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The past fifty years have witnessed a flowering of research on sign languages, largely on their phonology and morphology but in more recent years increasingly on their syntax and semantics. The first decade of this century also experienced rich comparative work across sign languages. For example, the Sign Language Typology Research Group at the University of Central Lancashire in Preston, United Kingdom, often in cooperation with the Max Planck Institute for Psycholinguistics in Leipzig, Germany, has been and is presently instrumental in multiple projects. These projects range from cataloging and describing endangered and little known sign languages in a browsable corpus to studies of specific topics, such as negative and interrogative constructions, possessive and existential constructions, numeral incorporation, and agreement systems. The Sign Language Typology Research Group has also organized international workshops in which researchers of sign typology can get together and discuss their results. Ulrike Zeshan (2004a, 2004b, 2006) has been at the forefront of much of this work, particularly on interrogatives and negatives.

Additionally, there has been considerable work on word order in particular sign languages, (from the seminal work of Fischer [1975] and the classic work of Volterra et al. [1984] to many of the articles in Brennan and Turner [1994] and the considerable work since), although several factors seem to stand in the way of a word-order typology for sign. Although sign languages vary in many ways syntactically (see Perniss, Pfau, and Steinbach 2007), typically they

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make substantial use of classifier predicates. (We have read about only two exceptions. One is Adamorobe Sign Language, used in an Akan village in eastern Ghana, which lacks classifiers for motion and location [Nyst 2007]. The other is Indo-Pakistani Sign Language, which Zeshan [2000, 27] originally reported to have “no systematically arranged paradigm of classificatory handshapes” but Zeshan [2003] later reported to have limited use of whole entity classifiers.)

Once we enter the realm of classifier predicates, we undoubtedly find movement from one indexed position to another, with all characteristics of the signing—from handshape, to palm and fingertip orientation, to location, to movement, to nonmanuals—potentially being determined by setting up a framework in which each physical element in the signed message is analogous to some action or participant (active or passive, including locatum) in an event (see, among others, McDonnell 1996; Vermeerbergen 1996; Sutton-Spence and Woll 1999; Leeson 2001), and this includes nonpresent referents (Engberg-Pedersen 2004). Additionally, it appears that context plays an enormous role in word order in sign languages, as seen in spontaneous conversation (compared with elicited data)—a fact that makes firm statements about particular word orders difficult to maintain (among others, see discussion in Deuchar 1983; Johnston et al. 2007; Jantunen 2008). So we expect much in common syntactically across sign languages in such utterances, which we do indeed find (Johnston 1989; Woll 2003; Vermeerbergen 2006; Napoli and Sutton-Spence n.d.), with questions of comparative word order receding in importance. Nevertheless, the field is fertile, and we look with optimism at the search for typological characteristics both at the level of more specific constructions being examined in the studies alluded to in the previous paragraph and at the overarching level of word order.

Phonetic Typology

In this book we look for overarching characteristics for typologizing sign languages by studying another component of the grammar:

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phonetics. It is often possible just from overhearing a snippet of spoken conversation to recognize that a language we ourselves do not speak belongs to some larger group, such as Chinese, Slavic, or Athabaskan, based solely on sound properties, whether phonetic or phonological. In fact, this common observation is not trivial; artificial intelligence has been using prosody analyzers for language recognition for years (Waibel 1988). Likewise, when we hear a nonnative speaker of English speak English, we can often guess at the larger group her or his mother tongue (L1) belongs to, just from phonetic and/or phonological properties carried over in the transfer from mother tongue to a second language (L2)—in this case English. Although influences from L1 on L2 are complex, there is general agreement that phonemic inventories, allophonic variations, phonotactic constraints, and prosody are all likely to be involved (Flege 1987; Rochet 1995; Boula de Mareüil, Marotta, and Adda-Decker 2004), sometimes to such an extent, particularly with respect to vowel quality and prosody, that intelligibility is threatened (Munro and Derwing 1995; Mayfield Tomokiyo and Waibel 2001; Burlison 2007).

With that in mind, we set out to see if we could typologize sign languages by phonetic characteristics, in particular by characteristics of the paths of primary movement. We chose to look at this particular component of the sign for several reasons.

Some scholars have argued that movement in sign is comparable to vowels in spoken language (Liddell and Johnson 1989; Perlmutter 1992). And some have argued that the distinction between full and reduced movement in sign is comparable to the distinction between strong and weak vowels in speech (Wilbur 1985). Additionally, in syllables that contain final holds, movement accounts for 55% of the duration and the final hold accounts for 45% (Wilbur and Nolan 1986), a finding that suggests movement may figure prominently in the perception of rhythm and stress (Wilbur 1990). Consistent with these findings, many have claimed that movement represents a visual analogue of sonority (Brentari 1990; Corina 1990b; Perlmutter 1992; Sandler 1993). Building on much of this work, Brentari (1998)

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offers the prosodic model of sign syllables, analyzing the sign as (1) two sets of features organized in a hierarchical feature geometry (where a feature geometry is independently motivated for sign languages—see Sandler 1986, 1987, 1989; Corina 1990a; Sandler and Lillo-Martin 2006); (2) inherent features (including handshape and location), which are comparable to consonants in speech; and (3) prosodic features (movement, both primary and secondary—a distinction we address in chapter 2 in the section “Primary Movement Only”), which she compares with vowels in speech. Regardless of whether one assumes the prosodic model, the recognition of movement as (somehow) vocalic and (somehow) relevant to prosody has shed light on phenomena in a variety of sign languages, including the appearance of something comparable to vowel harmony in the acquisition of BSL (Morgan 2006) and the accentual prosody (speed, intensity, and manner of movement) relevant to poetic form in LSF nursery rhymes (Blondel and Miller 2000, 2001).

All this led us to suspect we would find the movement parameter the most salient in a phonetic approach to a typology of sign languages. In support we note that the parameters of movement and location exert a stronger influence on the retrieval of signs during language perception or production than do the parameters of handshape or orientation (Corina and Hildebrandt 2002; Dye and Shih 2006). The movement parameter, however, is complex in a number of ways that were not accessible to us in our particular database (described in chapter 2). Still, the primary movement path was, for the most part, transparent; hence our choice. Since we are looking at movement paths in isolated citation forms of signs (rather than in conversations) and without regard to other parameters of the sign (rather than noting context), this is a purely phonetic study. It is arguable that our study is a comparison only of (part of the) syllable nuclei of signs.

The very narrowness of our study’s focus increases its potential to be important for typological considerations. To see this, consider, for example, syntactic studies. In comparing studies of syntactic

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phenomena, one faces the difficulty of different (or, worse, inexplicit) criteria for identifying syntactic units, of myriad theoretical approaches that affect one's interpretation of the results, and so on (see Johnston et al. 2007 for a detailed discussion of such problems in comparing studies on word order in sign languages)—factors that impede attempts at corroboration of findings and at a true understanding of findings. Another possible hindrance in the search for syntactic typologies of sign languages is that syntactic characteristics of the contact spoken language (especially of its written form) can influence those of the sign language (Fischer 1975; van den Bogaerde and Mills 1994; De Lange et al. 2004; Milkovic, Bradaric-Joncic, and Wilbur 2007; Yau 2008; Wojda 2010), particularly in the type of laboratory context so common to elicitation tasks (Deuchar 1983; Coerts 1994; among many others). Our study, instead, explicitly outlines our method of data collection and analysis, so others may attempt to (dis)confirm our findings without having to enter into any interpretations of a theoretical nature. Further, by looking at the direction of movement along a path, there is little chance that properties of the contact spoken language can influence our findings (although, in fact, we will see that gestures of the contact spoken language may be relevant, where whether those gestures are one-handed, two-handed and asymmetrical, or two-handed and symmetrical is the important factor, not direction of movement along a path). One might say, then, that a phonetic study like ours has the chance to offer an ideal typology of sign languages; indeed, the corpus is remarkably clean.

The Languages in Our Study

In this work we offer the results of a study of five sign languages: American Sign Language (ASL), British Sign Language (BSL), Italian Sign Language/*lingua italiana dei segni* (LIS), French Sign Language/*langue des signes française* (LSF), and Australian Sign Language (Auslan). We chose these particular languages for several reasons. First

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was serendipity: At an international sign conference at Swarthmore College (outside of Philadelphia, Pennsylvania) in spring 2008, we observed a conversation in which people were comparing ASL and BSL and claiming that BSL was rich in movements going away from the signer whereas ASL was rich in movements going toward the signer. This piqued our interest, so we questioned other signers there about the general idea, and some went as far as to claim that from watching a conversation at a distance, even without catching any particular lexical items, they could distinguish certain sign languages from other sign languages. We then set about trying to gather information on multiple sign languages and quickly found that either the corpora were limited or our access to them was inhibited by our inability to read the spoken language of the country the sign language is used in. So we opted for sign languages with dictionaries written in languages we read.

We settled on these five languages both because we read English, French, and Italian and because they offered the possibility of looking for generalizations within and across language families, as we will now discuss. We then added a sixth language to test some of our resulting hypotheses on.

Clusterings of Languages: Genetic and Origin-Bound/ Diaspora

BSL and Auslan share a common ancestor; likewise ASL, LIS, and LSF share a common ancestor, although in all cases there are multiple ancestors (as we will discuss). Accordingly, our selection of these particular five sign languages allows the possibility of finding genetic clusterings—which, in fact, we did. BSL and Auslan turn out to have a variety of similar characteristics, whereas LSF, LIS, and ASL group together in differing from BSL and Auslan on those characteristics and in a similar way.

We also found, however, that BSL and LSF cluster together on a number of phenomena, in contrast to the other three languages.

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This prompted us to reconsider the pertinent aspects of the languages' histories. Although BSL and Auslan share a common ancestor (McKee and Kennedy 2000), Auslan also has influences from Irish Sign Language (ISL) and ASL (Johnston and Schembri 2007). And although ASL, LIS, and LSF share a common ancestor (see Lane 1984 and Van Cleve and Crouch 1989 for a discussion of the first Deaf school in the United States in Hartford, Connecticut, where Laurent Clerc and Thomas Gallaudet used LSF in teaching; also see Radutzky 1993, 243, for a discussion of the first Deaf school in Italy in Rome, where Tommaso Silvestri used the methodical signs of *Epée* from LSF), ASL has also had strong influence from the sign languages used in the United States before LSF was introduced (Woodward 1978). This is particularly true of the sign languages used in Martha's Vineyard, Philadelphia, and New York (Tabak 2006). LIS, likewise, was influenced by the sign languages used in Italy before the introduction of LSF, particularly by the signs used in Rome, Naples, Milan, Turin, Parma, Genoa, Pisa, and Modena (Radutzky 1993).

Given that the languages that developed from the earlier languages without much interference from or contact with other sign languages (BSL and LSF) exhibit certain similarities, we might conclude that the particular similarities are representative of an unadulterated stage, so to speak. The languages that experienced significant contact with other sign languages (ASL, LIS, and Auslan) may, accordingly, show the types of variation that can happen from such contact, including creolization or borrowing. We therefore have adopted the terms "origin-bound" for BSL and LSF and "diaspora" for ASL, LIS, and Auslan.

From the way the languages cluster on various characteristics, we conclude that languages with a direct line of descent are distinct from languages with a line of descent affected by contact with another language (or languages); this may surprise (and perhaps disconcert) readers. Certainly, at least as far as historical linguists are concerned, including Lehmann (1962), Crowley (1992), and Joseph

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and Janda (2004), no such distinction is generally made. Rather, the two are the same except when the contact is so extreme that the genetic tree is rerooted.

Indeed, such rerooting might have occurred with respect to ASL. ASL emerged mainly from two sources: the variety of LSF Laurent Clerc brought to the United States (Lane 1984; Sacks 1989; Van Cleve and Crouch 1989) plus the sign already in use on Martha's Vineyard (which probably was not a variety of BSL; but see Groce 1985). Woodward (1976), using glottochronological procedures (as in Gudschinsky 1964), compares the lexicons of ASL and LSF and concludes that the degree of similarity (less than 60% of the lexicon) is lower than one would expect from a daughter given that the split was as recent as 1816, unless, in fact, that daughter has been creolized (see Woodward 1989).

To the contrary, Lupton and Salmons (1996) argue that ASL does not meet the usual definitions of a creole, pointing particularly to morphology they analyze as inflectional (and, thus, atypical of creoles). Although it is debatable whether ASL really has inflections (Liddell 2003) and further debatable what types of inflections creoles actually do allow (Patrick 1999), and although many still analyze ASL as a creole, Auslan is certainly not a creole (Woll 1991), and we know of no argument claiming that LIS is a creole.

So our finding that the sign daughters with a direct line of descent cluster together and in some ways are more conservative than the diaspora daughters may, in the worst case, turn out to be purely specific to the languages studied here. We doubt that, however. A distinction between daughters of an earlier language that were exposed to multiple other language groups through migration and daughters of that language that were not so exposed sometimes occurs in spoken language as well. Thus, in the Romance languages, the daughters of Proto-Romance that stayed on the Italic peninsula and its islands (the original home of Proto-Romance) have in many ways been more conservative than their sisters outside the Italic peninsula that had contact with other languages—the language(s)

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of Sardinia, among the most isolated, being perhaps the most conservative (Posner 1996; Marazzini 1999; Maiden, Smith, and Ledgeway 2010)—although we note that Romanian is also strongly conservative in many respects.

There is an additional reason not to be shocked at our division between origin-bound and diaspora languages—a very strong reason. All debates about the creole or hybrid status of ASL aside, and all debates about what happens in the history of spoken languages aside, we note that the histories of ASL, LIS, and Auslan differ from the histories of many spoken languages in a significant way. Consider ASL. In 1817 Laurent Clerc and Thomas Hopkins Gallaudet, a Frenchman and an American man, respectively, established the Connecticut Asylum for the Education and Instruction of Deaf and Dumb Persons (which later was renamed the American School for the Deaf; Lane 1984). The school opened with seven students, by the end of the year had thirty-three, and continued to grow steadily. Rather than an entire community of LSF users coming to the United States, these two men brought LSF to a group of students who had already been using a variety of sign languages and home sign. So the new users of LSF far outnumbered the old users. The ground was fertile for innovation. And this type of scenario is not unusual for new schools for the Deaf. So one should not a priori expect the history of languages in such a situation to proceed in the same manner as the history of languages when whole communities of speakers move from one place to another (see Woodward 2010). To the contrary, one might well expect differences in how the languages evolve. And, as we will show, the diaspora daughters we examine in this study do cluster together on a number of characteristics.

A final point is in order here. Throughout this discussion we have treated LSF and BSL as separate languages with no significant interaction. However, during the 1700s and early 1800s some British and Irish teachers of deaf children traveled to France for training in pedagogy methodology (Woll and Sutton-Spence 2004). It is possible that borrowing occurred from Old LSF into Old BSL

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via these teachers. Further, Old LSF had an influence on Old ISL (Matthews 1996; Leeson 2005), and ISL has interacted with BSL (Leeson 2005). In sum, it is possible that during the history of BSL there has been minimal borrowing both directly and indirectly from (Old) LSF. At this point the existence of such borrowing is speculative, so we proceed with the widely held position that the two languages are genetically unrelated and without contact significant enough to affect their grammars.

Import of This Work

As far as we know, very little has been published in the way of cross-linguistic studies of sign language phonetics. The present work, then, contributes to an area begging for more research; it asks questions that need to be asked, and it offers tentative answers.

This study is highly descriptive and uses tools from mathematics and statistics for analysis rather than relying solely on linguistic theory. The upshot is that the methodology and findings here are potentially useful for scholars working on a broad range of sign languages who may wish to draw on it for use from various theory stances.

The analytical methods employed are new to the field of linguistics. We constructed Venn diagrams showing the set relationships of movement directions of signs using the program VennMaster, which was developed for biological research to show analogous overlaps of classes of gene transcripts. Although this innovative approach to analysis gives results that are only as reliable as the data source used, it opens possibilities for further exploration with other corpora. Additionally, this approach allowed us to explore questions that otherwise would be very difficult to explore, and it uncovered unexpected patterns, leading to fairly radical—possibly controversial—interpretations, such as the finding that diaspora languages behave differently from origin-bound languages, and such as hypotheses about young sign languages versus mature ones.

With this book, then, we hope to open new discussions in both diachronic and synchronic approaches to the linguistic typology of sign languages.

Testing Our Results

Given the innovative analytical approach employed here and the fact that our results offer unexpected hypotheses particularly with regard to historical change, our study bears a heavy burden. We therefore chose to add a sixth language to the study, one that could help us test our hypotheses concerning young sign languages and whose genetic relationship to the other languages is unstudied (as far as we know): Nicaraguan Sign Language / *idioma de señas de Nicaragua* (ISN), used at a school for the Deaf in Managua, Nicaragua, and established in 1977.