language typology are less clearly analogous to questions in spoken language studies, such as the role of mouthing spoken language words or the degree to which fingerspelling systems (manual representations of the orthography used to write the surrounding

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spoken language) are integrated into the broader linguistic system (Zeshan & Palfreyman 2017). Signing Deaf communities also differ from one another socioculturally in ways that will surely impact how they use language to index identities and stances. For example, some Deaf communities may be more or less integrated with the surrounding hearing communities, or with other Deaf communities around the world. In some parts of the world, Deaf education consists of dedicated schools in which everyone signs, whereas Deaf children in other places may attend hearing schools or be forbidden to sign in school. Understanding the breadth of the human capacity for employing sociolinguistic variation will require study of signed language use in all of these diverse contexts. It is important when presenting results from signed language studies to carefully note whether, why, and how results might or might not be expected to generalize to other signed languages. This allows us to generate testable hypotheses and avoid reinforcing the misconception that signed languages are less diverse than spoken languages.

The following sections will introduce some of the important questions, findings, and research tools in the field of signed language sociophonetics. As noted above, some of these topics will look familiar to those who have studied spoken language sociophonetics, and others will highlight differences from spoken language data. Methodological considerations are discussed first (data collection and textual representation) followed by theoretical topics (sociolinguistic variables, the phonetics–phonology interface, and connections between synchronic variation and diachronic change). The final section presents a brief case study of a phenomenon known as dominance reversal as observed among several signers of a variety of American Sign Language (ASL) signed in the Philadelphia, Pennsylvania area. Our conclusion will pose some questions that arise from this preliminary observation of data as well as some of the many other areas yet left unexplored within signed language sociophonetics.

Literature review

Sociolinguistic data collection in Deaf communities

The methods we use for signed language data collection and analysis depend on the theoretical questions at hand. While it is possible to use qualitative methods like introspection and self-analysis of linguistic production (Mittelberg 2007) to understand reasons for variation, much of the focus of current research centers on qualitative and quantitative analysis of free or semi-structured conversations (McCaskill et al. 2011) and elicitation tasks (Volterra et al. 1984), and mining corpora for specific linguistic tokens (see Fenlon et al. 2015; Börstell 2016; McKee, Safar & Alexander 2021 for examples). All of these methods require video-recording signers, which complicates data collection. High-quality cameras are likely more obtrusive than audio recording devices for spoken languages and may therefore be more likely to affect the perceived formality of the setting, thus reducing naturalistic conversational styles. To minimize this effect, researchers may adopt several different strategies: recording in a comfortable setting that is familiar to the participant, minimizing equipment use, and eliminating the first few minutes of recording from analysis (Van Herreweghe & Vermeerbergen 2012; Lucas 2013). In signing communities, it is also especially important to consider shared or differing cultural affiliations between the participant and any interviewer or bystanders. It is often suggested that including only interlocutors of the same audiological status (that is, Deaf, hard of hearing, or hearing; Lucas & Valli 1992), ethnicity (Lucas & Valli 1992; McCaskill et al. 2011; Hill et al. 2015; Hill 2017), and even regional background (Fisher, Hochgesang & Tamminga 2021) can put the participant at ease and thus facilitate authentic, naturalistic conversation. Lucas & Valli (1992) found that some signers may employ

more English influence on their signing when interacting with hearing signers, while others may do so when signing with an interlocutor they don't know well.

Participant selection for sociolinguistic studies requires familiarity with local Deaf social contexts and, again, careful consideration of the research questions at hand. Effects of age, region, and language background as independent variables manifest differently in Deaf communities than in hearing communities (Lucas 2013). School affiliation has a significant impact on language variation in Deaf communities due to the prevalence of horizontal (peer-to-peer) language transmission over vertical (parent-to-child) transmission. This may be especially true for children attending Deaf residential schools. Participant age may correlate with educational language policy and therefore affect acquisition profiles in ways that are difficult to disentangle from other forces driving change. For example, in the United States (and probably elsewhere), older Deaf people and their signing tend to be affected by policies of strict oralism (no signing permitted in instruction) while the prevalence among younger Deaf children of education in the mainstream limits their exposure to native sign models and other Deaf peers (Johnson, Liddell & Erting 1989; Baynton 1996; Burch 2002). Van Herreweghe & Vermeerbergen (2012) suggest early onset of signed language acquisition, education in a school for the deaf, daily use of the signed language in question, and prolonged membership of the respective Deaf community as possible (though not exhaustive) criteria for selection. That said, these criteria could lead to disproportionate representation of elite or privileged Deaf community members (see Fisher, Hochgesang, Tamminga & Miller 2021), excluding significant populations of signers within a particular community. Costello, Fernández & Landa (2008) present the case of the Deaf community in Basque Country in Spain, where there is an extremely small number of deaf signers acquiring language from deaf language models. These authors point out that this situation necessitates special methodological considerations.

Thus signed language research is typical in that selection criteria must be determined by the research question at hand, but relevant selection criteria among Deaf communities are in fact unique. In addition to the previously studied factors just mentioned, we propose that being born to hearing signing or hearing non-signing families may be a source of variation among Deaf signers. Complementary research elucidating the historical context and social makeup of each community serve to support quantitative analysis of variation within a particular signing community (see Fisher, Tamminga & Hochgesang 2018; Fisher, Hochgesang, Tamminga & Miller 2021 for examples).

As Deaf signed language users have historically been oppressed and their language suppressed by hearing people, entry into signing communities is often limited to trusted points of contact referred to by Milroy (1987:70) as "brokers." Such brokers often have meaningful connections to the community members as well as the researchers, thereby implicitly and explicitly building trust for research participation (see McCaskill et al. 2011; Lucas 2013 for examples). Building on this model of trust is the researcher-participant model wherein early participants in research are trained to take part in data collection and other research activities (see the Philadelphia Signs Project; Fisher, Hochgesang & Tamminga 2021). This model extends beyond sociolinguistics research (see Singleton, Martin & Morgan 2015) and is good practice for research in and with Deaf communities as it advocates for a community-driven agenda and research with mutual benefit and reciprocity.

The need for video-recorded data poses an additional complication for signed language studies: it precludes the possibility of maintaining participant anonymity. Since both manual and nonmanual linguistic features are produced on and around the face, obscuring participants' faces to mask their identity is not a viable workaround. We must be clear about this in informed consent and protective of the participants in the ways in which we use these data in public forums (for example, restricting use of data by other sources, redacting any incriminating

information, etc.). Crasborn (2010) describes a number of ways in which the publication of video data from signed languages raises ethical concerns that researchers need to take into consideration. For example, participants' varying degrees of literacy in the written form of the surrounding spoken language may impact the accessibility of written informed consent documents. Crasborn discusses several best practices for eliciting informed consent in this context. However, he also points out that the possibility for unforeseen future technological advancements means that it is very hard for anyone to understand what they might be consenting to when they agree to have videos of themselves publicly shared on the internet, even given the best possible consent procedure. These ethical considerations are especially acute for researchers building publicly accessible corpora. An example of a project that is adopting new technological approaches to help manage different tiers of availability for video data is the Motivated Look at Indicating Verbs in ASL (MoLo) project (Dudis et al. 2020). By adding watermarks indicating access levels (open, researcher only, MoLo team only) to their videos, they put data privacy considerations visually front and center.

While academics typically publish their results in academic journals, awareness of the history of marginalization of Deaf communities leads many signed language researchers to adopt an ethos that they must ensure global accessibility of findings for Deaf communities in order to avoid further exploitation. Thus, considerations based on register, language accessibility, and technology must be made in information dissemination efforts. For example, in presentation and publication, Wolfram (2013) cautions against the use of academic jargon, while Lucas (2013) suggests linguistic and visual accommodations to ensure accessibility to community members. In addition, it is imperative that researchers create materials that are both technically accessible and useful to the participants and other community members. For example, Lucas, Bayley & Valli's (2001) book caters to Deaf community members' interest in lexical variation, while the Philadelphia Signs Project website (https://pennds.org/phillysigns/) was created to highlight lexical variation and stories of and by Deaf people from the Philadelphia region.

Issues in textual representation

The question of how to textually represent data is important for any sociophonetician. This question is more complex for researchers studying signed languages for several reasons, however. There is no widely used written form of signed languages nor any standardized notation system equivalent to the International Phonetic Alphabet, so there is no obvious choice for representing lexical items, regardless of whether the goal is to be informative about phonetic form or not. This section overviews approaches and challenges to textual representation.

Researchers documenting signed language may distinguish between "annotation," referring to any form of textual representation of language data, and "notation," a form of textual representation that gives information about the linguistic form (Hochgesang 2014). Common forms of signed language annotation include glossing and ID glossing (e.g., Johnston 2010; Hodge & Crasborn 2022). Glossing uses writing, generally in small caps, to represent words from the surrounding spoken language that roughly correspond in meaning to a sign. For example, a researcher may use the gloss BIRTHDAY to represent an ASL sign on paper that has the meaning 'birthday.' The problem with this approach is that, without an accompanying photo or, better still, video, the form of this sign remains unknown to the reader (Hochgesang 2022). The concept 'birthday' in particular is known to be represented by many different signs depending on a signer's region. One solution to this problem is the use of ID glossing, in which each sign that is perceived as a distinct lexical item receives a unique textual label. These labels are then housed in a database of videos so

that the precise form of each sign can be accessed. An example of such a database is ASL Signbank (Hochgesang, Crasborn & Lillo-Martin 2017–2021).

ID glossing greatly improves data accessibility over traditional glossing, especially by providing machine-readability. By linking to relevant entries in signbanks (through an External Controlled Vocabulary or ECV link in ELAN [Crasborn & Sloetjes 2008]), researchers can maintain the connection between textual representations and video and photo of the represented sign. Since this linking also connects ID glosses to additional information about a sign in its signbank entry (phonological and morphosyntactic properties), it allows for a certain amount of semi-automatic annotation in the linked transcripts. However, this approach is still insufficient for sociophonetic research. At the level of lemmatization, decisions must be made about what differences in form should justify a difference in labels. For example, there may be a sign that can occur as either a one- or two-handed sign. In some signers' lexicons, perhaps only the one-handed version exists. For other signers, the two-handed sign may be the citation form with the one-handed version surfacing in specific contexts. Database creators must make a systematic decision about whether only a single textual label should be used for both the one- and two-handed versions or whether two separate labels are warranted. If only one label is used, the information about handedness in a given production is lost in the textual representation. For less categorical distinctions than handedness, such as location or articulator velocity, the problem is even greater.

When textual representation needs to provide information about the form of a sign (or of a given production of a sign), a notation system must be used. Since the inception of signed language linguistics, multiple systems have been developed. The first, presented in Stokoe (1960), consisted of symbols for handshapes, movements, and locations, with diacritics representing palm orientation. For the most part, only phonemic contrasts were represented by Stokoe Notation; allophonic differences were generally obscured. For example, the same symbol was used to represent both of the handshapes in Figure 22.1 below, because this difference alone is not enough to produce a difference in meaning in conventionalized ASL signs (although it signals distinct letters in the ASL manual alphabet and could create distinct meaning within the classifier system).

This overlap in representation of distinct allophones makes Stokoe Notation ill-suited to phonetic and sociophonetic documentation. And since Stokoe's innovation, we have learned that signed language phonological structure can be described not just as an inventory of holistic handshapes, locations, movements, and orientations, but rather as features combining to produce these larger units. These features specify things like which fingers are involved in a sign's production and how flexed or extended the joints of those fingers are. Some notation systems that have grown out of Stokoe Notation still follow the same basic principle of holistic labels for handshapes, locations, movements, and orientations but with the ability to capture allophonic differences or errors in

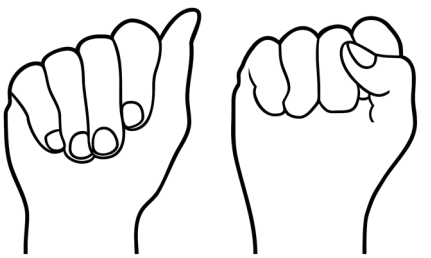

Figure 22.1 A handshape (left) and S handshape (right)

production. For example, the Hamburg Notation System for Sign Languages (HamNoSys; Hanke 2004) provides symbols to describe the handshape, orientation, and location at the beginning of a sign, and, where applicable, any changes in those categories that occur throughout the sign. HamNoSys also allows annotators to describe nonmanual (facial) gestures important to the sign production.

Even though our understanding of the mental organization of sign components has deepened, researchers still disagree about the precise inventory of smaller units that make up the phonological categories of handshapes, movements, and locations and how these units are organized with respect to one another in the phonology. Proposed notation systems vary in the degree to which they are designed to represent more abstract phonological categories or more phonetic detail (Hochgesang 2014), and because most correspond to a specific theory of the phonological organization of signs, this disagreement poses an obstacle to developing a single, widely used notation system.

Eccarius & Brentari (2008) provide a notation system for handshapes observed in ten different signed languages. This system is based on the Prosodic Model (Brentari 1998), which draws upon work from spoken language phonology such as autosegmental phonology, feature geometry, and Optimality Theory (Prince & Smolensky 2004) to propose a structure for the mental organization of the units of signed language phonology. In another model put forth by Liddell & Johnson (1989, 2019) and Johnson & Liddell (2011a, 2011b, 2011c, 2012), signs are composed of sequentially organized segments. Each segment contains values for the phonetic details involved in producing that portion of the sign, such as the flexion/extension of each finger joint and location of the hand(s) in space or on the signer's body. In other models, such as the Prosodic Model developed by Brentari (1998), the hierarchical organization of units in the phonology is reversed, where units that specify the timing relationship between different features (i.e., the segments) are isomorphic with the level of the morpheme, so that any change in handshape or location that occurs throughout the sign is specified only once as a property of the whole morpheme, rather than resulting from features that are specified independently at each temporally sequential portion of that morpheme. The reason for proposing this type of structure, rather than what is proposed by Johnson & Liddell, comes from evidence like the fact that handshapes tend to change in constrained ways throughout a sign: the handshapes at the beginning and end of a sign typically involve the same fingers and can only differ in joint configuration. Thus a single feature indicating the "important" fingers and another specifying opening or closing of those fingers can be used, rather than indicating the fingers and their configuration at the beginning, middle, and end of the sign.

Ultimately, the research question at hand determines which notation system is most appropriate to represent data for a given study. Even when expanded to allow for narrower transcription, Stokoe-based notation systems are still aimed more toward describing categories that distinguish signs within the lexicon, rather than representing distinctions in phonetic production. For example, Eccarius & Brentari's (2008) handshape coding system provides separate joint configuration symbols for the base finger joints, the base thumb joint, and the remaining finger joints. While this provides more information than a single label for an entire handshape, it still treats the second and third finger joints as a single category and so would not be useful for examining this level of phonetic detail. An alternative type of notation system can be found in Liddell & Johnson (1989, 2019) and Johnson & Liddell (2011a, 2011b, 2011c, 2012). This system treats signs as a series of static and dynamic segments (similar to consonants and vowels in articulatory manner). Within each static segment, the configuration of each individual joint, the location, and the palm orientation are identified. Within dynamic segments, these properties are identified as either changing or

not. This type of system allows us to capture differences that do not result in a change in category (either phonemic or allophonic) but that may nonetheless be systematic and predictable based on linguistic and/or sociolinguistic variables.

The issues raised in this section ultimately reflect the fact that the conundrum of disentangling phonetics from phonology is not new; signed language sociophoneticians are like all phoneticians and phonologists in needing to grapple with this question. We continue to highlight these issues in the following subsections, as we turn to a survey of existing empirical research on sociophonetic variation and change in signed languages.

Social influences on signed language variation

The first published observations on social factors influencing ASL come in Croneberg's two appendices (C and D) to the 1965 *Dictionary of American Sign Language* (Stokoe, Casterline & Croneberg 1965). Here, he describes the extensive, cross-country network of deaf people and the various social and economic factors that contribute to community development and maintenance and their impact on signed language variation and change. This work is considered foundational to understanding the role of social factors in signed language variation and change. Early research on sociolinguistic variation, including lexical and grammatical variation, highlighted unique aspects of the social forces at play in Deaf communities. For example, Woodward's (1973) study of ASL verb reduplication examined whether variation in reduplication could be attributed to the participant's hearing status (deaf or hearing), whether they had deaf parents (to represent variety in modes of transmission), whether they learned sign before age 6 (examining the role of earlier language exposure and transmission), and whether or not they attended college (to examine the role of education in preserving cultural values and maintaining more formal registers in the language). He found that the most important factor was deafness and the second most important was having deaf parents, reflecting the fact that signed language transmission was, at the time, typically from peer to peer in residential settings rather than from parent to child, as is usually observed with spoken languages.

Much subsequent research on the social factors influencing phonetic and phonological variation in signed languages has developed in the variationist tradition, especially following from Lucas, Bayley & Valli (2001). Lucas and colleagues video-recorded sociolinguistic interviews with 207 Deaf native or near-native ASL signers in seven locations across the United States with large and active Deaf communities (Staunton, Virginia; Frederick, Maryland; Boston, Massachusetts; Olathe, Kansas; New Orleans, Louisiana; Fremont, California; and Bellingham, Washington). Other quantitative studies of the factors conditioning the use of sociolinguistic variables in the phonetics, phonology, and lexicon of ASL include Bayley, Lucas & Rose (2000, 2002); Lucas, Bayley, Reed & Wulf (2001); Lucas et al. (2002); Wulf et al. (2002); and Lucas & Bayley (2005). In comparing this conditioning to what we know about variation and change in spoken languages, Lucas, Bayley & Valli (2001) primarily emphasize the empirical similarities in sociolinguistic variation between signed languages and spoken languages. They find that, like in spoken languages, phonological variation in ASL is systematically conditioned by both linguistic factors, such as phonological context and grammatical function, and also social factors, like region, ethnicity, age, and gender. However, they also highlight that the typical mode of language transmission (via deaf peers at residential schools) and education policy affecting deaf children have critical impacts on—and thus must be at the forefront of analyzing—ASL variation and change.

These studies of ASL provided a foundational model for documenting and analyzing variation in other signed languages, including British Sign Language (BSL; Fenlon et al. 2013; Fenlon,

Schembri & Cormier 2018), Australian Sign Language (Auslan; Schembri et al. 2009), Brazilian Sign Language (Libras; Schmitt 2020), and Italian Sign Language (LIS; Geraci et al. 2011). These studies not only diversify the literature in which ASL is over-represented but also contribute novel findings about factors that predict phonetic variation that were not included in the ASL studies. For example, both Schembri et al. (2009) and Fenlon et al. (2013) found an effect of lexical frequency. Fenlon et al. in fact found only one significant social factor (region) in variation of the 1 handshape, and they attribute this difference from ASL findings to the fact that they only included up to three instances of any single lexical item from a given signer and included lexical item as a factor in their mixed-effects regression. They suggest that results attributed in Bayley, Lucas & Rose (2002) to complex interactions with social factors may have in fact been due to an over-representation of pronoun signs.

The project by Lucas, Bayley & Valli (2001) also provided a framework for an overlapping group of ASL researchers when they set out to document and analyze Black ASL as it is used in the American South. Research on the variety of ASL used by Black American signers in the United States goes back at least to Woodward & Erting's (1974, 1975) observations that some Black southern signing did not exhibit all of the phonological changes noted by Frishberg's (1975) study of historical change in ASL. Woodward (1976) subsequently reports on lexical items, phonological variation, and language attitudes among Black southern signers and compares these to white and northern signers. Building on these studies as well as drawing from anecdotal observation in southern Black Deaf communities and from research on African American English (AAE), McCaskill et al. (2011) filmed free conversation, interviews, and word-elicitation tasks at seven sites with 96 Black ASL users who attended segregated (signers age 55 and older) and desegregated (signers age 35 and younger) schools. One generalization that can be taken from the detailed findings published in McCaskill et al. (2011) and related publications (for example, Hill 2017) is that Black ASL is more linguistically conservative than mainstream ASL in a number of respects. The existence of a distinct variety of ASL among Black Deaf Americans has been argued to result from racial segregation: during the late 1800s and well into the twentieth century, the oralist approach was seen to be more advanced and thus more fitting for white signers. Black signers were not given access to oralist pedagogy and thus maintained their ASL use where white signers did not (Woodward 1976; McCaskill et al. 2011). A review by Toliver-Smith & Gentry (2017) suggests that while Black ASL is acknowledged as a distinct entity, systematic study of this variety is still scarce.

Recently, there has been a deliberate effort to understand how intersectional identities within Deaf communities impact variation and change in signed languages. For example, Blau (2017) looks at sociophonetic variation in Deaf gay men, finding that they articulate signs more distally (with joints farther away from the torso, closer to the hand) than the citation form as compared to participants who did not identify as part of that community. Though the study was small, it suggests that alternation in articulated joints may have more meaning than previously thought, giving rise to the possibility that this type of variation could be a distinctive marker of a particular social group. Palfreyman (2020) analyzes four variables in an Indonesian Sign Language (BISINDO) corpus and argues that variation reflects social meaning in that community in four ways: as a reinforcement of regional identity; as commentary on ASL influence on the language and people; as distinction between deaf and hearing roles in society; and as an indicator of Javanese identity. In this case, ASL plays a similarly imperialist role in the Indonesian Deaf community as English does in formerly colonized communities; it is a symbol of contact with outside communities and educational attainment while also evidence of how BISINDO has been supplanted by an outside influence with outsized power. The hearing–deaf dynamics are similarly fraught, in

that hearing community members tend to have more power and decision-making abilities than do Deaf community members, and this plays out in the language in that it reflects identity and other affiliations. These dimensions point to the interface of complex intersectional experiences that must be considered in variationist research within Deaf communities. Lastly, Mirus, Fisher & Napoli (2019) look at lexical and sublexical changes in iconic signs in American Sign Language. Some of these changes are in response to inevitable misalignment of form and meaning due to environmental changes. For example, with technology updates, the sign for "using a credit card" now resembles the swiping movement of credit card use rather than the old form which imitates the manual carbon copying of a credit card by a merchant. Other changes reflect cultural and social realignment with the values and experiences of various Deaf social groups: the sign meaning 'lesbian' has changed contact location from the webbing between the thumb and index finger to the tip of the index finger in an L-handshape, thus moving away from an iconic sign suggestive of sexual acts to a more arbitrary sign to indicate a community of people. Ultimately, the authors suggest that language change must take into account the idea of correction prompted by sensitive topics within the community, as they are external forces that invariably influence the production of language itself.

Approaches to signed language variation at the phonetics–phonology interface

The variationist research discussed in the previous subsection has typically used logistic regression, implemented in programs such as Varbrul (Rousseau & Sankoff 1978), as its key statistical tool. Logistic (or relatedly, multinomial) regression requires the dependent variable to be discrete—that is, involving choices between a small class of qualitatively distinct options. Modeling the factors that make one choice or the other more likely is a natural fit for variable phonological phenomena, which arguably manipulate abstract symbolic units. For example, in Bayley, Lucas & Rose's (2002) study of variation in the 1-handshape variable, non-citation variants such as the L-handshape or the open hand are modeled as distinct options that a signer might choose. Similarly, treating the variation between ear-to-chin and chin-to-ear forms of the sign DEAF as involving discrete variants, as Bayley, Lucas & Rose (2000) do, is consistent with Liddell & Johnson's (1989:244–245) analysis of these forms as involving phonological metathesis.

In some cases the statistical tools of the variationist framework have led researchers into a more arbitrary discretization of a seemingly continuous dimension. For example, Lucas et al. (2002) coded a lexical class of one-handed signs canonically produced at the temple, the ASL "know" sign class, as being either citation form (above the eyebrow ridge) or lowered (below the eyebrow ridge). They found that grammatical category and phonological context significantly influenced the probability of lowering. Tamminga, Fisher & Hochgesang (2020) similarly bin weak-hand production variation into a small number of discrete categories even though the phenomena in their study—weak-hand lowering in canonically two-handed signs and weak-hand involvement in canonically one-handed signs—almost certainly exist on a continuous dimension. These weak-hand variable phenomena highlight two additional complications for research on signed language sociophonetics. First, it seems likely that there are multiple variable processes at play simultaneously: a two-handed sign could exhibit either gradient lowering or wholesale omission of the weak hand (the latter sometimes being called "weak hand drop"). Second, there is not agreement on what form is in fact "canonical" for any given sign, and the possibility space is quite complicated: different signers may have different or multiple lexical representations for different signs. Both of these issues, of course, have parallels in the study of intra- and inter-speaker

variation in spoken languages. We see them as interesting areas of theoretical investigation rather than obstacles.

A recent development that may prove crucial in understanding these questions is a stream of research applying technological tools to measure variation along phonetically gradient dimensions (Tyrone & Mauk 2010; Tyrone 2015). The use of instrumental techniques to study the articulation of signed languages is comparable to the use of technology like ultrasound or electromagnetic articulography to track the speech articulators in spoken languages. The new technologies being used to automatically capture properties of sign articulation include motion capture systems and electronic data glove systems. Motion capture systems involve placing markers on the body and then recording motion at a high sampling rate in three-dimensional space. Optical motion capture systems such as Optotrak and Vicon use infrared light to track motion, although there are other options. Data glove systems, or cybergloves, involve gloves that the signer wears to capture the physical movement of the hands using strain gauges. Another technological development is the application of motion detection algorithms to normal video. Tyrone (2015) provides a thorough review of these instrumental options and their pros and cons. While researchers are exploring how these technologies may be further developed to facilitate automated processing of signed language, at the moment such technologies are limited and not in wide use by linguists.

Many of the instrumental studies that have been done so far in signed language phonetics have investigated location variation under experimentally controlled conditions. Results of these studies have shown that signing speed, characteristics of surrounding signs, and where a sign appears in an utterance can all affect sign location. For example, Tyrone & Mauk (2010) investigated the location of the ASL sign WONDER, which is specified for forehead location. In contrast to the variationist literature reviewed above, lowering here was not operationalized as a categorical variable. The location of each token of WONDER was measured using the optoelectronic system, Optotrak. Small infrared light emitting devices were fixed to each signer's index finger and their location was tracked by infrared cameras. Location was measured as millimeters above or below a device fixed to the signer's head. This approach allowed sign lowering to be treated as a gradient phonetic process and showed that the location of WONDER became lower as signing rate increased for five of their six participants. Signing rate also interacted with phonetic context (the location of preceding and following signs) and utterance position (initial or final) to affect lowering. Parameters other than location deserve treatment as gradient phonetic phenomena as well. Cheek (2001) found that handshape also varies in accordance with the phonetic impact of surrounding signs and signing rate. Such studies on handshape are scarce, however, and even fewer have addressed movement. Tyrone (2012) suggests this imbalance comes from the relative ease of measuring location and of comparing location data to spoken language phonetic data.

Even with the availability of new instrumental technologies, signed language phoneticians face several unique obstacles. One is the issue of data normalization. Spoken language phoneticians follow well-established and tested methods of transforming measurements such as formant values to account for the fact that speakers have vocal tracts of different shapes and sizes (see, e.g., Adank, Smits & van Hout 2004; Cox & Docherty this volume; Watt, Renwick & Stanley this volume). In contrast, we have no established way to account for the fact that signers' articulators also differ in size and shape. Furthermore, phonetic implementation of a feature like location may involve not only raising and lowering of the hand/arm. Mauk & Tyrone (2012) found that signers may move their head toward their hand rather than simply moving their hand toward their head to achieve a forehead location. Thus describing phonetic implementation requires attention even to

movement of articulators which are typically considered passive. This level of description is typically not provided in the sociophonetic literature, however.

Yet another reason we know so little about signed language phonetics, and a partial explanation for the lack of precise articulatory description of data, stems from an assumption that has seemed to pervade thinking about the visual modality: that, because the articulators are visually accessible, there is no consequential mediation between perception and processing. That is, researchers have treated the phonetics–phonology interface as unimportant for signed languages because we have characterized the articulators as directly accessible because they are visible. For example, Crasborn (2012:7) suggests the lack of phonetic description of signed languages may proceed from "the impression that we can see the articulators in sign languages [which] has made it self-evident what the phonological form looks like, and in that way reduced the need for an accurate phonetic description." Similarly, Brentari (2019:47), describing signal differences between the spoken and signed modalities, writes, "the articulators in sign languages are directly visible, while the articulators in speech have to be inferred indirectly. For example, when the hands assume a particular shape we can see all moments of the articulatory process, while when the tongue assumes a particular shape we cannot." It is not clear, however, why visual perception should be considered any more direct than auditory perception. Tyrone (2012) argues that this assumption has been an obstacle to our understanding of signed language phonetics. We contend that the issue is perhaps a lack of integration of knowledge from the field of visual perception that has prevented signed language linguists from describing phonetics in terms of the visual signal, rather than that the bridge from phonetic signal to phonological form is trivial. The issues raised above in the study of weak-hand variation—where multiple analyses are available for any given surface form—highlight the problem with this assumption: even when the variable in question is as seemingly categorical as involvement of the weak hand, visual access to production does not provide automatic access to underlying representations or preclude mediating perceptual processes. Description of form is therefore, we argue, no less crucial to signed language research than to studies of spoken language.

Connections to diachronic change

While studies of synchronic variation have made progress highlighting the linguistic and social conditioning of variation in signed languages, the use of similar data to study signed language change-in-progress is somewhat less common. Of particular relevance to this chapter, the study of what in spoken languages is often called "sound change"—that is, change in the phonetics and phonology of a language (Boberg this volume)—is not a deeply developed area in the visual-manual modality. It has even been claimed that signed languages do not undergo this type of change at the phonological level (Moser 1990). Napoli & Sanders (in progress) propose iconicity as the force that rules out this type of change. We suggest that the rarity of uninterrupted generational transmission (i.e., Deaf parents to Deaf children) of signed languages may also play a role in why this type of change has not been observed. Investigation of change over time in a signed language of a relatively isolated Deaf community might shed light on this hypothesis. Despite our lack of understanding of regular change, or lack thereof, in signed languages, a handful of influential studies have laid the groundwork for future research activity in this area by connecting potential pressures from conversational signing to observations about historical outcomes.

A touchstone in the study of signed language change is Frishberg (1975), which lays out a number of dimensions of historical change that, she argues, all involve an overall tendency away

from iconicity in favor of arbitrariness. Her discussion of the motivations for these trajectories draws a clear line between the pressures of conversational signing and the diachronic outcomes. For example, one dimension is an increase in both handshape and movement symmetry, which she attributes to the articulatory ease of programming both hands simultaneously and the perceptual benefits of redundancy. An opposing tendency she identifies, which she terms "head displacement" (1975:703), is for two-handed signs to become one-handed when they are near the face, where visual perception may be more easily able to detect smaller or subtler movements and therefore doesn't require as much redundant input. Frishberg's subsequent dissertation further develops the case that ASL "has evolved through regular linguistic change from a more pantomimic or iconic origin to its present day more arbitrary or symbolic state" (Frishberg 1976:2).

Frishberg's work is based on her observations of how the contemporaneous forms of signs as documented in Stokoe, Casterline & Croneberg (1965) compare to scholars' descriptions of nineteenth-century Old French Sign Language (from which ASL is generally argued to be descended) and, as an intermediate reference point, Long (1918). While groundbreaking, the generalizations she puts forward are probably best interpreted as hypotheses that could be supported or falsified through quantitative analysis. An example of such a study is Woodward & DeSantis's (1977) study of head displacement. Woodward & DeSantis (1977) elicit eight two-handed ASL signs canonically articulated on the face from 75 ASL signers (40 white and 35 Black) and French Sign Language (LSF) cognates from 60 LSF signers, and find an implicational relationship such that signers who have the one-handed form also have the two-handed form (but not necessarily vice versa). This suggests that the one-handed form is a later development. They also find that older signers retain more two-handed sign forms than younger signers among both their American and French participants, which could be an apparent-time reflection of change-in-progress.

Woodward & DeSantis (1977:334) also find quantitative support for the kinds of perceptual mechanisms Frishberg proposed, such as evidence that deletion of the second hand is "allowed first in those areas that are more salient to vision." On the other hand, Tamminga, Fisher & Hochgesang (2020) fail to find conversational signing evidence to support the related prediction that weak-hand lowering, construed as a gradient lenition process providing a pathway to weak-hand deletion, should occur more frequently around the face than around the torso.

Rimor et al. (1984) test the relationship between synchronic pressures and change with experimental evidence from a speeded serial transmission task (where a message is passed between signers in a chain) and a style-shifting task (eliciting isolated citation forms compared to conversational forms). They argue that their results support the proposal that both synchronic and diachronic reductions are attributable to the pressures of articulatory and perceptual ease. The treatment of ease of articulation and perception in the signed language literature has become more complex in recent years. Napoli, Sanders & Wright (2014) give an in-depth discussion of what articulatory ease means for both nonmanual and manual aspects of signed languages. For a sample of ASL lexical items, they advocate for the functional importance of ease of articulation by comparing elicited forms that signers would use in casual connected signing and a reference citation form for each sign. Sanders & Napoli (2016) introduce "reactive effort"—the effort required to hold the rest of the body still while the active articulators work—as a force shaping movement distributions in signed language lexicons. Finally, phonetic reduction processes have been identified as part of the grammaticalization pathways by which open-class lexical items can come to take on closed-class grammatical functions over time, in signed languages just as in spoken languages (Pfau & Steinbach 2006; Johnston et al. 2015).

CASE STUDY Convergence in Philadelphia ASL dominance reversal

In addition to presenting methodologies and considerations particular to the sociophonetic study of signed languages, the previous sections have touched upon several sources of variation that can be fruitfully investigated from a sociophonetic perspective. In this section, we focus upon one in particular to provide a more in-depth demonstration of an area of investigation currently being pursued in the field: dominance reversal in ASL.

ASL and other signed languages make use of both hands as articulators, but the two hands can play independent roles in sign formation. Very broadly, signs may be one-handed, symmetrical two-handed, or asymmetrical two-handed. For one-handed signs, signers typically use their preferred hand to articulate the sign. A signer's preferred hand is determined by their handedness behavior across everyday tasks, whereas the concept of a dominant hand refers to abstract generalizations about how signs are formed. In asymmetrical two-handed signs, one hand plays the dominant role as an active articulator that has a fuller range of handshape possibilities. Meanwhile, the hand playing the non-dominant role serves as the passive articulator and can have only one of a small set of handshapes.

The notion of dominance here is a phonotactic one, characterizing abstract constraints on statistically more probable and improbable sign forms (Battison 1974). No signed language studied to date has a contrastive role for left-hand versus right-hand dominance (Crasborn 2011). While the default is often for signers to realize dominant hand forms with their preferred hand, they are free to switch which hand plays the dominant role during the production of conversational signing. This phenomenon, called "dominance reversal" (Frishberg 1985), tends to be attributed to cases where the preferred hand is otherwise occupied, such as if the signer is carrying a coffee cup. However, it is possible for dominance reversal to occur in conversational signing without obvious nonlinguistic motivation. Dominance reversal has been attested not only in ASL but also in a number of other signed languages (Nilsson 2007; Hendriks 2008; Crasborn & Sáfár 2016). We take dominance reversal to be phonetic in that it involves form variation that does not seem to be encoded in the phonology. Because dominance reversal is inherently categorical, however, it is not subject to the same obstacles of measurement described earlier in the chapter for more gradient phenomena.

Dominance reversal, and handedness more generally, is reported to be of low social or perceptual salience, at least for fluent signers. Crasborn (2011), for example, notes that signers do not report remembering the hand preference of their recent interlocutors. Nonetheless, it has been argued that reversal can be used "for the purpose of creating semantic connections or contrasts between elements within the narrative" (Frishberg 1985:83). There is also some preliminary evidence that dominance reversal in ASL can be sensitive to social factors (Frishberg 1985) and stylistic factors (Zimmer 1989), but most of the focus has been on the discourse-pragmatic uses of dominance reversal. Here we report a small case study suggesting convergence between interlocutors in dominance reversal in Philadelphia ASL.

Methods

The case study uses data from two participants in the Philadelphia Signs Project (PSP), a corpus of sociolinguistic interviews in ASL with Deaf Philadelphians. The interviews are modeled after Labov's (1984) interview methodology and previous sociolinguistic work in ASL (Lucas, Bayley & Valli 2001).

Our coding for dominance reversal relied on a simple categorization of whether the hand playing the dominant role was or was not reversed during continuous signing. Following Crasborn & Safar (2016:239), signs or stretches of signing were designated as reversed when the participant used their apparent non-preferred hand to play the dominant role in an asymmetrical two-handed sign or to articulate a one-handed sign. In our coding, the beginnings and endings of utterances were identified as soon as hand movement began or ended. The coding was done in ELAN on a tier separate from the other levels of annotation being used in the corpus. We coded two-handed symmetrical signs according to the hand dominance of the previously articulated signs, even though dominance is technically not a factor in these types of signs. In other words, we began coding a sequence of signs as reversed when there was first evidence for reversal, and continued this classification in the sequence until there was positive evidence that dominance was no longer reversed. When a two-handed sign began the utterance, we followed the hand dominance of the last sign in the previous utterance.

"Buoys" are a manual way of keeping track of referents in signed language discourse. They typically make use of the non-dominant hand as a persistent representation of the referent while the dominant hand continues to add new and meaningful content (see Quer et al. 2017:86). Following Hendriks (2008), we categorized buoys as simultaneous constructions and thus did not code them as reversed. We did include one-word responses such as RIGHT, NOT, or YES in dominance reversal coding, whereas Crasborn & Safar (2016) do not.

The dependent variable in our analyses in this section is the number of minutes during which a signer exhibited dominance reversal, reported as a percentage of the overall time during which that signer was signing during the interview. Many more fine-grained measures of dominance reversal could be adopted, but this approach provides a reasonable first-pass estimation of how prevalent dominance reversal is overall within an individual's signing behavior during a conversation.

While previous research has made clear that dominance reversal can be used for discourse-pragmatic purposes, it is equally clear that dominance reversal is never obligatory even when the discourse context would motivate its use. This means that there is more to be said about when and why signers use dominance reversal: What kinds of social and stylistic factors might additionally influence a signer's choice to reverse dominance? Here we take a preliminary look at the possible influence of social interaction between interlocutors on the rate at which those interlocutors use dominance reversal. We do this by looking at a case where we have data from the same signer across more than one interview event.

We focus on a series of three recorded interviews involving Domonic, a Black Deaf man in his late twenties at the time of the recordings. Domonic is now one of our project interviewers, but was himself interviewed as a participant before he joined the interviewer team. His initial interview was conducted by a Black Deaf woman in her late thirties named Janessa. We compare his use of dominance reversal in that interview to two interviews that he conducted with Danisha, a Black Deaf woman in her thirties. Danisha was interviewed twice because she felt her first interview used a less natural register than she would typically use in conversation and requested to redo it.

Results

Figure 22.2 presents Domonic's dominance reversal rate, alongside the dominance reversal behavior of his interlocutor in each interview. Figure 22.2 shows that Domonic's tendency to use dominance reversal varied across the three interviews he participated in. In his original participant interview,

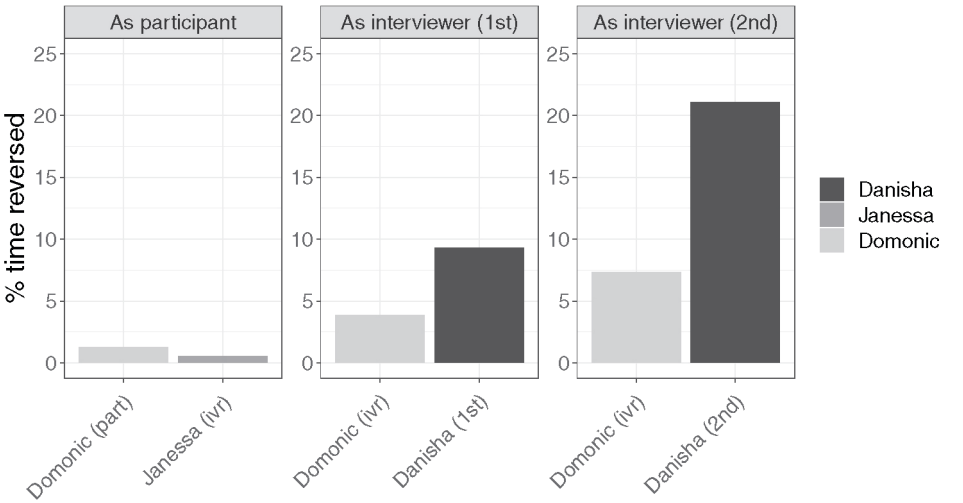

Figure 22.2 Dominance reversal rates in Domonic's signing across three interviews, compared to his interlocutor's reversal rate in each interview

shown in the first panel of Figure 22.2, he used a low rate of dominance reversal, around 1 percent. His interlocutor, Janessa, also used a minimal amount of less than 1 percent dominance reversal in that conversation. In the interviews that he conducted with Danisha, who uses reversal frequently, Domonic also uses a higher rate of dominance reversal, although not as high as Danisha herself. The second panel shows that he used reversal in 4 percent of his continuous signing time in the first interview with Danisha, where her reversal rate was 9 percent. Finally, the third panel shows that when Domonic interviewed Danisha for the second time, both signers used even more dominance reversal: 7 percent for Domonic, and 21 percent for Danisha. The basic generalization across the three panels of Figure 22.2 is that Domonic uses more dominance reversal in conversational interactions where his conversational partner also uses more dominance reversal.

One possibility to consider when we see within-signer variation mirroring the interlocutor's behavior in this way is that the pattern reflects socially motivated accommodation (also called convergence) between interlocutors, as in Communication Accommodation Theory (CAT; Giles, Coupland & Coupland 1991). CAT is closely related to Bell's (1984) Audience Design model of style-shifting, in which variation within the language use of individuals is derived from and motivated by the variation that is present in the larger community. On an accommodation analysis of Figure 22.2, we might think that Domonic is dynamically converging with his interlocutor, and likely they with him at the same time, in each of these situations. An account leaning on accommodation and style-shifting might eventually be able to help us make sense of the reversal frequency differences between the two conversations involving both Danisha and Domonic. Danisha characterized her first interview as conforming to certain prestige norms (which may be a reference to the hegemony of signing styles used more frequently by white signers), whereas in her second interview she explicitly articulated an intention to set aside such conformity in favor of using a style she called "Ebonics," which suggests the variety linguists call Black ASL (McCaskill et al. 2011; Hill et al. 2015). Since Danisha explicitly

set up the second interview as reflective of her Black identity and linguistic style, which Domonic was aware of, their shared identity as Black signers could be a factor in supporting either mutually reinforcing convergence or Domonic's accommodation to Danisha's deliberately undertaken style-shifting.

Another possible explanation to consider for the pattern in Figure 22.2 is that a more mechanistic process such as priming may be involved. In psycholinguistics, priming is the phenomenon where a language user, having recently processed a stimulus (such as a single sign or a grammatical construction), can recognize or retrieve the same or a related stimulus more easily. Under this analysis, instances where one signer switches their dominance could prime their interlocutor to also reverse dominance soon afterward. If Domonic interacts with a high-reversal signer, priming alone could lead to him using dominance reversal more often than he would in interactions with signers using less reversal. While the bulk of the psycholinguistic evidence for priming is in spoken languages (Warren this volume), there is ample experimental evidence that it is also a relevant processing phenomenon in signed languages (Emmorey 1991; Corina & Grosvald 2012; Hall, Ferreira & Mayberry 2015). Although we are not aware of previous demonstrations that priming can influence variation in conversational signing, the spoken language sociolinguistic literature provides extensive support for the idea that priming shapes which variants language users choose in particular moments of conversational speech. Therefore, it is reasonable to propose that dominance may also respond to priming in conversational signing.

When language users repeat the features of each other's linguistic behavior in short-term interactions, it is notoriously difficult to disentangle the various cognitive and sociostylistic mechanisms that may be at play (Szmrecsanyi 2008; Clark 2018; Tamminga 2019). Furthermore, both of these possibilities rely on there being cross-signer variation in dominance reversal rates in the first place; neither accommodation nor priming can fully explain the different rates of reversal that we see in Figure 22.2. Nor are we in a position to assess who is accommodating to whom or who is priming whom. We are grateful to an editor for the suggestion that the increase in reversal amounts across subsequent interviews might reflect a lessening impact of the Observer's Paradox. As signers become more familiar with their interlocutors, they are likely to converse more with them as they would with others in their daily lives. However, we think it is an important first step to observe that dominance reversal is exhibiting not only differences between signers but also intra-signer fluctuations and patterns of alignment between signers in conversation. These observations motivate further investigation of dominance reversal as a phenomenon that is shaped by social and stylistic factors in addition to the pragmatic demands of the discourse context.

Discussion

This case study leads us to many follow-up research questions: Is dominance reversal subject to psycholinguistic priming? Is it used to index Black and/or other social identities or registers? Within a given conversation, what other variables are likely to co-occur with dominance reversal? With regard to the data presented above, evidence of priming might consist of close proximity between instances of dominance reversal for the two signers. Evidence that the signers are using dominance reversal to index Black identity or other identities might be found if the interviews were coded for topic or stance and dominance reversal were found to co-occur with certain identity-related topics or when the signer is expressing a certain stance toward places or people. Follow-up interviews with more signers would also be important for pursuing this question. These data can also be investigated further using a more precise measurement of dominance reversal, such as sign count, rather than time.

Future directions

We have cited work that examines correlations between certain sociophonetic variants and membership in particular demographic groups. However, the broader field now recognizes speaker agency through the concept of indexicality. Eckert (2008) argues that sociolinguistic variation is not simply a matter of constraints on which variants a person has access to based on aspects of identity like social class. Rather, variants constitute a set of variables from which a speaker constructs a style. The association of variants with types is locally constructed. That is, the same variant can be associated with different identities or stances in different contexts. We would not expect this process to be unique to any specific modality. The question of how signers use linguistic variants to index various types, addressed in preliminary works cited above by Blau (2017) and Palfreyman (2020), should therefore be taken up by more researchers. The relationship between Deaf and hearing identities and communities, and between signed and spoken languages, may also result in interesting patterns of indexical use of language by signers. The uniqueness of these dynamics represent an opportunity to learn about identity and language use in new ways, and are likely a promising area of future research.

Another much-needed area of development in signed language sociophonetics is the development of financially accessible and easy-to-learn tools for measuring aspects of production. The lack of affordable tools not only presents methodological limitations but also constitutes an ethical problem, as this bars students, community researchers, and linguists in less well-funded departments from full participation in the field. Once technology becomes more readily available, the field will need to develop methods for normalizing phonetic measurements across signers. Finally, as discussed, and as with all areas of signed language linguistics, data from more languages are needed in order to confirm, challenge, and deepen understandings that have been thus far based upon research of a limited number of languages. Investigation of the protactile modality (e.g., Edwards & Brentari 2020) and its sociophonetics is also needed. These advancements will serve to bring the phonetic and sociophonetic study of signed languages on a par with spoken language inquiries. This parity is necessary if we are to learn the scope of the human capacity for employing gradient linguistic phenomena for social expression.

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References

Adank, Patti, Roel Smits & Roeland van Hout. 2004. A comparison of vowel normalization procedures for language variation research. *Journal of the Acoustical Society of America* 116(5). 3099–3107. https://doi.org/10.1121/1.1795335

Battison, Robbin. 1974. Phonological deletion in American Sign Language. *Sign Language Studies* 5(1). 1–19. https://doi.org/10.1353/sls.1974.0005

Bayley, Robert, Ceil Lucas, & Mary Rose. 2000. Variation in American Sign Language: The case of DEAF. *Journal of Sociolinguistics* 4(1). 81–107. https://doi.org/10.1111/1467-9481.00104

Bayley, Robert, Ceil Lucas, & Mary Rose. 2002. Phonological variation in American Sign Language: The case of 1 handshape. *Language Variation and Change* 14(1). 19–53. https://doi.org/10.1017/S0954394502141020

Baynton, Douglas. 1996. *Forbidden signs: American culture and the campaign against sign language*. University of Chicago Press.

Bell, Allan. 1984. Language style as audience design. *Language in Society* 13(2). 145–204. https://doi.org/10.1017/S004740450001037X

Blau, Shane. 2017. Indexing gay identities in American Sign Language. *Sign Language Studies* 18(1). 5–40. https://doi.org/10.1353/sls.2017.0019

Börstell, Carl, & Robert Östling. 2016. Visualizing lects in a sign language corpus: Mining lexical variation data in lects of Swedish Sign Language. In Nicoletta Calzolari et al. (eds.), *Proceedings of the Tenth International Conference on Language Resources and Evaluation (LREC 2016)*, 13–18. European Language Resources Association.

Brentari, Diane. 1998. *A prosodic model of sign language phonology*. MIT Press.

Brentari, Diane. 2019. *Sign language phonology*. Cambridge University Press.

Brentari, Diane & Petra Eccarius. 2010. Handshape contrasts in sign language phonology. In Diane Brentari (ed.), *Sign languages*, 284–311. Cambridge University Press.

Burch, Susan. 2002. *Signs of resistance*. New York University Press.

Cheek, Davina Adrianne. 2001. *The phonetics and phonology of handshape in American Sign Language*. PhD dissertation, University of Texas at Austin.

Clark, Lynn. 2018. Priming as a motivating factor in sociophonetic variation and change. *Topics in Cognitive Science* 10(4). 729–744. https://doi.org/10.1111/tops.12338

Corina, David P., & Michael Grosvald. 2012. Exploring perceptual processing of ASL and human actions: Effects of inversion and repetition priming. *Cognition* 122(3). 330–345. https://doi.org/10.1016/j.cognition.2011.10.011

Costello, Brendan, Javier Fernández & Alazne Landa. 2008. The non-(existent) native signer: Sign language research in a small deaf population. In Ronice M. de Quadros (ed.), *Sign languages: Spinning and unraveling the past, present and future*, 77–94. Editora Arara Azul.

Crasborn, Onno. 2010. What does "informed consent" mean in the internet age? Publishing sign language corpora as open content. *Sign Language Studies* 10(2). 276–290. https://doi.org/10.1353/sls.0.0044

Crasborn, Onno. 2011. The other hand in sign language phonology. In Marc van Oostendorp, Colin J. Ewen, Elizabeth Hume & Keren Rice (eds.), *The Blackwell companion to phonology,* 223–240. Wiley.

Crasborn, Onno. 2012. Phonetics. In Roland Pfau, Markus Steinbach & Bencie Wol (eds.), *Sign Language: An international handbook*, 4–20. De Gruyter.

Crasborn, Onno & Anna Sáfár. 2016. An annotation scheme to investigate the form and function of hand dominance in the Corpus NGT. In Roland Pfau, Markus Steinbach & Annika Herrmann (eds.), *A matter of complexity*, 231–251. De Gruyter Mouton. https://doi.org/10.1515/9781501503238-010

Crasborn, Onno & Han Sloetjes. 2008. Enhanced ELAN functionality for sign language corpora. In Onno Crasborn, Eleni Efthimiou, Thomas Hanke, Ernst D. Thoutenhoofd & Inge Zwitserlood (eds.), *Proceedings of the LREC2008 3rd Workshop on the Representation and Processing of Sign Languages*, 39–43.

Dudis, Paul G., Julie A. Hochgesang, Emily Shaw, and Miako Villanueva. 2020. Introduction to 'Motivated Look at Indicating Verbs in ASL (MoLo)' Project. Poster presented at the HDLS14, Virtual Conference, November. https://doi.org/10.17605/OSF.IO/H8GK4

Eccarius, Petra & Diane Brentari. 2008. Handshape coding made easier: A theoretically based notation for phonological transcription. *Sign Language & Linguistics* 11(1). 69–101. https://doi.org/10.1075/sl&l.11.1.11ecc

Eckert, Penelope. 2008. Variation and the indexical field. *Journal of Sociolinguistics* 12(4). 453–476. https://doi.org/10.1111/j.1467-9841.2008.00374.x

Edwards, Terra & Diane Brentari. 2020. Feeling phonology: The conventionalization of phonology in protactile communities in the United States. *Language* 96(4). 819–840. https://doi.org/10.1353/lan.2020.0063

Emmorey, Karen. 1991. Repetition priming with aspect and agreement morphology in American Sign Language. *Journal of Psycholinguistic Research* 20(5). 365–388. https://doi.org/10.1007/BF01067970

Fenlon, Jordan, Adam Schembri, & Kearsy Cormier. 2018. Modification of indicating verbs in British Sign Language: A corpus-based study. *Language* 94(1). 84–118. https://doi.org/10.1353/lan.2018.0002

Fenlon, Jordan, Adam Schembri, Trevor Johnston & Kearsy Cormier. 2015. Documentary and corpus approaches to sign language research. In Eleni Orfanidou, Bencie Woll & Gary Morgan (eds.), *Research methods in sign language studies: A practical guide*, 156–173. Wiley. https://doi.org/10.1002/9781118346013

Fenlon, Jordan, Adam Schembri, Ramas Rentelis, and Kearsy Cormier. 2013. Variation in handshape and orientation in British Sign Language: The case of the '1' hand configuration. *Language & Communication* 33(1). 69–91. https://doi.org/10.1016/j.langcom.2012.09.001

Fisher, Jami N., Julie A. Hochgesang & Meredith Tamminga. 2021. *Philadelphia Signs Project*. https://pennds.org/phillysigns/

Fisher, Jami N., Julie A. Hochgesang, Meredith Tamminga & Robyn Miller. 2021. Uncovering the lived experiences of elderly Deaf Philadelphians. In *Our lives–our stories: Life experiences of elderly deaf people*, 277–322. De Gruyter Mouton. https://doi.org/10.1515/9783110701906-011

Fisher, Jami N., Meredith Tamminga & Julie A. Hochgesang. 2018. The historical and social context of the Philadelphia ASL community. *Sign Language Studies* 18(3). 429–460. https://doi.org/10.1353/sls.2018.0010

Frishberg, Nancy J. 1975. Arbitrariness and iconicity: Historical change in American Sign Language. *Language* 51(3). 696–719. https://doi.org/10.2307/412894

Frishberg, Nancy J. 1976. *Some aspects of the historical development of signs in American Sign Language.* PhD dissertation, University of California, San Diego.

Frishberg, Nancy J. 1985. Dominance relations and discourse structures. In William Stokoe & Virginia Volterra (eds.), *SLR'83. Proceedings of the 3rd International Symposium on Sign Language Research*, 79–90. CNR.

Geraci, Carlo, Katia Battaglia, Anna Cardinaletti, Carlo Cecchetto, Caterina Donati, Serena Giudice & Emiliano Mereghetti. 2011. The LIS corpus project: A discussion of sociolinguistic variation in the lexicon. *Sign Language Studies* 11(4). 528–574. https://doi.org/10.1353/sls.2011.0011

Giles, Howard, Nikolas Coupland & Justine Coupland. 1991. Accommodation theory: Communication, context, and consequence. In Howard Giles, Nikolas Coupland & Justine Coupland (eds.), *Contexts of accommodation: Developments in applied sociolinguistics*, 1–68. Cambridge University Press.

Hall, Matthew L., Victor S. Ferreira & Rachel Mayberry. 2015. Syntactic priming in American Sign Language. *PLoS ONE* 10(3). https://doi.org/10.1371/journal.pone.0119611

Hammarström, Harald, Robert Forkel, Martin Haspelmath & Sebastian Bank. 2021. *Glottolog 4.4*. Max Planck Institute for Evolutionary Anthropology. https://doi.org/10.5281/zenodo.4761960

Hanke, Tomas. 2004. HamNoSys – Representing sign language data in language resources and language processing contexts. In Maria Teresa Lino et al. (eds.), *The Fourth International Conference on Language Resources and Evaluation, LREC 2004*. European Language Resources Association.

Hendricks, Bernadet. 2008. *Jordanian Sign Language: Aspects of grammar from a cross-linguistic perspective*. PhD dissertation, University of Amsterdam.

Hill, Joseph C. 2017. The Importance of the sociohistorical context in sociolinguistics: The case of Black ASL. *Sign Language Studies* 18(1). 41–57. https://doi.org/10.1353/sls.2017.0020

Hill, Joseph, Carolyn McCaskill, Robert Bayley & Ceil Lucas. 2015. The Black ASL (American Sign Language) Project: An overview. In Jennifer Bloomquist, Lisa J. Green & Sonja J. Lanehart (eds.), *The Oxford handbook of African American language*, 316–337. Oxford University Press.

Hochgesang, Julie A. 2014. Using design principles to consider representation of the hand in some notation systems. *Sign Language Studies* 14(4). 488–542. https://doi.org/10.1353/sls.2014.0017

Hochgesang, Julie A., Onno Crasborn & Diane Lillo-Martin. 2017–2021. *ASL Signbank*. Haskins Lab, Yale University. https://aslsignbank.haskins.yale.edu/

Hochgesang, Julie A. 2022. Managing sign language acquisition video data: A personal journey in the organization and representation of signed data. In Andrea L. Berez-Kroeker, Bradley McDonnell, Eve Koller & Lauren B. Collister (eds.), *The Open handbook of linguistic data management*. MIT Press Open. https://mitp-web.mit.edu/books/open-handbook-linguistic-data management-and-archiving

Hodge, Gabrielle & Onno Crasborn. 2022. Good practices in annotation. In Jordan Fenlon & Julie A. Hochgesang (eds.), *Signed language corpora*, 46–89. Gallaudet University Press.

Johnson, Robert E. & Scott K. Liddell. 2011a. Toward a phonetic representation of signs: Sequentiality and contrast. *Sign Language Studies* 11(2). 241–274. https://doi.org/10.1353/sls.2010.0008

Johnson, Robert E. & Scott K. Liddell. 2011b. A segmental framework for representing signs phonetically. *Sign Language Studies* 11(3). 408–463. https://doi.org/10.1353/sls.2011.0002
Johnson, Robert E. & Scott K. Liddell. 2011c. Toward a phonetic representation of hand configuration: The fingers. *Sign Language Studies* 12(1). 5–45. https://doi.org/10.1353/sls.2011.0013
Johnson, Robert E. & Scott K. Liddell. 2012. Toward a phonetic representation of hand configuration: The thumb. *Sign Language Studies* 12(2). 316–333. https://doi.org/10.1353/sls.2011.0020
Johnson, Robert E., Scott Liddell & Carol Erting. 1989. Unlocking the Curriculum: Principles for achieving access in Deaf education. Working Paper 89-3.
Johnston, Trevor. 2010. From archive to corpus: Transcription and annotation in the creation of a signed language corpus. *International Journal of Corpus Linguistics* 15(1). 106–131. https://doi.org/10.1075/ijcl.15.1.05joh
Johnston, Trevor, Donovan Cresdee, Adam Schembri & Bencie Woll. 2015. FINISH variation and grammaticalization in a signed language: How far down this well-trodden pathway is Auslan (Australian Sign Language)? *Language Variation and Change* 27(1). 117–155. https://doi.org/10.1017/S0954394514000209
Labov, William. 1984. Field methods of the project on linguistic change and variation. In John Baugh & Joel Sherzer (eds.), *Language in use: Readings in sociolinguistics*, 28–53. Pearson.
Liddell, Scott K. & Robert E. Johnson. 1989. American Sign Language: The phonological base. *Sign Language Studies* 64(1). 195–277. www.jstor.org/stable/26204052
Liddell, Scott K. & Robert E. Johnson. 2019. Sign language articulators on phonetic bearings. *Sign Language Studies* 20(1). 132–172. https://doi.org/10.1353/sls.2019.0016
Long, J. Schuyler. 1918. The Sign Language. A manual of signs. *American Annals of the Deaf*. 230–249.
Lucas, Ceil. 2013. Methodological issues in studying sign language variation. In Laurence Meurant, Aurélie Sinte, Mieke Van Herreweghe & Myriam Vermeerbergen (eds.), *Sign language research, uses and practices*, 258–308. De Gruyter Mouton.
Lucas, Ceil & Robert Bayley. 2005. Variation in ASL: The role of grammatical function. *Sign Language Studies* 6(1). 38–75. https://doi.org/10.1353/sls.2006.0005
Lucas, Ceil, Robert Bayley, Ruth Reed & Alyssa Wulf. 2001. Lexical variation in African American and white signing. *American Speech* 76(4). 339–360. https://doi.org/10.1215/00031283-76-4-339
Lucas, Ceil, Robert Bayley, Mary Rose & Alyssa Wulf. 2002. Location variation in American Sign Language. *Sign Language Studies* 2(4). 407–440. https://doi.org/10.1353/sls.2002.0020
Lucas, Ceil, Robert Bayley & Clayton Valli. 2001. *Sociolinguistic variation in American Sign Language*. Gallaudet University Press.
Lucas, Ceil & Clayton Valli. 1992. *Language contact in the American Deaf community*. Academic Press.
Mauk, Claude E. & Martha E. Tyrone. 2012. Location in ASL: Insights from phonetic variation. *Sign Language & Linguistics* 15(1). 128–146.
McCaskill, Carolyn, Ceil Lucas, Robert Bayley & Joseph Hill. 2011. *The hidden treasure of Black ASL: Its history and structure*. Gallaudet University Press.
McKee, Rachel, Josefina Safar & Sara Pivac Alexander. 2021. Form, frequency and sociolinguistic variation in depicting signs in New Zealand Sign Language. *Language & Communication* 79. 95–117. https://doi.org/10.1016/j.langcom.2021.04.003
Milroy, Lesley. 1987. *Observing and analyzing natural language*. Blackwell.
Mirus, Gene, Jami N. Fisher & Donna Jo Napoli. 2019. (Sub)lexical changes in iconic signs to realign with community sensibilities and experiences. *Language in Society* 49(2). 283–309. https://doi.org/10.1017/S0047404519000745
Mittelberg, Irene. 2007. Methodology for multimodality: One way of working with speech and gesture data. In Monica Gonzalez-Marquez, Irene Mittelberg, Seana Coulson & Michael J. Spivey (eds.), *Methods in cognitive linguistics*. 225–248. https://doi.org/10.1075/hcp.18.16mit
Moser, Margaret G. 1990. The regularity hypothesis applied to ASL. In Ciel Lucas (ed.), *Sign language research: Theoretical issues*, 50–56. Gallaudet University Press.
Napoli, Donna Jo & Nathan Sanders. In progress. Iconicity and biomechanics in the historical reconstruction of sign languages: A case study of the movement parameter in the Old LSF family.
Napoli, Donna Jo, Nathan Sanders & Rebecca Wright. 2014. On the linguistic effects of articulatory ease, with a focus on sign languages. *Language* 90(2). 424–456. https://doi.org/10.1353/LAN.2014.0026
Nilson, Anna-Lena. 2007. The non-dominant hand in a Swedish Sign Language discourse. In Lorraine Leeson, Myriam Vermeerbergen & Onno Alex Crasborn (eds.), *Simultaneity in signed languages: Form and function*, 163–185. John Benjamins. https://doi.org/10.1075/cilt.281.08nil

Palfreyman, Nick. 2020. Social meanings of linguistic variation in BISINDO (Indonesian Sign Language). *Asia-Pacific Language Variation* 6(1). 89–118. https://doi.org/10.1075/aplv.00008.pal

Pfau, Roland & Markus Steinbach. 2006. *Modality-independent and modality-specific aspects of grammaticalization in sign languages*. Universitätsverlag Potsdam.

Pfau, Roland, Markus Steinbach & Bencie Woll (eds.). 2012. *Sign language: An international handbook*. De Gruyter Mouton

Prince, Alan & Paul Smolensky. 2004. *Optimality theory: Constraint interaction in generative grammar*. Wiley.

Quer, Josep, Carlo Cecchetto, Caterina Donati, Carlo Geraci, Meltem Kelepir, Roland Pfau & Markus Steinbach (eds.) with collaboration of Brendan Costello & Rannveig Sverrisdóttir. 2017. *SignGram blueprint: A guide to sign language grammar writing*. De Gruyter Mouton. https://library.oapen.org/bitstream/handle/20.500.12657/27399/9781501511806.pdf

Rimor, Mordechai, Judy Kegl, Harlan Lane & Trude Schermer. 1984. Natural phonetic processes underlie historical change & register variation in American Sign Language. *Sign Language Studies* 43. 97–119.

Rousseau, Pascale & David Sankoff. 1978. Advances in variable rule methodology. In David Sankoff (ed.), *Linguistic variation: Models and methods*, 57–69. Academic Press.

Sanders, Nathan & Donna Jo Napoli. 2016. Reactive effort as a factor that shapes sign language lexicons. *Language* 92(2). 275–297. https://doi.org/10.1353/LAN.2016.0032

Schembri, Adam, David McKee, Rachel McKee, Sara Pivac, Trevor Johnston & Della Goswell. 2009. Phonological variation and change in Australian and New Zealand Sign Languages: The location variable. *Language Variation and Change* 21(2). 193–231. https://doi.org/10.1017/S0954394509990081

Schmitt, Deonísio. 2020. The history of sign language: Diachronic Libras variation in Santa Catarina. In Deonísio Schmitt (ed.), *Brazilian Sign Language Studies*, 201–226. De Gruyter Mouton.

Singleton, Jenny L., Amber Martin & Gary Morgan. 2015. Ethics, deaf-friendly research, and good practice when studying sign languages. In Eleni Orfanidou, Bencie Woll & Gary Morgan (eds.), *Research methods in sign language studies: A practical guide*, 7–20. Wiley.

Stokoe, William C. 1960. *Sign language structure. An outline of the visual communication systems of the American Deaf*. Linstok Press.

Stokoe, William C., Dorothy Casterline & Carl Croneberg. 1965. *A dictionary of American Sign Language on linguistic principles*. Gallaudet College.

Szmrecsanyi, Benedikt. 2008. *Morphosyntactic persistence in spoken English*. De Gruyter Mouton.

Tamminga, Meredith. 2019. Sources of microtemporal clustering in sociolinguistic sequences. *Frontiers in Artificial Intelligence* 2(10). https://doi.org/10.3389/frai.2019.00010

Tamminga, Meredith, Jami N. Fisher & Julie A. Hochgesang. 2020. Weak hand variation in Philadelphia ASL: A pilot study. *University of Pennsylvania Working Papers in Linguistics* 25(2). Article 15. https://repository.upenn.edu/pwpl/vol25/iss2/15

Toliver-Smith, Andrea & Betholyn Gentry. 2017. Investigating Black ASL: A systematic review. *American Annals of the Deaf* 161(5). 560–570. https://doi.org/10.1353/aad.2017.0006

Tyrone, Martha E. 2012. Phonetics of sign location in ASL: Comments on papers by Russell, Wilkinson, & Janzen and by Grosvald & Corina. *Laboratory Phonology* 3(1). 61–70. https://doi.org/10.1515/lp-2012-0005

Tyrone, Martha E. 2015. Instrumented measures of sign production and perception: Motion capture, movement analysis, eye-tracking, and reaction times. In Eleni Orfanidou, Bencie Woll & Gary Morgan (eds.), *Research methods in sign language studies: A practical guide*, 89–104. Wiley. https://doi.org/10.1002/9781118346013.ch6

Tyrone, Martha E. & Claude E. Mauk. 2010. Sign lowering and phonetic reduction in American Sign Language. *Journal of Phonetics* 38(2). 317–328. https://doi.org/10.1016/j.wocn.2010.02.003

Tyrone, Martha E. & Claude E. Mauk. 2012. Phonetic reduction and variation in American Sign Language: A quantitative study of sign lowering. *Laboratory Phonology* 3(2). 425–453. https://doi.org/10.1515/lp-2012-0019

Van Herreweghe, Mieke & Myriam Vermeerbergen. 2012. Data collection. In Pfau, Steinbach & Woll, 1023–1044.

Volterra, Virginia, Alessandro Laudanna, Serena Corazza, Elena Radutzky & Francesco Natale. 1984. Italian Sign Language: The order of elements in the declarative sentence. In Filip Loncke, Penny Boyes Braem & Yvan Lebrun (eds.), *Recent research on European sign languages*, 19–48. Swets and Zeitlinger.

Wolfram, Walt. 2013. Language awareness in community perspective: Obligation and opportunity. In Robert Bayley, Richard Cameron & Ceil Lucas (eds.), *The Oxford handbook of sociolinguistics,* 754–772. Oxford University Press.
Woodward, James C. 1973. Some observations on sociolinguistic variation and American Sign Language. *Kansas Journal of Sociology* 9(2). 191–200.
Woodward, James C. 1976. Black southern signing. *Language in Society* 5(2). 211–218. https://doi.org/10.1017/S004740450000703x
Woodward, James C. & Carol Erting. 1974. Synchronic variation and historical change in American Sign Language. Paper presented at the summer meeting of the LSA, Amherst.
Woodward, James C. & Carol Erting. 1975. Synchronic variation and historical change in ASL. *Language Sciences* 37. 9–12.
Woodward, James C. & Susan De Santis. 1977. Two to one it happens: Dynamic phonology in two sign languages. *Sign Language Studies* 17. 329–346. https://doi.org/10.1353/sls.1977.0013
Wulf, Alyssa, Paul Dudis, Robert Bayley & Ceil Lucas. 2002. Variable subject presence in ASL narratives. *Sign Language Studies* 3(1). 54–76. https://doi.org/10.1353/sls.2002.0027
Zeshan, Ulrike & Nick Palfreyman. 2017. Sign language typology. In Alexandra Y. Aikhenvald & R.M.W. Dixon (eds.), *The Cambridge handbook of linguistic typology*, 178–216. Cambridge University Press. https://doi.org/10.1017/9781316135716.007
Zimmer, June. 1989. Toward a description of register variation in American Sign Language. In Ceil Lucas (ed.), *The sociolinguistics of the Deaf community*, 253–272. Academic Press. https://doi.org/10.1016/B978-0-12-458045-9.50018-5

Appendix

NOT – https://aslsignbank.haskins.yale.edu/dictionary/gloss/515.html
RIGHT – https://aslsignbank.haskins.yale.edu/dictionary/gloss/533.html
WONDER – https://aslsignbank.haskins.yale.edu/dictionary/gloss/853.html
YES – https://aslsignbank.haskins.yale.edu/dictionary/gloss/1472.html